DOE/RL-98-01

Rev. 1

Hanford Science and Technology Needs Statements, 1999

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

Approved for Public Release

INFORMATION CLEARANCE FORM

A. Information Category

- [ ] Abstract
- [ ] Summary
- [ ] Visual Aid
- [ ] Full Paper
- [ ] Journal Article
- [X] Internet
- [ ] Software
- [ ] Report
- [X] Other Needs Statements

B. Document Number ~~DOE-98-1~~, Revision 1 DOE/RL-98-01 Rev 1

C. Title
Hanford Science and Technology Needs Statements, 1999

Note: Technolgoy needs statements are revised and issued annually. Information release was obtained for Revision 0.

D. Internet Address www.pnl.gov/stcg/needs.stm

E. Required Information

1. Is document potentially Classified? [X] No [ ] Yes (MANDATORY)
   Manager's Signature Required
   If Yes ______ [ ] No [ ] Yes Classified
   ADC Signature Required
2. Internal Review Required? [X] No [ ] Yes
   If Yes, Document Signatures Below
   Counsel ______
   Program ______
3. References in the Information are Applied Technology [X] No [ ] Yes
   Export Controlled Information [X] No [ ] Yes
4. Does Information Contain the Following: (MANDATORY)
   a. New or Novel (Patentable) Subject Matter? [X] No [ ] Yes
   If "Yes", Disclosure No.: ______
   b. Information Received in Confidence, Such as Proprietary and/or Inventions?
   [X] No [ ] Yes If "Yes", Affix Appropriate Legends/Notices.
   c. Copyrights? [X] No [ ] Yes If "Yes", Attach Permission.
   d. Trademarks? [X] No [ ] Yes If "Yes", Identify in Document.
5. Is Information requiring submission to OSTI? [X] No [ ] Yes
   If Yes UC- 2000 and B&R- EW4040500
6. Release Level? [X] Public [ ] Limited
7. Charge Code H3AB3 HANF 6800

F. Complete for a Journal Article

1. Title of Journal ______

G. Complete for a Presentation

1. Title for Conference or Meeting ______
2. Group Sponsoring ______
3. Date of Conference ______
4. City/State ______
5. Will Information be Published in Proceedings? [ ] No [ ] Yes
6. Will Material be Handed Out? [ ] No [ ] Yes

H. Author/Requestor
Gregory T. Berlin
(Print and Sign)

Responsible Manager
Terry L. Walton
(Print and Sign)

I. Reviewers

Reviewers	Yes	Print	Signature	Public Y/N (If N, complete J)
General Counsel	[ ]			Y / N
Office of External Affairs	[ ]			Y / N
DOE-RL	[X]	John P. Neath		(Y) / N
Other	[ ]			Y / N
Other	[ ]			Y / N

J. If Information Includes Sensitive Information and is not to be released to the Public indicate category below.

- [ ] Applied Technology
- [ ] Personal/Private
- [ ] Proprietary
- [ ] Business-Sensitive
- [ ] Predecisional
- [ ] UCNI
- [ ] Protected CRADA
- [ ] Export Controlled
- [ ] Procurement-Sensitive
- [ ] Patentable
- [ ] Other (Specify) ______

Information Clearance Approval

APPROVED FOR RELEASE — OFFICIAL — VB 9/30/98

K. If Additional Comments, Please Attach Separate Sheet

INFORMATION CLEARANCE FORM

A. Information Category

- [ ] Abstract
- [ ] Summary
- [ ] Visual Aid
- [ ] Full Paper
- [ ] Journal Article
- [X] Internet
- [ ] Software
- [ ] Report
- [X] Other Needs Statements

B. Document Number DOE-98-1, Revision 1

C. Title

Hanford Science and Technology Needs Statements, 1999

Note: Technolgoy needs statements are revised and issued annually. Information release was obtained for Revision 0.

D. Internet Address www.pnl.gov/stcg/needs.stm

E. Required Information

1. Is document potentially Classified? [X] No [ ] Yes (MANDATORY)

   Manager's Signature Required

   If Yes ______ [ ] No [ ] Yes Classified

   ADC Signature Required

2. Internal Review Required? [X] No [ ] Yes
   If Yes, Document Signatures Below

   Counsel ______

   Program ______

3. References in the Information are Applied Technology [X] No [ ] Yes

   Export Controlled Information [X] No [ ] Yes

4. Does Information Contain the Following: (MANDATORY)

   a. New or Novel (Patentable) Subject Matter? [X] No [ ] Yes

   If "Yes", Disclosure No.: ______

   b. Information Received in Confidence, Such as Proprietary and/or Inventions?

   [X] No [ ] Yes If "Yes", Affix Appropriate Legends/Notices.

   c. Copyrights? [X] No [ ] Yes If "Yes", Attach Permission.

   d. Trademarks? [X] No [ ] Yes If "Yes", Identify in Document.

5. Is Information requiring submission to OSTI? [X] No [ ] Yes

   If Yes UC- ______ and B&R- ______

6. Release Level? [X] Public [ ] Limited

7. Charge Code H3AB3

F. Complete for a Journal Article

1. Title of Journal

G. Complete for a Presentation

1. Title for Conference or Meeting ______
2. Group Sponsoring ______
3. Date of Conference ______
4. City/State ______
5. Will Information be Published in Proceedings? [ ] No [ ] Yes
6. Will Material be Handed Out? [ ] No [ ] Yes

H. Author/Requestor

Gregory T. Berlin
(Print and Sign)

Responsible Manager

Terry L. Walton
(Print and Sign)

I. Reviewers

Reviewers	Yes	Print	Signature	Public Y/N (If N, complete J)
General Counsel	[ ]			Y / N
Office of External Affairs	[ ]			Y / N
DOE-RL	[X]			Y / N
Other	[ ]			Y / N
Other	[ ]			Y / N

J. If Information Includes Sensitive Information and is not to be released to the Public indicate category below.

Information Clearance Approval

- [ ] Applied Technology
- [ ] Personal/Private
- [ ] Proprietary
- [ ] Business-Sensitive
- [ ] Predecisional
- [ ] UCNI
- [ ] Protected CRADA
- [ ] Export Controlled
- [ ] Procurement-Sensitive
- [ ] Patentable
- [ ] Other (Specify) ______

K. If Additional Comments, Please Attach Separate Sheet

A-6001-401 (10/97)

DOE/RL-98-01
REV. 1

Hanford Science and Technology Needs Statements, 1999

Revision 1

DOE/RL-98-01
REV. 1

Department of Energy
Richland Operations Office
P.O. Box 550
Richland, Washington 99352

98-STP-491

Addressees (See Attached List)

FISCAL YEAR (FY) 1999 HANFORD SCIENCE AND TECHNOLOGY NEEDS

Enclosed for your information and use are the consolidated Hanford Science and Technology Needs for FY 1999. These needs have gone through an extensive development and review cycle which consisted of the Hanford Projects (DOE and Contractor), the Site Technology Coordination Group (STCG) subgroups, and the STCG Management Council. The reviews included representatives from the U.S. Environmental Protection Agency, Washington State Department of Ecology, Indian Nations, Hanford Advisory Board, and DOE. After careful review, all parties agreed to endorse these as the Hanford Needs.

It is our position, that by developing and supporting these needs it will help to focus science and technology investments on site problems where current costs are prohibitive or no acceptable solutions currently exist. The Hanford Site Science and Technology Needs are posted and maintained on the Internet and can be accessed through the Hanford Home Page (http:\\www.hanford.gov).

If you have any questions, please contact Dennis A. Brown, Science and Technology Programs Division, on (509) 372-4030.

Lloyd Piper, Chair
Hanford Site Technology
Coordination Group

STP:DAB

Enclosure:

DOE/RL-98-01
REV. 1

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 collages and universities on those needs. This document describes those needs which 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) 1999, 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 PHMC and ERC) and reviewed and endorsed by the Hanford Site Technology Coordination Group (STCG) which included the full participation of DOE-RL 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.pnl.gov/stcg/
- The Hanford Homepage at http://www.hanford.gov
- The Pacific Rim Enterprise Center's web site at http://www2.pacific-rim.org/pacific_rim/

Private industry, federal agencies, and colleges and universities are encouraged to review the need statements and contact the Hanford STCG 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. The Pacific Rim Enterprise Center (206-224-9934) also provides assistance to businesses interested in marketing technologies to the DOE.

DOCUMENT ORGANIZATION

The Science and Technology Needs Document is organized by major problem areas and coincides with the STCG subgroups which are as follows: Decontamination and Decommissioning, Mixed Waste, Subsurface Contaminants, High Level Waste Tanks, and Spent Nuclear Fuel. Each problem area begins with a technology needs table which list the needs in numerical order with a relative ranking of high, medium, or low. 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 for 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 which provides justification for elimination of the need, ties together last years needs and this years needs, and identifies any other major changes which took place during the revision cycle.

FY 1999 DECONTAMINATION & DECOMMISSIONING TECHNOLOGY NEEDS

ID #	NEEDS TITLE
RL-DD01	Cesium Capsule Leak Detection System for WESF
RL-DD02	Glove Box Size Reduction System for PFP
RL-DD03	Terminal Clean-Out and TRU Waste Decontamination of PFP
RL-DD04	TRU Waste Fixatives for PFP
RL-DD05	Characterization of Buildings 324 and 327
RL-DD06	Decontamination of Buildings 324 and 327
RL-DD07	Fixatives for Buildings 324 and 327
RL-DD08	Remote Cutting Technologies for Buildings 324 and 327
RL-DD09	Tank Remediation for Building 324
RL-DD010	Radiation Hardened Robotics for Building 324
RL-DD011	Structural Integrity Inspection Technologies - 324/327 Buildings Hot Cell Liners
RL-DD017	Segregation of Waste for the D&D Program
RL-DD021	Metal Decontamination and Recycling for the D&D Program
RL-DD029	Critically Safe Vacuum System for 233-S
RL-DD030	Cutting Plutonium Contaminated Pipe for 233-S
RL-DD031	Non-Intrusive Detection of Pipe Contents for 233-S
RL-DD032	Contamination Fixative for 233-S
RL-DD033	Field Screening for Hazardous Materials for 105-F and 105-DR Reactors
RL-DD034	Remote/Robotic Technologies for CDI
RL-DD035	Visual/Spatial Imaging for CDI
RL-DD036	Radiation Survey for CDI
RL-DD037	Liquids Detection for CDI

ID #	NEEDS TITLE
RL-DD038	Liquids Characterization for CDI
RL-DD039	Solids (Sediment/Sludge/Dust) Characterization for CDI
RL-DD040	Concrete Characterization for CDI
RL-DD041	Capsule Integrity Assessment Method for WESF
RL-DD042	Hot Cell Window Life Extension for WESF
RL-DD043	Crane System Upgrades for Hot Cell Canyon and Cesium Capsule Pool in WESF
RL-DD044	Cesium and Strontium Removal From K3 Duct at WESF
RL-DD045	Fixatives for K3 Duct at WESF
RL-DD046	Clean-Out of Isolated Piping Systems in Building 324
RL-DD047	Remote Viewing for Hot Cells in Buildings 324 and 327

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

CESIUM CAPSULE LEAK DETECTION SYSTEM FOR WESF

Identification No.: RL-DD01
Date: September, 1998

Program: Decontamination and Decommissioning
OPS Office/Site: Richland Operations Office/Hanford Site
Operable Unit (if applicable): N/A
Waste Stream: Approximately 1900 stainless-steel capsules that contain 75 million Curies of cesium and strontium byproduct materials in the WESF pool cells (NM-15)
Waste Management Unit (if applicable): N/A
Facility: Waste Encapsulation Storage Facility (WESF)

Site Priority Ranking: Medium

Need Title: Cesium Capsule Leak Detection System for WESF

Need Description: WESF is operated as a safe storage facility for 1,928 double-wall corrosion-resistant metal capsules that contain either cesium chloride or strontium fluoride from fuel processing waste. The capsules are in five pool cells and have been stored underwater since about 1967. Current plans are to continue underwater storage until about 2015, at which time the capsules will be turned over to the High Level Waste Disposal Program. Although no significant problems have been experienced, there is the continuing possibility of one or more of the capsules developing a leak and contaminating a pool cell. There is need for an effective monitoring system to quickly identify a leaking capsule such that it can be removed. (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-DD036).

Current Baseline Technology: Each active pool cell has a water beta monitoring system that will detect that a capsule has failed and that radioactive materials have migrated into the water. The system, however, is not adequate to permit isolation of an individual leaking capsule. The current method 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. If the inner wall of the capsule is free to move against the external wall (as noted by impact), the integrity of the capsule is presumed to be intact, i.e., there is little or no inclusion of water from the pool and little or no swelling of the inner capsule. 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.

Functional Performance Requirements: There is need for an easily deployable technology that will allow for rapid underwater identification of a single leaking capsule. 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 rems per second at contact and 11 rems per second at 24 inches.

Schedule Requirements: Immediate - long term. Technology could be deployed immediately. The current basis 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 Tank Farm high-level waste at the Hanford Vitrification facility in the 2013-2017 time frame. The technology could be used over the long-term (20 years).

Problem Description: WESF stores strontium and cesium capsules in pool cells that were constructed to provide shielding and cooling for approximately 1900 capsules. There are 5 pool cells that are actively storing capsules, each measuring approximately 6'x20'x13' (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.

PBS No.	***WBS No.***	***TIP No.***
RL-TP02	1.4.2	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 and 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 alternate shielded location, which would minimize the risk of pool cell decontamination and worker exposure.

Cost Savings Potential (Mortgage Reduction): N/A

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 as a secondary waste product.

Other: None identified.

Consequences of Not Filling Need: Current baseline methods are labor intensive and tedious. The potential exists for a leaking capsule to contaminate a pool to the degree that worker entry is prohibited before the capsule can be identified and removed to an alternate shielded location.

Outsourcing Potential: N/A

End User: EM-60

Site Technical Points of Contact: Gerry McCormick - BWHC (509) 372-8173, Robbin Duncan - BWHC (509) 373-2229, Fen Simmons - BWHC (509) 376-4747

Contractor Facility/Project Manager: Bill Bailey - BWHC (509) 372-4999

DOE End-User/Representative Points of Contact: Larry Romine - EM-60 (509) 376-4747

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

GLOVE BOX SIZE REDUCTION SYSTEM FOR PFP

Identification No.: RL-DD02
Date: September, 1998

Program: Decontamination and Decommissioning
OPS Office/Site: Richland Operations Office/Hanford Site
Operable Unit (if applicable): N/A
Waste Stream: Alpha contamination that is 1) dispersible, 2) fixed, and 3) embedded (NM-11)
Waste Management Unit (if applicable): N/A
Facility: Plutonium Finishing Plant

Site Priority Ranking: High

Need Title: Glove Box Size Reduction System for PFP

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 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.

Current Baseline Technology: The PFP glove boxes will be removed during deactivation. One path to disposal would be to package the items and ship them as transuranic (TRU) waste to the Waste Isolation Pilot Plant (WIPP). Without size reduction and decontamination, however, this path is cost prohibitive. Presently, ongoing decontamination activities require intensive manpower, produce secondary waste, and are costly. Decontamination techniques available include the use of wipes, strippable coatings and gels, hydro-lancing, ice blasting, steam, acid washes and electropolishing. There is minimal size reduction capability at PFP at this time. Metal cutting would be limited to the use of mechanical shears and shear balers.

Functional Performance Requirements: Lessons-learned from previous plutonium 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, 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-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.

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

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, 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, 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 transuranic 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.

PBS No.	***WBS No.***	***TIP No.***
RL-TP05	1.4.5 - PFP	Candidate

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*:** TPA Milestone M-83-00: Complete Stabilization of Process Areas Resulting from EIS ROD [PFP (Date: TBD - under negotiation)]
TPA Milestone M-83-02, Complete Identified Interim Actions - PFP (December 1998)
TPA Milestone M-83-02-T04, 234-5Z Duct Level Clean-out (December 1998)
DNFSB 94-1: Completion of PFP terminal clean-out, 2002

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

Cost Savings Potential (Mortgage Reduction): Mortgage rates can be reduced through the implementation of cost effective methods for size reduction, separation of non-TRU materials, and decontamination to reduce the size and volume of material for TRU-waste disposal.

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

Other: None identified.

Consequences of Not Filling Need: Current methods would be used which are costly and time consuming. These methods would slow Hanford cleanup progress.

Outsourcing Potential: There may be some outsourcing potential in providing decontamination and size reduction technologies.

End User: EM-60

Site Technical Points of Contact: Gerry McCormick - BWHC (509) 372-8173, Charlie Kronvall (509) 373-3309, Paul Roege - BWHC (509) 372-043, Grady Cox BWHC (509)-373-4201

Contractor Facility/Project Manager: Fredrick Crawford - BWHC (509) 372-8138

DOE End User/Representative Points of Contact: Larry Romine - EM-60 (509) 376-4747

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

TERMINAL CLEAN-OUT AND TRU WASTE DECONTAMINATION OF PFP

Identification No.: RL-DD03
Date: September, 1998

Program: Decontamination and Decommissioning
OPS Office/Site: Richland Operations Office/Hanford Site
Operable Unit (if applicable): N/A
Waste Stream: Alpha contamination that is 1) dispersible, 2) fixed, and 3) embedded (MN-11)
Waste Management Unit (if applicable): N/A
Facility: Plutonium Finishing Plant

Site Priority Ranking: High

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

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 Canyon floor.

Fast acting, low life-cycle cost surface decontamination technologies, including those which 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.

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, alternate cleaning techniques are desired.

Decontamination technologies currently available are as follows:
Concrete -- scabbling, hydro-lancing;
Metal -- wipes, hydro-lancing, ice blasting, steam, acid washes, electropolishing;
Glove boxes -- wipes, strippable coatings/gels.

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.

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

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 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.

PBS No.	***WBS No.***	***TIP No.***
RL-TP05	1.4.5 - PFP	Candidate

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: TPA Milestone M-83-00: Complete Stabilization of Process Areas Resulting from EIS ROD [PFP (Date: TBD - under negotiation)]
TPA Milestone M-83-02, Complete Identified Interim Actions - PFP (December 1998)
TPA Milestone M-83-02-T04, 234-5Z Duct Level Clean-out (December 1998)
DNFSB 94-1: Completion of PFP terminal clean-out, 2002

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

Cost Savings Potential (Mortgage Reduction): Mortgage rates can be reduced through the implementation of cost effective methods for decontamination.

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.

Consequences of Not Filling Need: Current methods will be used which are costly and time consuming. These methods will slow Hanford cleanup progress.

Outsourcing Potential: There may be some outsourcing potential in developing decontamination technologies. An example of existing chemistry that has not been applied in the field is the use of silver persulfate solutions to remove plutonium from process systems.

End User: EM-60

Site Technical Points of Contact: Gerry McCormick - BWHC (509) 372-8173, Robbin Duncan (509) 373-2229, Charlie Kronvall (509) 373-3309, Paul Roege - BWHC (509) 372-043, Grady Cox BWHC (509)-373-4201

Contractor Facility/Project Manager: Fredrick Crawford - BWHC (509) 372-8138

DOE End-User/Representative Points of Contact: Larry Romine - EM-60 (509) 376-4747

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

TRU WASTE FIXATIVES FOR PFP

Identification No.: RL-DD04
Date: September, 1998

Program: Decontamination and Decommissioning
OPS Office/Site: Richland Operations Office/Hanford Site
Operable Unit (if applicable): N/A
Waste Stream: Radioactively contaminated surfaces with loose or dispersible contamination (NM-11)
Waste Management Unit (if applicable): N/A
Facility: Plutonium Finishing Plant

Site Priority Ranking: Medium

Need Title: Waste Fixatives for PFP

Need Description: Long-life fixatives to 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.

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

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 - 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.

Schedule Requirements: 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.

PBS No.	*WBS No.*	*TIP No.*
RL-TP05	1.4.5 - PFP	Candidate

Justification for Need:

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

Regulatory: TPA Milestone M-83-00: Complete Stabilization of Process Areas Resulting from EIS ROD [PFP (Date: TBD - under negotiation)]
TPA Milestone M-83-02, Complete Identified Interim Actions - PFP (December 1998)
TPA Milestone M-83-02-T04, 234-5Z Duct Level Clean-out (December 1998)
DNFSB 94-1: Completion of PFP terminal clean-out, 2002

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

Cost Savings Potential (Mortgage Reduction): Current fixative methods require periodic replacement and increase life cycle costs.

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

Other: None identified.

Consequences of Not Filling Need: Use current technology at high maintenance cost.

Outsourcing Potential: Unknown

End-User: EM-60

Site Technical Points of Contact: Gerry McCormick - BWHC (509) 372-8173, Charlie Kronvall - BWHC (509) 373-2229, Paul Roege - BWHC (509) 372-0443, Grady Cox, BWHC (509) 373-4201

Contractor Facility/Project Manager: Fredrick Crawford - BWHC (509) 372-8138

DOE End-User/Representative Points of Contact: James Mecca - EM-60 (509) 376-7471

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

CHARACTERIZATION OF BUILDINGS 324 & 327

Identification No.: RL-DD05
Date: September, 1998

Program: Decontamination and Decommissioning
OPS Office/Site: Richland Operations Office/Hanford Site
Operable Unit (if applicable): N/A
Waste Stream: Mixtures of contaminated and non-contaminated equipment and materials in or from materials processing facilities, reactors, and hot cells. The material and equipment may include radioactive/mixed wastes, equipment, tanks, pipes, concrete, etc.
Waste Management Unit (if applicable): N/A
Facility: Buildings 324 and 327

Site Priority Ranking: High

Need Title: Characterization of Buildings 324 and 327

Need Description: Characterization technologies are needed for determining radiation levels in situ. Differentiation between transuranic (TRU) waste and non-transuranic (non-TRU) waste is a primary concern. In addition, a verifiable method for determining that materials qualify for free-release is necessary.

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.

Functional Performance Requirements: A method is needed that will allow for real-time differentiation between TRU and non-TRU waste and/or between low level waste and free-release waste. Characterization is required for material contained in a variety of configurations including drums, plastic bags, equipment, processing facilities, etc.

a) **Ducts/Piping -** Improvements are needed for the remote in situ characterization of contamination levels in ducts and piping. Some ductwork has obstructions. 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 (5,000-25,000 rad/hr).

c) **Segregation Techniques** - Techniques are needed that can differentiate between contaminated and non-contaminated material and equipment that have 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.

Schedule Requirements: Immediate - long term. The 324 and 327 facilities are scheduled for transition to EM-40 by October 2007.

Problem Description:

a) **Ducts/Piping** - In situ characterization techniques are needed for characterizing contamination within ducts and piping. In some instances there are obstructions that restrict the use of currently used methods.
b) **Remote Radiation Mapping** - It is difficult to determine where contamination hot spots are in high radiation areas (radiation levels on the order of 5,000-25,000 rad/hr in hot cells). A method that would provide point specific information is desired to optimize decontamination resources. Current methods for obtaining this data are labor intensive, long in duration, wasteful of personnel occupational radiation exposure, expensive and subject to a variety of random and systematic errors due to the use of multiple performers taking repetitive measurements over rather extended time periods.
c) **Segregation techniques** - It is often difficult to 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 adds unnecessary costs for handling and disposal.

PBS No.	***WBS No.***	***TIP No.***
RL-TP08	1.4.10 - 324/327 FT Project	N/A

Justification for Need:

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

Regulatory: N/A.

Environmental Safety and Health: Supports ALARA and radiological mapping for future D&D efforts.

Cost Savings Potential (Mortgage Reduction): Significant cost savings in long-term surveillance and maintenance may be realized by confidently mapping radiological areas at the end of deactivation.

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 as a waste product.

Other: None identified.

Consequences of Not Filling Need: There is the potential that increased conservatism due to inadequate data could lead to increased surveillance and maintenance prior to final D&D. Final D&D will be hampered by the lack of data.

Outsourcing Potential: Unknown

End-User: EM-60

Site Technical Points of Contact: Gerry McCormick - BWHC (509) 372-8173, Robbin Duncan - BWHC (509) 2229, Rich Hobart - BWHC (509) 373-2316

Contractor Facility/Project Manager: George Hayner - BWHC (509) 372-8135

DOE End-User/Representative Points of Contact: Larry Romine - EM-60 (509) 376-4747

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

DECONTAMINATION OF BUILDINGS 324 AND 327

Identification No.: RL-DD06
Date: September, 1998

Program: Decontamination and Decommissioning
OPS Office/Site: Richland Operations Office/Hanford Site
Operable Unit (if applicable): N/A
Waste Stream: Alpha, Beta, and Gamma contamination that is 1) dispersible, 2) fixed, and 3) embedded
Waste Management Unit (if applicable): N/A
Facility: Buildings 324 and 327

Site Priority Ranking: High

Need Title: Decontamination of Buildings 324 and 327

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

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

Functional Performance Requirements: Decontamination methods are needed that minimize worker exposure, secondary waste generation, costs, and risk and are readily deployable. Methods that clean to free-release levels are preferable. The specific need is for the decontamination of B-Cell. The cells typically contain stainless-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 several millirems to as high as 500,000 rad/hr. Waste minimization and remote handling methods are of prime importance.

Schedule Requirements: Immediate – long term. Selection of the technology should occur in 2003 and deployment in Building 324 should be complete by 2005.

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.

PBS No.	***WBS No.***	***TIP No.***
RL-TP08	1.4.10 - 324/327 FT Project	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: TPA Milestone M-89: Close 324 non-permitted areas by October 2005.

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

Cost Savings Potential (Mortgage Reduction): Mortgage rates can be reduced through the implementation of cost effective methods for decontamination. Costs can be reduced by reductions in the final volume of waste for disposal.

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.

Consequences of Not Filling Need: Current methods will be used which are costly, time consuming, and generate considerable additional waste. These methods will slow Hanford cleanup progress.

Outsourcing Potential: There may be some outsourcing potential in developing decontamination technologies.

End User: EM-60

Site Technical Points of Contact: Gerry McCormick - BWHC (509) 372-8173, Robbin Duncan - BWHC (509)-2229, Rich Hobart - BWHC (509) 373-2316

Contractor Facility/Project Manager: George Hayner - BWHC (509) 372-8135

DOE End-User/Representative Points of Contact: Larry Romine - EM-60 (509) 376-4747

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

FIXATIVES FOR BUILDINGS 324 AND 327

Identification No.: RL-DD07
Date: September, 1998

Program: Decontamination and Decommissioning
OPS Office/Site: Richland Operations Office/Hanford Site
Operable Unit (if applicable): N/A
Waste Stream: Radioactively contaminated surfaces with loose or dispersible contamination.
Waste Management Unit (if applicable): N/A
Facility: Buildings 324 and 327

Site Priority Ranking: High

Need Title: Fixatives for Buildings 324 and 327

Need Description: Long-life fixatives to 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, hot cells, and ductwork.

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

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

Schedule Requirements: Immediate - long term. Selection of the technology should occur in 2003 and deployment may occur 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.

PBS No.	*WBS No.*	*TIP No.*
RL-TP08	1.4.10 - 324/327 FT Project	N/A

Justification for Need:

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

Regulatory: N/A

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

Cost Savings Potential (Mortgage Reduction): Current fixative methods require periodic replacement and increase life cycle costs.

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

Other: None identified.

Consequences of Not Filling Need: Use current technology at high maintenance cost.

Outsourcing Potential: Unknown

End User: EM-60

Site Technical Points of Contact: Gerry McCormick - BWHC (509) 372-8173, Robbin Duncan - BWHC (509)-2229, Rich Hobart - BWHC (509) 373-2316

Contractor Facility/Project Manager: George Hayner - BWHC (509) 372-8135

DOE End-User/Representative Points of Contact: Larry Romine - EM-60 (509) 376-4747

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

REMOTE CUTTING TECHNOLOGIES FOR BUILDINGS 324 AND 327

Identification No.: RL-DD08
Date: September, 1998

Program: Decontamination and Decommissioning
OPS Office/Site: Richland Operations Office/ Hanford Site
Operable Unit (if applicable): N/A
Waste Stream: Radioactively contaminated materials, equipment, tanks, pipes. Asbestos contaminated materials also require cutting.
Waste Management Unit (if applicable): N/A
Facility: Buildings 324 and 327

Site Priority Ranking: High

Need Title: Remote Cutting Technologies for Buildings 324 and 327

Need Description: Low life-cycle cost, cutting technologies are needed immediately for radioactively contaminated materials, equipment, tanks, racks, pipes, etc. Some situations may require remote capabilities.

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

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 (5,000 - 25,000 rad/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, etc.

Schedule Requirements: Immediate - long term. Equipment removal from B-Cell is already underway and is scheduled for completion in November 2000. Deployment in Building 324 should be complete by 2005.

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 wastes, cause a high degree of worker fatigue and are costly.

PBS No.	***WBS No.***	***TIP No.***
RL-TP08	1.4.10 - 324/327 FT Project	N/A

Justification for Need:

Technical: Current methods are often too slow and labor intensive. High radiation levels prevent direct worker access.

Regulatory: TPA Milestone M-89: Complete closure of non-permitted areas by October 2005.

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

Cost Savings Potential (Mortgage Reduction): Cost savings can be realized through the time savings due to faster cutting technology.

Cultural/Stakeholder Concerns: Stakeholders have expressed concerns with regard to the amount of waste destined for burial at Hanford 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.

Consequences of Not Filling Need: Current cutting technologies will be deployed and may take longer than originally planned.

Outsourcing Potential: Unknown

End User: EM-60

Site Technical Points of Contact: Gerry McCormick - BWHC (509) 372-8173, Robbin Duncan - BWHC (509) 373-2229, Rich Hobart - BWHC (509) 373-2316

Contractor Facility/Project Manager: George Hayner - BWHC (509) 372-8135

DOE End-User/Representative Points of Contact: Larry Romine - EM-60 (509) 376-4747

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

TANK REMEDIATION FOR BUILDING 324

Identification No.: RL-DD09
Date: September, 1998

Program: Decontamination and Decommissioning
OPS Office/Site: Richland Operations Office/Hanford Site
Operable Unit (if applicable):
Waste Stream: High level radiation waste tank heels
Waste Management Unit (if applicable):
Facility: Building 324

Site Priority Ranking: Medium

Need Title: Tank Remediation for Building 324

Need Description: Methods are needed for remediation of residual waste from tanks used for storing highly radioactive liquid associated with material processing and testing within the facility hot cells.

Current Baseline Technology: Remove and size reduce tanks with current cutting technology (plasma arc torch).

Functional Performance Requirements: Remote techniques are needed to remove tank heels or to prevent dispersion of contamination upon cutting or disassembly. The residual material ranges from low level to high level material with potential for transuranic waste. The residues are in the form of liquids, liquid sludges, solids and dispersible material.

Schedule Requirements: Prior to facility transition -- scheduled for 2005.

Problem Description: Hardened heels remain in storage tanks that were used in treatability processes within facility hot cells. The residual materials were left in the tanks after they were flushed and rinsed.

PBS No.	***WBS No.***	***TIP No.***
RL-TP08	1.4.10 - 324/327 FT Project	N/A

Justification for Need:

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

Regulatory: DOE-RL-96-73, Rev. 1, "324 Building Radiochemical Engineering Cells, High-Level Vault, Low-Level Vault and Associated Area Closure Plan."

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

Cost Savings Potential (Mortgage Reduction): N/A. Required prior to transition.

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

Other: None identified.

Consequences of Not Filling Need: Potential safety hazard.

Outsourcing Potential: N/A

End User: EM-60

Site Technical Points of Contact: Gerry McCormick - BWHC (509) 372-8173, Robbin Duncan - BWHC (509) 373-2229, Rich Hobart - BWHC (509) 373-2316

Contractor Facility/Project Manager: George Hayner - BWHC (509) 372-8135

DOE End-User/Representative Points of Contact: Larry Romine - EM-60 (509) 376-4747

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

RADIATION HARDENED ROBOTICS FOR BUILDING 324

Identification No.: RL-DD010
Date: September, 1998

Program: Decontamination and Decommissioning
OPS Office/Site: Richland Operations Office/Hanford Site
Operable Unit (if applicable): N/A
Waste Stream: Highly radioactive materials within hot cells
Waste Management Unit (if applicable): N/A
Facility: Building 324

Site Priority Ranking: Medium

Need Title: Radiation Hardened Robotics for Building 324

Need Description: Remote handling methods are needed for high radiation areas such as hot cells. Automated systems are needed to survey contaminated areas and to deploy decontamination, characterization and cutting technologies.

Current Baseline Technology: Cranes and master slave manipulators

Functional Performance Requirements: Automated systems must be able to perform remote activities requiring a range of motions and weight requirements in high radiation fields (on the order of 5,000 to 25,000 rad/hour) and with a life expectancy of greater than one year. The systems need to have motor skills that allow them to deploy decontamination technologies and characterization tools and to perform cutting activities. The systems may be operated pneumatically, hydraulically, or electrically but must be able withstand the harsh environments of the hot cells. It is highly desirable that the robotics have "two-arm" capabilities to enable the remote mounting of other decontamination tools to the basic platform.

Schedule Requirements: Immediate: Equipment removal from B-Cell is already underway and is scheduled for completion in November 2000.

Problem Description: Hot cell cleanout activities require the decontamination, dismantling, and removal of equipment and debris. Activities are best performed remotely due to the high radiation field. In some cases, overhead cranes are the only equipment available to perform work. Such cranes often prove to not have the fine motor control necessary to accomplish a given task. Remote cutting operations are often tedious and labor intensive which may lead to worker fatigue and potential for dropping of equipment and other failures.

PBS No.	***WBS No.***	***TIP No.***
RL-TP08	1.4.10 - 324/327 FT Project	N/A

Justification for Need:

Technical: Activities in high radiation areas require remote operations.

Regulatory: DOE-RL-96-73, Rev. 1, "324 Building Radiochemical Engineering Cells, High-Level Vault, Low-Level Vault and Associated Area Closure Plan."

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

Cost Savings Potential (Mortgage Reduction): Schedule acceleration due to more efficient remote operations may result in a cost saving.

Cultural/Stakeholder Concerns: Worker exposure can be significantly reduced by using remotely deployed systems that avoid putting workers at risk. Better characterization data will lead to better and more cost effective decontamination/removal decisions, thus minimizing quantities of materials handled, stored or disposed as a waste product. The location of the 324 facility 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

Consequences of Not Filling Need: Will continue to use existing technology (i.e. cranes and master slave manipulators).

Outsourcing Potential: Unknown

End User: EM-60

Site Technical Points of Contact: Gerry McCormick - BWHC (509) 372-8173, Robbin Duncan - BWHC (509) 373-2229, Rich Hobart - BWHC (509) 373-2316

Contractor Facility/Project Manager: George Hayner - BWHC (509) 372-8135

DOE End-User/Representative Point of Contact: Larry Romine - EM-60 (509) 376-4747

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

STRUCTURAL INTEGRITY INSPECTION -- 324/327 BUILDINGS HOT CELL LINERS

Identification No.: RL-DD011
Date: September, 1998

Program: Decontamination and Decommissioning
OPS Office/Site: Richland Operations Office/Hanford
Operable Unit (if applicable): N/A
Waste Stream: Stainless-steel hot cell liners
Waste Management Unit (if applicable): N/A
Facility: Buildings 324 and 327

Site Priority Ranking: High

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

Need Description: A method is required for the reliable inspection of the integrity of hot cell liners to support the selection of an appropriate method for decontamination.

Current Baseline Technology: Visual inspection, camera

Functional Performance Requirements: The hot cell liners are composed of .25-.50 inch 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.

Schedule Requirements: Immediate: Equipment removal from B-Cell is already underway and is scheduled for completion in November 2000.

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.

PBS No.	***WBS No.***	***TIP No.***
RL-TP08	1.4.10 - 324/327 FT Project	N/A

Justification for Need:

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

Regulatory: DOE-RL-96-73, Rev. 1, "324 Building Radiochemical Engineering Cells, High-Level Vault, Low-Level Vault and Associated Area Closure Plan."

Environmental Safety and Health: N/A. This is a regulatory requirement. Breaks in the liner, if found, will be patched.

Cost Savings Potential (Mortgage Reduction): New technologies will be evaluated in a cost/benefit analysis versus the baseline process.

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

Consequences of Not Filling Need: Uncertainty of the integrity of the liner will require more robust and expensive decontamination procedures.

Outsourcing Potential: N/A

End User: EM-60

Site Technical Points of Contact: Gerry McCormick - BWHC (509) 372-8173, Robbin Duncan - BWHC (509) 373-2229, Rich Hobart - BWHC (509) 373-2316

Contractor Facility/Project Manager: George Hayner - BWHC (509) 372-8135

DOE End-User/Representative Point of Contact: Larry Romine - EM-60 (509) 376-4747

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

SEGREGATION OF WASTE FOR THE D&D PROGRAM

Identification No.: RL-DD017
Date: September, 1998

Program: Decontamination and Decommissioning
OPS Office/Site: Richland Operations Office/Hanford Site
Operable Unit (if applicable): N/A
Waste Stream: Contaminated and non-contaminated equipment and materials from materials processing facilities, glove boxes, reactors and hot cells. Contaminated materials may include radioactive or mixed wastes, equipment, tanks, pipes, concrete, etc. (ER-01, ER-02, ER-05, ER-06, ER-08, and T3-ER).
Waste Management Unit (if applicable): N/A
Facility: Materials processing facilities, decontamination facilities, hot cells, fuel basins and reactors

Site Priority Ranking: High

Need Title: Segregation of waste for the D&D program for the purpose of disposal.

Need Description: A system is needed that segregates between transuranic and non-transuranic waste and between low level and free-release waste.

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 without any characterization.

Functional Performance Requirements: A method is needed for the real-time segregation of TRU and non-TRU waste, and between low level and free-release waste. The segregation method and its associated characterization technologies are needed for material contained in a variety of configurations including drums, plastic bags, equipment, concrete chunks, and gravel. The technology must work on material/equipment with inaccessible surfaces larger than crushed materials.

Decommissioning activities require an integrated system that will automatically identify, characterize and segregate the material based on the disposal option it meets.

Schedule Requirements: This is an ongoing need that could be applied as long as D&D activities are being performed at the Hanford Site.

Problem Description: It is difficult to differentiate between the different levels of contamination that determine how an item or some material should be disposed. Potentially contaminated surfaces are often inaccessible to current detection methods. Some materials are managed in their entirety as low level, transuranic and/or mixed wastes, which adds unnecessary costs for handling and disposal.

PBS No.	***WBS No.***	***TIP No.***
RL-ER06	1.6.6	N/A

Justification for Need:

Technical: A rapid means to segregate materials with the proper characterization of wastes can 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): 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 handled, stored or disposed as a waste product is desirable by the stakeholders.

Other: None identified

Consequences of Not Filling Need: The potential exists for materials to be handled and disposed of as contaminated or as TRU when they are not, and therefore disposed of at additional cost.

Outsourcing Potential: Unknown

End-User: EM-40

Site Technical Points of Contact: Kim Koegler - BHI (509) 372-9294, Mike Mihalic - BHI (509) 373-1382, Sue Garrett - PNNL (509) 372-4266

DOE End-User/Representative Points of Contact: Jim Goodenough (509) 376-0893

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

METAL DECONTAMINATION AND RECYCLING FOR THE D&D PROGRAM

Identification No.: RL-DD021
Date: September, 1998

Program: Decontamination and Decommissioning
OPS Office/Site: Richland Operations Office/Hanford Site
Operable Unit (if applicable): N/A
Waste Stream: Metals contaminated as low level waste (ER-05)
Waste Management Unit (if applicable): N/A
Facility: Hanford facilities undergoing final decontamination and decommissioning

Site Priority Ranking: High

Need Title: Metal decontamination and recycling for the D&D program

Need Description: Metal decontamination and recycling to cost-effectively reduce radioactive waste volumes and allow for recycle/reuse of metals and equipment.

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/m^3 for disposal, handling and transportation). When suspect materials are to be decontaminated, chemical treatment or surface cleaning with high-pressure water jets are applied prior to the release of these materials.

Functional Performance Requirements: Methods are needed that can cost-effectively decontaminate materials to free-release levels for recycle or reuse. The requirements for the technology include:

- Decontaminate pipes and internal components to free-release levels to allow for unrestricted use or recycling
- 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.

Schedule Requirements: Decontamination and decommissioning are ongoing at the Hanford Site. A technology could be applied immediately or until Hanford D&D is completed.

Problem Description: The estimated total volume of metallic waste exceeds 150,000 m^3. 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.

PBS No.	***WBS No.***	***TIP No.***
RL-ER06	1.6.6	N/A

Justification for Need:

Technical: Current methods are not cost effective for reducing radioactive waste volumes.

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): Potential areas of cost savings are: cost of disposal is avoided, cost of obtaining an asset is reduced (e.g., 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 resulting in reduced long-term liability.

Other: None identified.

Consequences of Not Filling Need: Continued loss of potentially recyclable materials to ERDF. D&D projects within the DOE continue to be encumbered with disposal costs.

Outsourcing Potential: Unknown

End-User: EM-40

Site Technical Points of Contact: Kim Koegler - BHI (509) 372-9294, Mike Mihalic - BHI (509) 373-1382, Sue Garrett - PNNL (509) 372-4266

DOE End User/Representative Points of Contact: Jim Goodenough (509) 376-0893

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

CRITICALLY SAFE VACUUM SYSTEM FOR 233-S

Identification No.: RL-DD029
Date: September, 1998

Program: Decontamination and Decommissioning
OPS Office/Site: Richland Operations Office/Hanford Site
Operable Unit (if applicable): N/A
Waste Stream: Solids with TRU contamination (ER-05 and T3-ER)
Waste Management Unit (if applicable): N/A
Facility: 233-S

Site Priority Ranking: High

Need Title: Critically Safe Vacuum System for 233-S

Need Description: Due to the presence of plutonium in the 233-S facility, a critically safe vacuum system is required for general cleanup.

Current Baseline Technology: The project has been using general industry vacuums with HEPA filters in areas with no criticality concerns. Where there is a criticality concern, materials are collected by hand and placed in appropriate containers.

Functional Performance Requirements: The vacuum system must meet all the normal requirements for a nuclear industry vacuum (e.g., use HEPA filters so as not to cause airborne contamination) and must collect the dust/material in a criticality safe container (e.g., <5" in diameter). The system must provide a critically safe configuration to exclude conditions for criticality anywhere within the system.

Schedule Requirements: Immediately

Problem Description: The 233-S facility contains dust and debris that contains plutonium. If the dust and debris are collected using the baseline HEPA filtered vacuums, there is a concern for criticality.

PBS No.	***WBS No.***	***TIP No.***
RL-ER06	1.6.6	N/A

Justification for Need:

Technical: Fissile material must be maintained in a geometrically favorable design configuration to ensure criticality remains not credible. Also, as part of the decommissioning process, all contamination, including plutonium, is to be removed from the facility. Therefore, it is imperative to maintain the plutonium in a geometrically favorable condition during removal and waste handling.

Regulatory: Geometrically favorable design must be maintained at all times to ensure criticality remains not credible.

Environmental Safety & Health: Non-compliance with the above-mentioned regulations could increase the potential for a criticality event, greater contamination and possible environmental impacts, including the potential for populace exposure.

Cost Savings Potential (Mortgage Reduction): This need is not an issue of cost and should not have a large impact (neither positive nor negative) on the cost of the project.

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

Other: None identified.

Consequences of Not Filling Need: Inability to vacuum residues (i.e., dust, sand, debris) from process area rooms would result in potentially greater exposures from manual clean-up of residues.

Outsourcing Potential: N/A

End User: EM-40

Site Technical Points of Contact: Kim Koegler – BHI (509) 372-9294, George Carter - BHI (509) 373-2141,, Sue Garrett - PNNL (509) 372-4266

DOE End User/Representative Points of Contact: Jeff Bruggeman - DOE (509) 376-7121, Jim Goodenough - DOE (509) 376-0893

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

CUTTING PLUTONIUM CONTAMINATED PIPE FOR 233-S

Identification No.: RL-DD030
Date: September, 1998

Program: Decontamination and Decommissioning
OPS Office/Site: Richland Operations Office/Hanford Site
Operable Unit (if applicable): N/A
Waste Stream: Solid waste with TRU contamination (ER-05 and T3-ER)
Waste Management Unit (if applicable): N/A
Facility: 233-S

Site Priority Ranking: High

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

Need Description: Alternative cutting techniques 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.

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 spills of dispersible and fixed contamination.

Functional Performance Requirements: The piping to be cut range in size from 0.5 inch to 7.0 inch OD of schedule 10 or schedule 40 stainless steel. Piping may be vertical or horizontal, free standing or against walls or floors, and in congested areas at elevated locations..

Schedule Requirements: Immediate

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.

PBS No.	***WBS No.***	***TIP No.***
RL-ER06	1.6.6	N/A

Justification for Need:

Technical: Current baseline technologies do not provide a mechanism for preventing spills of removable 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): If no additional techniques 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.

Consequences of Not Filling Need: If no additional techniques are found, then additional confinements will have to be designed and constructed causing delays and unplanned expense.

Outsourcing Potential: N/A

End User: EM-40

Site Technical Points of Contact: Kim Koegler – BHI (509) 372-9294, George Carter - BHI (509) 373-2141, Sue Garrett - PNNL (509) 372-4266

DOE End User/Representative Points of Contact: Jeff Bruggeman - DOE (509) 376-7121, Jim Goodenough - DOE (509) 376-0893

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

NON-INTRUSIVE DETECTION OF PIPE CONTENTS FOR 233-S

Identification No.: RL-DD031
Date: September, 1998

Program: Decontamination and Decommissioning
OPS Office/Site: Richland Operations Office/Hanford Site
Operable Unit (if applicable): N/A
Waste Stream: N/A
Waste Management Unit (if applicable): N/A
Facility: 233-S

Site Priority Ranking: High

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

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

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 techniques are known. The current technique 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.

Functional Performance Requirements: The technique must be able to detect liquids or explosive gases (e.g., H_2) 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.

Schedule Requirements: Immediate

Problem Description: Pipes in 233-S must be breached to detect liquids or explosive gases prior to disposal. Drilling techniques cause heat and present possible increased risk during breaching.

PBS No.	***WBS No.***	***TIP No.***
RL-ER06	1.6.6	N/A

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): 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.

Consequences of Not Filling Need: Additional sampling activities may be necessary in areas outside the boundaries of the current project.

Outsourcing Potential: N/A

End User: EM-40

Site Technical Points of Contact: Kim Koegler – BHI (509) 372-9294, George Carter - BHI (509) 373-2141, Sue Garrett - PNNL (509) 372-4266

DOE End User/Representative Points of Contact: Jeff Bruggeman - DOE (509) 376-7121, Jim Goodenough - DOE (509) 376-0893

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

CONTAMINATION FIXATIVE FOR 233-S

Identification No.: RL-DD032
Date: September, 1998

Program: Decontamination and Decommissioning
OPS Office/Site: Richland Operations Office/Hanford Site
Operable Unit (if applicable): N/A
Waste Stream: Solids with TRU contamination (ER-05 and T3-ER)
Waste Management Unit (if applicable): N/A
Facility: 233-S

Site Priority Ranking: High

Need Title: Contamination Fixative for 233-S

Need Description: A fixative is needed to capture airborne and removable contamination and affix contamination on facility surfaces and within piping and vessels.

Current Baseline Technology: The current technique is a "fog." The system applies a capture coating by generating a fog that does not disturb loose contamination. The fog will then, over time, adhere to all surfaces. The resulting fixative remains tacky based on the typical solution composition. Drying time can be from several hours to over one year, based on test coupons. Plans are to apply a coat of paint to accessible areas after the fixative is applied. Internal equipment areas would not be painted.

Functional Performance Requirements: A method is needed to affix loose and airborne contamination to surfaces. The technique should be easy to apply, have some indicator for wet/dry, should not be tacky upon drying, and be able to coat the interior of 1.0 inch to 7.0 inch OD pipes. The method should be appliable with some airflow in contained areas.

Schedule Requirements: Immediate

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 is tacky 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.

PBS No.	*WBS No.*	*TIP No.*
RL-ER06	1.6.6	N/A

Justification for Need:

Technical: The baseline method leaves the surface tacky and my 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): 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.

Consequences of Not Filling Need: The baseline technique will be used resulting in tacky surfaces. Also, delays may be caused if there are airflow problems during application.

Outsourcing Potential: N/A

End User: EM-40

Site Technical Points of Contact: Kim Koegler – BHI (509) 372-9294, George Carter - BHI (509) 373-2141, Sue Garrett - PNNL (509) 372-4266

DOE End User/Representative Points of Contact: Jeff Bruggeman - DOE (509) 376-7121, Jim Goodenough - DOE (509) 376-0893

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

FIELD SCREENING FOR HAZARDOUS MATERIALS FOR 105-F AND 105-DR REACTORS

Identification No.: RL-DD033
Date: September, 1998

Program: Decontamination and Decommissioning
OPS Office/Site: Richland Operations Office/Hanford Site
Operable Unit (if applicable): N/A
Waste Stream: Hazardous or mixed wastes (ER-01, ER-02, ER-06 and ER-08)
Waste Management Unit (if applicable): N/A
Facility: Reactors 105-F and 105-DR

Site Priority Ranking: High

Need Title: Field Screening for Hazardous Materials for 105-F and 105-DR Reactors

Need Description: A better field and/or in situ screening method is needed for indicating the presence of hazardous materials so that waste may be segregated as may be required based on waste disposal criteria. The main hazardous contaminants of concern are RCRA metals, PCBs and sodium dichromate.

Current Baseline Technology: The current method of collecting and sending samples to laboratories results in a turnaround time of two to three weeks.

Functional Performance Requirements: A near real-time, in situ method is needed to indicate the presence of RCRA metals, PCBs and sodium dichromate to regulatory waste acceptance criteria (i.e., land disposal requirements). 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 the facilities.

Schedule Requirements: Immediate and ongoing for up to 5 years.

Problem Description: 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, then 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.

PBS No.	***WBS No.***	***TIP No.***
RL-ER06	1.6.6	N/A

Justification for Need:

Technical: Characterization information is needed to properly segregate waste. Quicker methods involving less handling will result in less error and the ability to classify each piece of waste versus entire packages of waste.

Regulatory: Waste classification is needed to segregate waste and meet waste disposal requirements.

Environmental Safety & Health: Proper segregation of waste is performed to ensure environmental safety and health.

Cost Savings Potential (Mortgage Reduction): 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.

Cultural/Stakeholder Concerns: Stakeholders are concerned that waste is handled properly.

Other: None identified.

Consequences of Not Filling Need: Laboratory analysis of waste samples will continue to be the baseline for segregating waste.

Outsourcing Potential: Unknown

End User: EM-40

Site Technical Points of Contact: Kim Koegler – BHI (509) 372-9294, David S. Smith – BHI (509) 376-3055, Sue Garrett – PNNL (509) 372-4266

DOE End User/Representative Points of Contact: Jim Goodenough (509) 376-0893

CANYON DISPOSITION INITIATIVE; CHARACTERIZATION TECHNOLOGY NEEDS PACKAGE

INTRODUCTION

The Hanford Canyon Disposition Initiative (CDI) Project is a collaborative project that includes participation across the DOE Office of Environmental Management including EM-30, EM-40, EM-50, and EM-60. The CDI Project will establish an end-state for the five Hanford processing canyons. Working with regulators and other shareholders, potential disposition alternatives have been identified for detailed analysis. The 221-U Facility (U-Plant) is the pilot for this initiative.

The first phase of the CDI Project is characterization to support the detailed analysis, including performance assessment, of final disposition alternatives for the 221-U Facility. This detailed analysis will support a timely record of decision (ROD) for the canyon end-state. Characterization activities will be accomplished primarily during Fiscal Year 1999.

This characterization technology needs package has been developed to communicate the technology needs for the CDI Project in its initial phase of characterization. The characterization technology needs statements provide the basis by which technology will be identified and evaluated for deployment. These statements provide for the identification of available technologies, and for technology development when needed to fill a technology gap.

Technologies will be identified and evaluated for their potential to improve over the baseline in characterization and performance assessment. Technologies will be selected for demonstration and deployment consistent with the project scope and schedule.

This package contains a general information section that is relevant to one or more of the individual characterization technology needs statements. General information includes a physical description of the facility and its components, and other information relevant to conducting characterization activities. Pictures are included to provide the reader an understanding of physical conditions, e.g., congestion. Following general information on the facility is a sampling and characterization requirements section; this section provides a summary of the requirements. Finally, the following individual characterization technology needs statements are attached:

1. Remote/Robotic Technologies (Platforms for Access, Characterization and Sampling)
2. Visual/Spatial Imaging
3. Radiation Survey
4. Detection of Freestanding Liquid
5. Liquid Characterization
6. Solids (Sediments/Sludge/Dust) Characterization

7. Concrete Characterization.

The baseline approach to characterization of the 221-U Facility is the collection of samples for off-site laboratory analysis for the contaminants of concern. Needs statements DD023, DD024 and DD025 represent an opportunity to identify technologies that do not require sample collection. Any technology that provides for in situ analysis must digitally store information on the location and concentrations of contaminants, display the information in near real-time, and allow for interfacing with other characterization technologies.

Much of the characterization will require remote deployment because of radiation fields (up to 500 R/hr, more typical up to 10 R/hr) and/or lack of space. Any proposed technologies must address these deployment issues.

Preference will be given to technologies that operate on more than one media and address many contaminants, thereby reducing the number of individual characterization technologies required.

Additional information on the CDI Project can be found in the following documents:

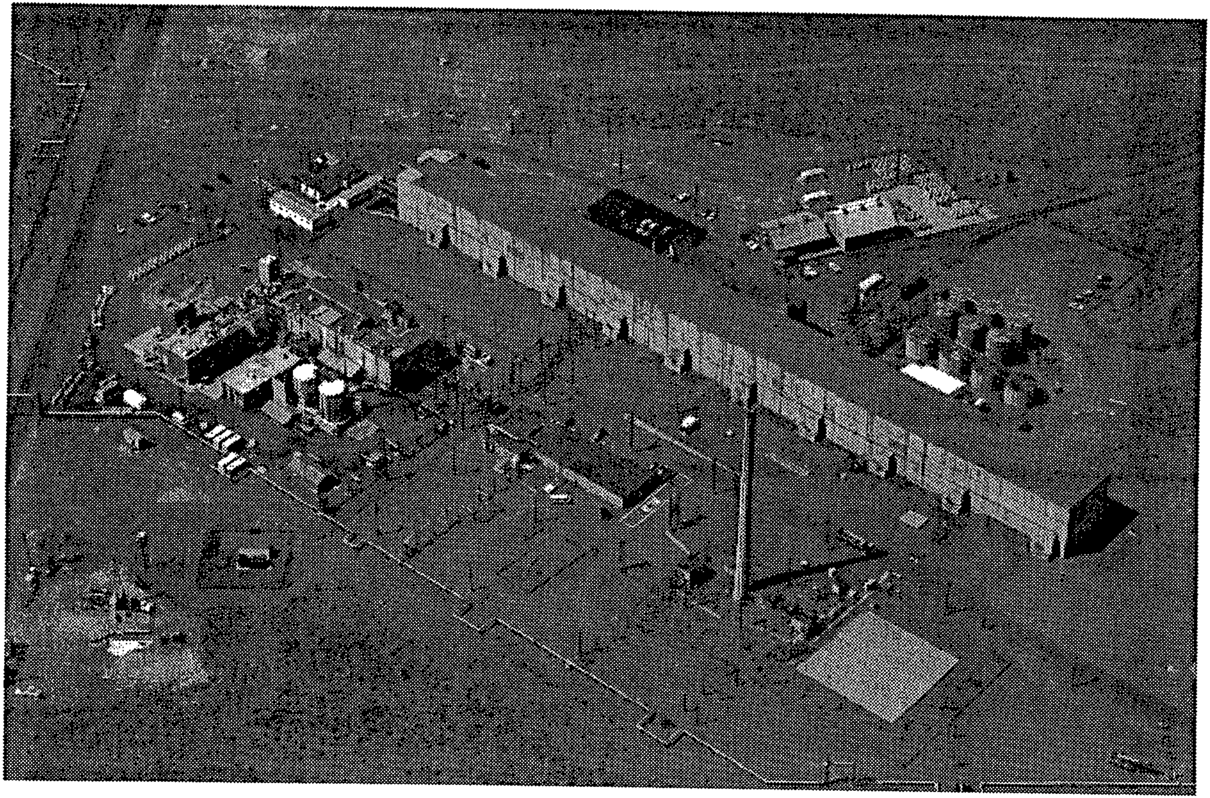
- Phase I Feasibility Study for the Canyon Disposition Initiative (221-U Facility); DOE/RL-97-11 Rev. 1; March 1998
- Data Quality Objectives Summary Report for the 221-U Canyon Disposition Alternatives; Miller, M.S., et al; BHI-01091, Rev. 1; February 1998
- Sampling and Analysis Plan for 221-U Facility; DOE/RL-97-68, Rev. 0; February 1998.

GENERAL INFORMATION (Figures 1 and 2)

The 221-U Facility is a multi-storied building approximately 246.9 m (810 feet) in length. The building and equipment were originally designed to permit the production of plutonium. However, it was never used for this purpose. After construction, it was remodeled and used for the recovery of uranium from tank farm wastes. The foundation is constructed of reinforced concrete varying from 1.8 to 2.4 m (6 to 8 feet) thick. The outside walls are reinforced concrete varying from 0.9 m (3 feet) to 1.5 m (5 feet) thick. It has a concrete roof varying in thickness from 0.9 m (3 feet) to 1.2 m (4 feet) thick. The building is divided into two main portions by a concrete wall 1.5 m to 2.7 m thick (5 to 9 feet) thick running the full length of the building. One portion is called the canyon, and the other is called the galleries. The length of the building is divided into twenty sections, at approximately 12.2 m (40 feet) intervals.

This building is not being used for any processing activities. However, the cells and canyon deck are being used for storage of contaminated process equipment.

The special work permit change room for regulated work areas is located at the northwest end of the operating gallery and was the central point used for entrance into the canyon.



E9805108.5

FIGURE 1. 221-U FACILITY AERIAL VIEW

221-U Canyon Building Section

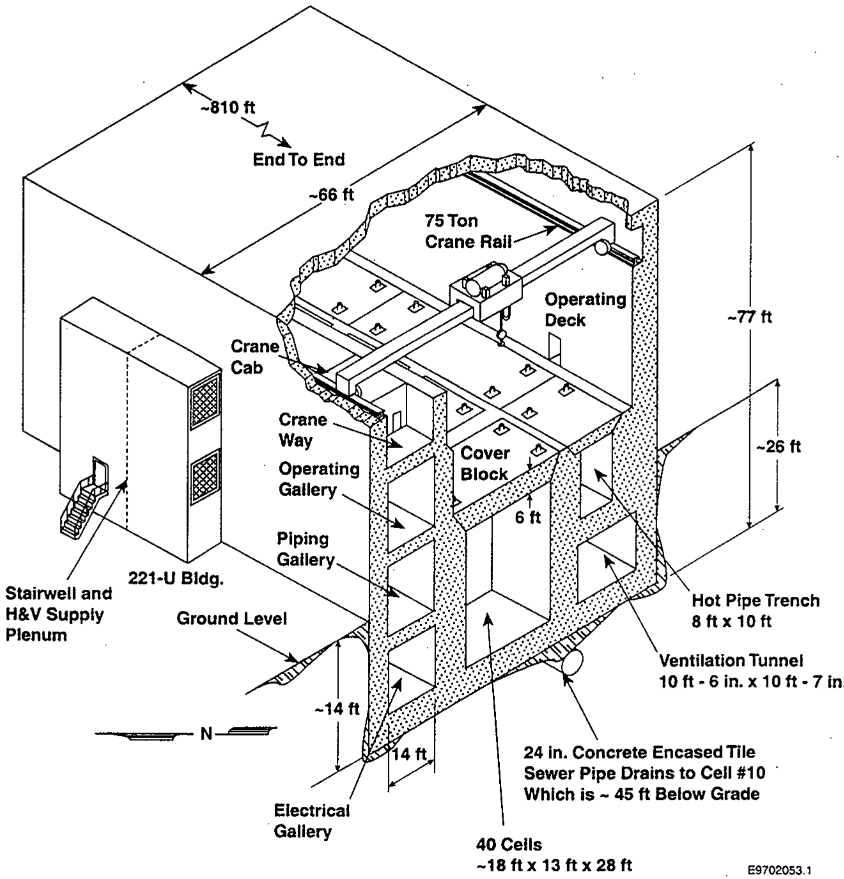


FIGURE 2 221-U FACILITY CROSS SECTION

The 30,000-cfm ventilation system is still active. Exhausting is possible through the 291-U exhaust facility by activating the electrically driven exhaust fans. The crane is currently inoperable, but is being refurbished. The following utilities are available: electrical power (480v) to the canyon; sanitary sewer on even wings of 221-U; and sanitary water to 271-U (adjacent to 221-U).

Galleries

There are three galleries, one above the other, along the front side of the building. The gallery side of the building is 4.3 m (14 feet) wide.

The **electrical gallery** (below grade) is split into two separate parts by a railroad tunnel entering the building. The clearance from the floor to the ceiling inside the gallery is approximately 4.6 m (15 feet). As the name implies, this gallery houses electrical switchgear and controls for controlling process equipment located on the canyon side of the building. The switchgear occupies less than 10% of the available space. The electrical gallery measures approximately 4.3 x 243.8 m (14 x 800 feet). There are no openings between the electrical gallery and the canyon. Access into the gallery is available through stairwell entrances at each odd-numbered section and through 3.7 m (12 feet) wide double wooden doors at section 11 and 13 of the attached office building (271-U).

The results of past direct radiological surveys and general area dose rate data for the electrical gallery show the alpha contamination is less than 20 dpm, the beta/gamma contamination is in the range of less than 1 x 10^3 to 72 x 10^3 dpm, and the dose ranges from 9 to 40 μR/hr.

The **pipe gallery** is also split into two separate sections by the railroad tunnel and has essentially the same dimensions as the electrical gallery. Clearance is restricted by the mass array of piping suspended from the ceiling and leading through the barricade wall into the canyon side of the building. Like the electrical gallery, there are no openings into the canyon from the pipe gallery. Access into the pipe gallery is possible through the stairwells at each odd-numbered section that run up the side of the building from the electrical gallery to the fourth level (the crane gallery), or through 3.7 m (12 feet) wide double wooden doors at sections 11 and 13 of the attached office building (271-U).

All cell piping, except process transfer lines, was brought to the pipe gallery, terminating in connections on the wall. From here, connections were made to the weigh tanks and control boards in the operating gallery. All connections are normal. Chemical headers, electrical and steam distribution lines were also located in this gallery.

The results of past direct radiological surveys and general area dose rate data for the pipe gallery show the alpha contamination is less than 20 dpm, the beta/gamma contamination is in the range of less than 1×10^3 to 125×10^3 dpm, and the dose ranges from 8 to 150 μR/hr.

The **operating gallery** is located above the pipe gallery and is similar to the electrical and pipe galleries, but is unique in that the railroad tunnel does not divide it into two parts. It runs the full length of the building and contains instrumentation and piping manifold stations for controlling the process in the canyon. Entrance into the operating gallery is possible from the 221-U building, through 3.7 m (12 feet) wide double doors at sections 11 and 13, or through the stairwell entrances at all odd-numbered sections. Since the original construction of the building, three openings were made from the operating gallery into the canyon portion of the building. Two of the openings have since been sealed. The remaining opening is a pedestrian passage through the 2.1 m (7 feet) thick wall, and is located at section 2. The sealed openings are at sections 11 and 20.

At each section was a gauge board from which control and instrument lines ran the cells, via the pipe gallery. Tanks used to weigh chemicals were provided with inlet connections from appropriate chemical headers in the pipe gallery and outlets to the cell vessel connections, also located in the pipe gallery.

The results of past direct radiological surveys and general area dose rate data for the operating gallery show the alpha contamination is less than 20 dpm, the beta/gamma contamination is in the range of less than 1×10^3 to 40×10^3 dpm, and the dose ranges from 7 to 11 μR/hr.

The **crane gallery (crane way)** is directly above the operating gallery and is accessible through air-lock doors at sections 11 and 13 from the attached office building (271-U), or through the stairwells at the odd-numbered sections. The crane gallery is a regulated work zone. Electrically operated wire cage doors have been installed in the stairwells between the operating gallery level and the crane gallery level to prevent unauthorized entrance into the canyon. This level the entire building is considered a canyon radiation zone. Fresh-air openings in the canyon crane gallery have been blanked off.

The crane gallery is partitioned from the canyon by a 1.5 m (5 feet) thick wall, but it has no ceiling and is open to the process canyon.

There are two cranes in the canyon, both are traveling cranes and ride a common track. The main crane is a 75-ton capacity bridge crane and it has a ten-ton capacity auxiliary hoist attached. It has an 18.3 m (60 feet) span, and travels a maximum rate of 48.8 m (160 feet) per minute. There are four smaller hoists (not operational) suspended from the bridge. Two are one ton capacity and two are ½ ton capacity. The main hoist is operated by a thirty horse power motor and has a 1.5 m (5 feet) per minute lifting speed. This crane is controlled visually through optics located in a special constructed and shielded crane cab.

The results of past direct radiological surveys and general area dose rate data for the crane gallery show the alpha contamination is less than 20 dpm, the beta/gamma contamination is in the range of 10 x 10^3 to 100 x 10^3 dpm, and the dose ranges from less than 0.5 to 2 mR/hr.

Cells (Figures 3, 4, and 5)

The canyon portion of the building is approximately 11.0 m (36 feet) wide and is divided into twenty sections. Each section is approximately 12.2 (40 feet) wide and contains two process cells. The cells contain process equipment, such as vessels, centrifuges, piping etc. The cells measure approximately 3.4 x 4.9 m (11 x 16 feet) and are 8.5 m (28 feet) deep from the top of the concrete cell covers to the bottom of the cell. Exceptions are cells in sections 1, 2 and 5. Sections 1 and 2 have slightly larger cells, and one of the two cells in section 5 (cell 10) is designed to accumulate water in the canyon. This cell is 14.3 m (47 feet) deep. All cells and the pipe trench drained to this cell via a 61 cm (24 inch) concrete-encased tile sewer pipe. Stepped, removable concrete blocks cover the cells. Only the key cover block will be removed during initial characterization activities, this provides an access opening of 0.6 x 3.4 m (2 x 11 feet).

The canyon cells housed the processing equipment for feed concentration and centrifugation, solvent-extraction, waste treatment and solvent treatment. Stepped, removable 1.8 m (6 feet) thick concrete blocks cover and provide access to the cells.

All pipe, instrument, sampling and control lines into the cell were encased in the concrete and terminate in connector flanges on the cell walls. These flanges were installed with a high degree of precision and the cell walls and floor were finished accurately to standard dimensions so that the connector arrangement in the cells was fixed and uniform. Piping from the cell to the gallery is brought up in an S shape rather than a straight through the concrete in order to minimize the escape of radiation from the cell.

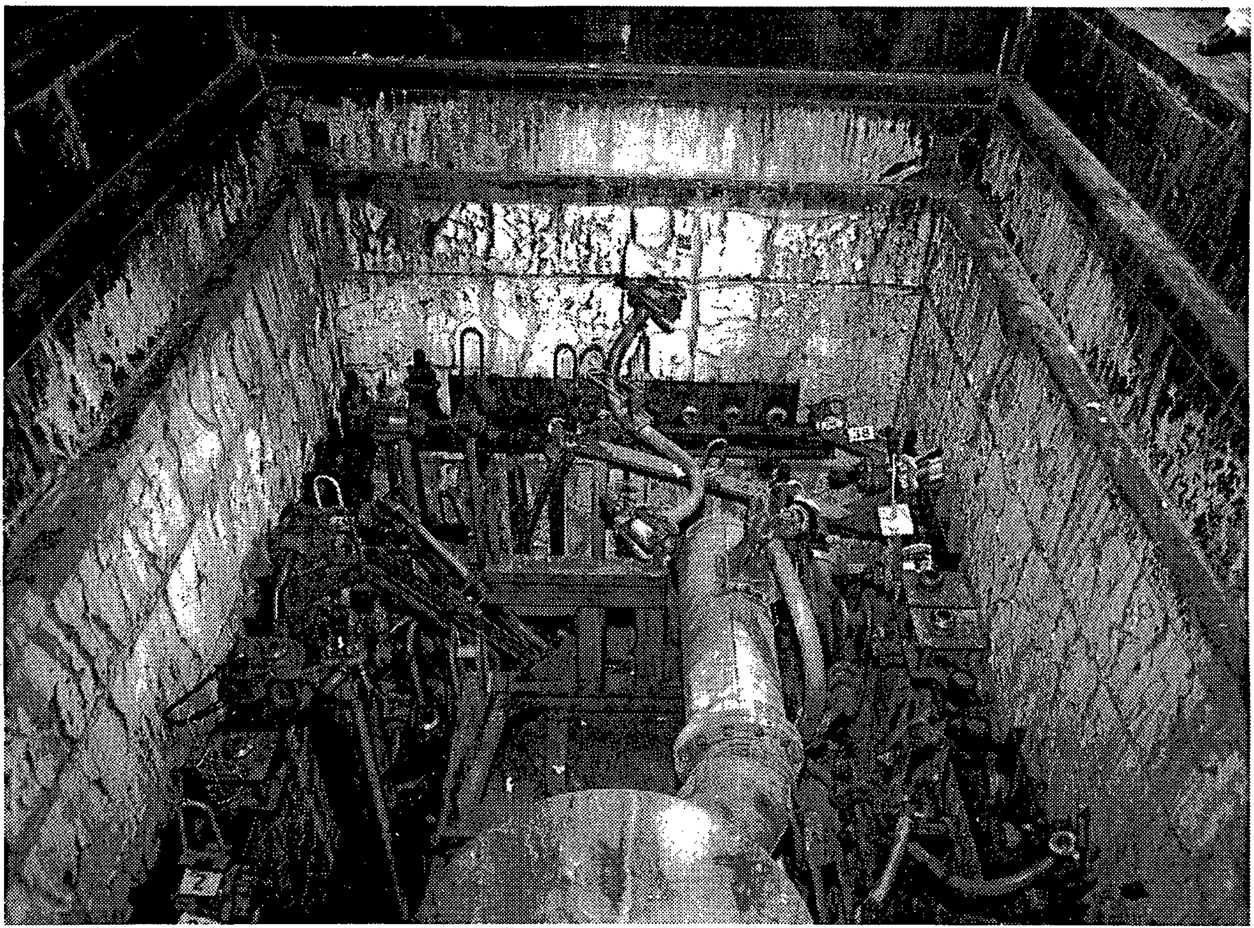
Equipment was placed on the cell floor and held in position by guides built into the cell, thus establishing a standard relationship between the connector flanges on vessels and cell walls.

Because of the difficulties created by the expansion joint that separated adjacent sections, no piping runs through the walls between sections.

The dosage in the cells is not known, but may be up to 500 R/hr.

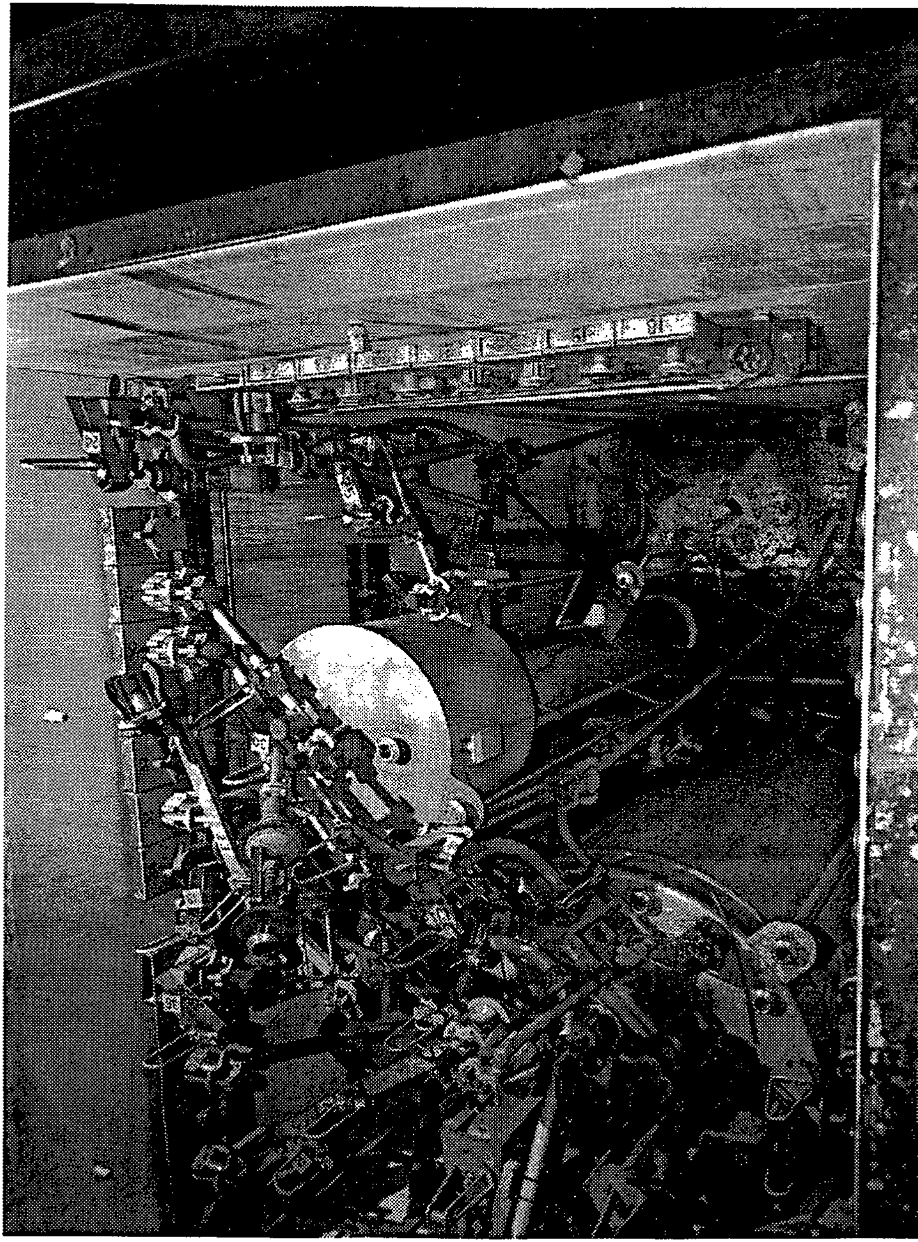
Deck (Figure 6)

The tops of the cell covers form the deck of the canyon. The deck is level with the floor of the operating gallery. Height from the deck to the ceiling is approximately 12.2 m (40 feet). The canyon deck is a regulated work zone.



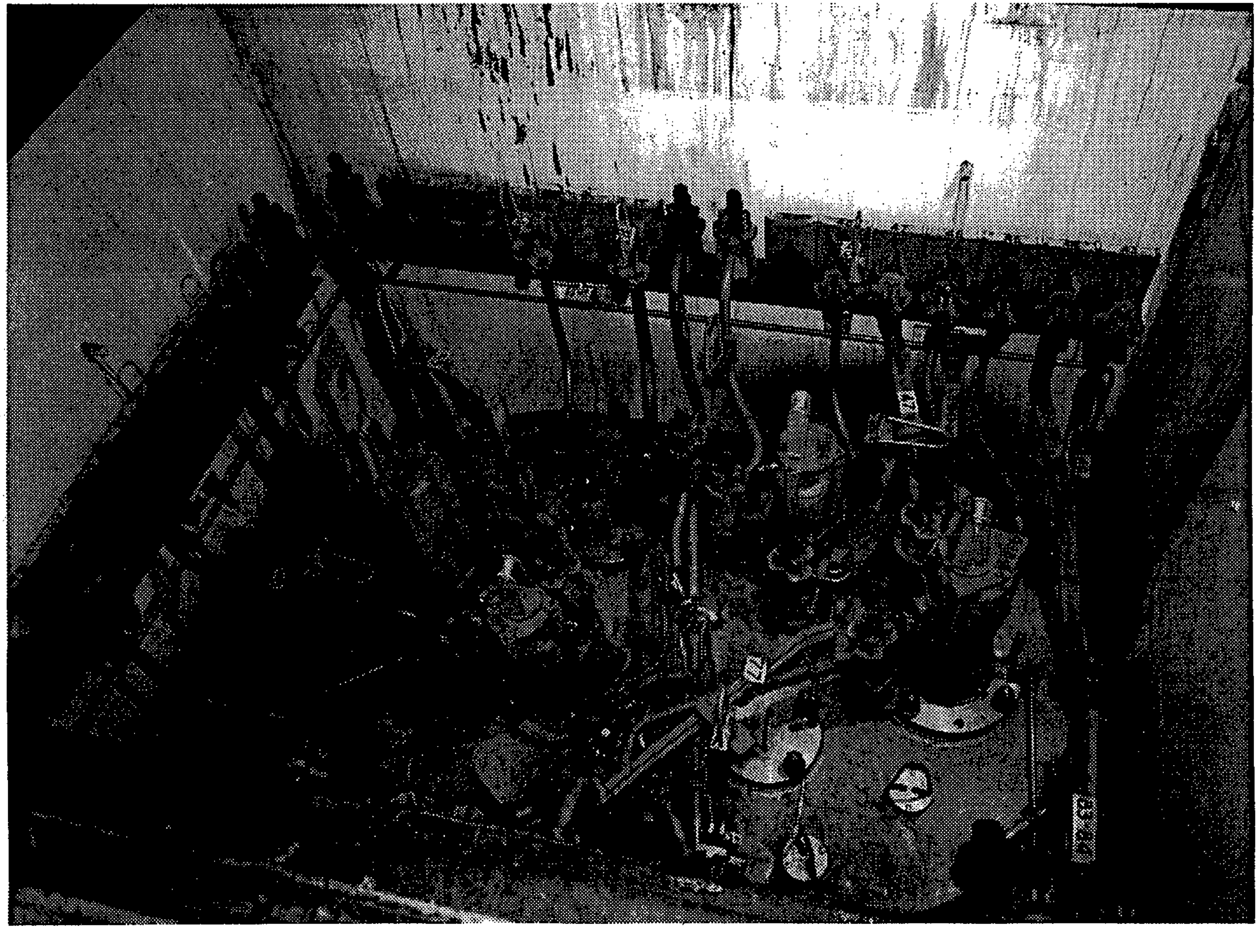
E9805108.4

FIGURE 3 221-U FACILITY OPEN CELL



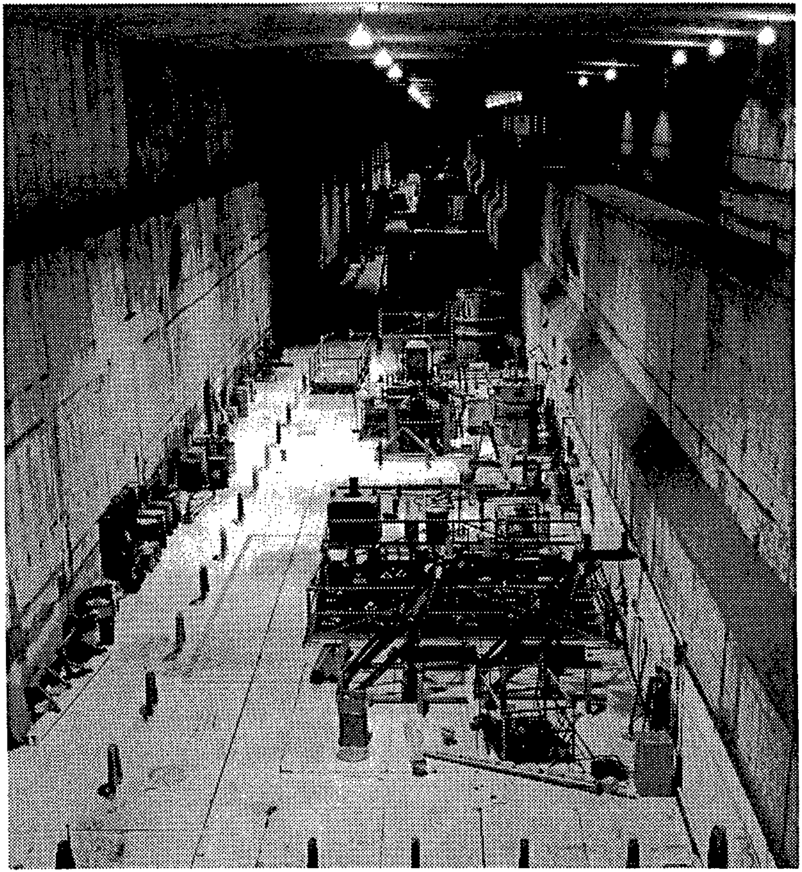
E9805108.3

FIGURE 4 221-U FACILITY OPEN CELL



E9805108.2

FIGURE 5 221-U FACILITY OPEN CELL



E9805108.1

FIGURE 6 221-U FACILITY CANYON DECK

Entrance into the canyon is possible through air-lock doors at ground level located at each of the odd-numbered sections. These entrances are at the deck level.

The deck level of the canyon has been decontaminated to a level that allows reasonable access with a low level of radiation exposure. However, there is equipment stored on the deck that substantially contributes to the radiological inventory of the facility. Equipment dose rates range from less than 20 to 14,000 dpm/100 cm^2 alpha and 20 x 10^3 to greater than 1 million dpm/100 cm2 beta/gamma. Some equipment may contain liquid. Pieces of equipment that required lubrication may still have liquid oil in their reservoirs.

The results of past direct radiological surveys and general area dose rate data for the canyon deck show the alpha contamination ranges from less than 20 to 140,000 dpm/100 cm^2, the beta/gamma contamination ranges from 1 x 10^3 to greater than 1,000 x 10^3 dpm/100 cm^2, and the dose ranges from less than 0.5 to 510 mR/hr.

Railroad Tunnel

The railroad tunnel enters the building at section 2, penetrating the electrical and pipe gallery portion of the building, and continues into the canyon portion of the building. Originally, the unloading of a railroad car in the canyon could be performed with the bridge crane by moving the 2-L cell cover block. However, studies were made of the necessity for keeping this railroad tunnel covered, and findings revealed that the cover blocks over the railroad tunnel were not necessary. The cover blocks were disposed of and this portion of the canyon deck is open at all times.

The contamination levels are unknown in the railroad tunnel.

Pipe Trench

Piping connections between cells were made through the cell walls and the pipe trench. The hot pipe trench runs parallel to the cells from section 3 to 20 and is 2.4 m wide by 3.0 m deep (8 x 10 feet). It contains intercell process piping and residual material transfer piping. Stepped, removable concrete blocks, similar to those over the cells, cover the hot pipe trench and provide access. Covers for the hot pipe trench are sized to match the adjacent cell allowing uninterrupted access to contiguous work areas.

Lines to and from the cells terminate in connector flanges in the trench. Just as in the cells, the connector flanges are held in fixed standard position by steel supports embedded in the concrete trench floor. The trench piping was in prefabricated sections attached to the flanges with automatic connectors. Between the piping and associated hardware, the hot pipe trench is extremely congested. The trench cover is in removable sections similar to the cell covers.

Alterations and replacements of trench piping could be made with the same remotely operated equipment used for cell maintenance.

Dosage levels are assumed to be in the same range as the cells, i.e., up to 500 R/hr.

Ventilation Tunnel

The concrete ventilation tunnel, 3.3 m tall and 3.2 m wide (11 x 10.5 feet), is directly beneath the hot pipe trench and provides ventilation for the cells and pipe trench. Air from the canyon deck flows through slots in the cell cover blocks to the cells and pipe trench and then through 25.4 cm (10 inch) diameter terra cotta ducts from each cell and each section of the pipe trench to the ventilation tunnel. The tunnel exhausts to the 291-U exhaust stack. There is a 0.9 x 0.9 m (3 x 3 feet) access chimney on the exterior of the facility at the South end.

According to some drawings the tunnel was constructed with baffles spaced regularly along the floor to contain any condensate or other liquid that may have entered, and to disrupt the airflow to minimize particulate from entering the stack. The ventilation tunnel also drains any condensate to the concrete-encased tile sewer pipe that drains to cell 10.

The contamination levels are unknown for the ventilation tunnel.

SAMPLING AND CHARACTERIZATION REQUIREMENTS

The sampling and characterization requirements for the CDI Project are defined in the Sampling and Analysis Plan for 221-U Facility (DOE/RL-97-68). Following is a summary of these requirements:

Note that this summary is for quick reference only, the Sampling and Analysis Plan is the authority for sampling requirements.

- Deck
  - Photo/video record
  - Concrete; phase I three chip samples from each of the following categories, phase II additional chip samples to be determined
    1. Walkway
    2. Equipment sitting
    3. Equipment may have sat
- Equipment; equipment will be categorized by type (e.g., tanks, centrifuges)
  - Identify void space
  - Identify standing liquid
  - Two liquid samples for each category (if needed)
  - General radiation dose
  - Gamma survey
  - Smearable and fixed alpha surveys
  - Nondestructive assay (NDA) for transuranics (TRU)

- Cells; there are the following four categories of cells, sampling described is the same for each category
  1. Uranium recovery
  2. Waste Treatment
  3. Solvent Treatment
  4. Miscellaneous
     - Photo/video record
     - General radiation dose
     - Gamma survey
     - Concrete; two or three core samples → 6 in. to 8 in. deep, approximately 2 in. diameter
     - Equipment
       - Identify void space
       - Identify standing liquid, sample if present

- Drain Pipe
  - Photo/video record
  - General radiation dose

- Gamma survey
- One scale/sediment sample

- Hot Pipe Trench
  - Photo/video record
  - Radiation dose
  - Pipes
    - Gamma survey
    - Identify standing liquid, sample if present
    - Concrete chip samples (possible)

- Galleries
  - Photo/video record
  - General radiation dose
  - One composite sample of any liquid/sludge in electrical gallery sumps
  - Pipes
    - Gamma survey
    - Identify standing liquid, sample if present

- Rail Tunnel
  - Photo/video record
  - General radiation dose
  - Gamma survey
  - Smearable and fixed alpha surveys
  - Concrete; eight chip samples

- Ventilation (Wind) Tunnel
  - Photo/video record
  - One dust/scale composite sample (as available).

CANYON DISPOSITION INITIATIVE
TECHNOLOGY NEED STATEMENT
REMOTE/ROBOTIC TECHNOLOGIES FOR CDI

Identification No.: RL-DD034
Date: September, 1998

Program: Decontamination and Decommissioning
OPS Office/Site: Richland Operations Office/Hanford Site
Facility: Materials processing facilities (five processing canyons)

Site Priority Ranking: High

Need Title: Remote/robotic technologies for access and deployment of characterization and sampling tools.

Need Description: Remote technology is needed for access and deployment of characterization and sampling tools throughout the 221-U Facility. Many areas cannot be reached using conventional methods or personnel. Remote systems are needed for entry, sample collection, and deployment of sensor packages (such as NDA) or characterization tools. Functions (e.g., characterization, sample collection) will be performed for concrete, solids/sludge, and liquids. Dismantlement end-effectors (e.g., pipe cutting) may be required to gain access for sample collection.

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 rail tunnel has not been sufficiently characterized to determine if manned entry is allowable. 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.

Functional Performance Requirements: Remote technologies must be integrated with characterization and sampling tools to accomplish requirements described in the other technology needs statements. The remote technologies must function in an environment containing radionuclide contamination (up to 500 R/hr, more typical up to 10 R/hr), process chemicals, acids, and caustic solutions. Long-length deployments will be required into tunnels and the drain pipe. Less lengthy deployments are also required in highly congested areas such as the cells. See the general information section for additional description of the 221-U Facility.

Schedule Requirements: Immediate to one year.

Problem Description: Determination of nature and extent of radionuclide and non-radionuclide contamination is required to support the evaluation of alternatives for final disposition of the

221-U Facility. Remote technologies for characterization and sample collection are needed in areas where manned entry is not possible, and to minimize worker exposure to hazards.

PBS No.	*WBS No.*	*TIP No.*
RL-ER06	1.6.6	N/A

Justification for Need:

Technical: Characterization information is required to support the detailed analysis, including performance assessment, of 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 & Health: Improved characterization methods will result in reduced worker exposure and reduced contamination spread.

Cost Savings Potential (Mortgage Reduction): 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 $1B. 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 likely be applicable at these and other similar DOE facilities.

Consequences of Not Filling Need: Current baseline techniques will be used (where possible) potentially exposing personnel to high radiation. It is also very time consuming and expensive. Facility areas where personnel access is prohibitive will not be characterized.

Outsourcing Potential: Unlikely

End User: EM-30, EM-40, EM-60

Site Technical Points of Contact: Kim Koegler - BHI (509) 372-9294, Shannon Saget - DOE (509) 372-4029, Jim Rugg - BHI (509) 373-6585, Sue Garrett - PNNL (509) 372-4266

DOE End User/Representative Points of Contact: John Sands (509) 372-2282, Jim Goodenough(509) 376-0893

CANYON DISPOSITION INITIATIVE
TECHNOLOGY NEED STATEMENT
VISUAL/SPATIAL IMAGING FOR CDI

Identification No.: RL-DD035
Date: September, 1998

Program: Decontamination and Decommissioning
OPS Office/Site: Richland Operations Office/Hanford Site
Facility: Materials processing facilities (five processing canyons)

Site Priority Ranking: High

Need Title: Visual/spatial imaging of the 221-U Facility and equipment.

Need Description: Visual/spatial imaging is required throughout the 221-U Facility to provide for characterization planning, etc. An accurate visual record is needed to plan for characterization methods and operations, and to identify locations for sample collection.

Current Baseline Technology: A handheld camcorder has been used to establish limited record of the canyon deck. The 221-U Facility canyon deck is a respirator area, so personnel access is allowed. The rail tunnel has not been sufficiently characterized to determine if manned entry is allowable, and 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.

Functional Performance Requirements: The technology must be able to function in an environment containing radionuclide contamination (up to 500 R/hr, more typical up to 10 R/hr), process chemicals, acids, and caustic solutions. The technology must function remotely on long-length deployments up to 800 feet. Access sizes for a remote platform range from 24 inches to 10 feet. Less lengthy deployments are also required with access sizes of less than 6 inches in highly congested areas. Resulting maps of objects will be required to meet a resolution on the order of one inch. The technology must be integrated with remote deployment platforms (if required for access). See the general information section for additional description of the 221-U Facility.

Schedule Requirements: Immediate to one year.

Problem Description: Determination of nature and extent of radionuclide and non-radionuclide contamination is required to support the evaluation of alternatives for final disposition of the 221-U Facility. Visual record is needed to support characterization planning.

PBS No.	*WBS No.*	*TIP No.*
RL-ER06	1.6.6	N/A

Justification for Need:

Technical: Characterization information is required to support the detailed analysis, including performance assessment, of 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 & Health: Improved characterization methods will result in reduced worker exposure and reduced contamination spread.

Cost Savings Potential (Mortgage Reduction): 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 $1B. 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 likely be applicable at these and other similar DOE facilities.

Consequences of Not Filling Need: Current baseline techniques will be used (where possible) potentially exposing personnel to high radiation. It is also very time consuming and expensive. Facility areas where personnel access is prohibitive will not be characterized.

Outsourcing Potential: Unlikely

End User: EM-30, EM-40, EM-60

Site Technical Points of Contact: Kim Koegler - BHI (509) 372-9294, Shannon Saget - DOE (509) 372-4029, Jim Rugg - BHI (509) 373-6585, Sue Garrett - PNNL (509) 372-4266

DOE End User/Representative Points of Contact: John Sands (509) 372-2282, Jim Goodenough (509) 376-0893

CANYON DISPOSITION INITIATIVE
TECHNOLOGY NEED STATEMENT
RADIATION SURVEY FOR CDI

Identification No.: RL-DD036
Date: September, 1998

Program: Decontamination and Decommissioning
OPS Office/Site: Richland Operations Office/Hanford Site
Facility: Materials processing facilities (five processing canyons)

Site Priority Ranking: High

Need Title: General radiation surveys of concrete and equipment in the materials processing facilities.

Need Description: Technologies are needed that will provide (1) general radiation dose, (2) TRU levels in or on equipment and piping using NDA/NDE, and (3) spatially locate hot spots. Beta/gamma radiation surveys are required throughout the 221-U Facility.

Current Baseline Technology: The standard method for determining the extent of contact and general area radiation fields consists of a radiological control technician passing a gamma-ray sensitive detector such as an RO-2 of RO-7 probe near the surfaces or at a set distance from the surface. Measurements are then recorded by hand and, in some cases, written on drawings to identify locations.

Functional Performance Requirements: The radiation survey technologies must be able to detect alpha, beta and gamma radiation at least to the onsite laboratory detection limits (onsite laboratory detection limits are 10,000 pCi/g for alpha, 30,000 pCi/g for beta while offsite laboratory detection limits are 10 and 15 pCi/g respectively). The technologies must be useable in situ and in near real time (e.g., are quicker than sending samples offsite for analysis). The methods should be cost effective and must be operable with little or no exposure to personnel in highly contaminated, highly congested areas. Detection is needed in confined and congested areas and/or high radiation fields (up to 500 R/hr, more typical up to 10 R/hr). The technologies must be integrated with remote deployment platforms (if required for access). See the general information section for additional description of the 221-U Facility.

Schedule Requirements: Immediate

Problem Description: Determination of nature and extent of radionuclide and non-radionuclide contamination is required to support the evaluation of alternatives for final disposition of the 221-U Facility. General radiation surveys are required for worker protection and work planning.

PBS No.	***WBS No.***	***TIP No.***
RL-ER06	1.6.6	N/A

Justification for Need:

Technical: Characterization information is required to support the detailed analysis, including performance assessment, of 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 & Health: Improved characterization methods will result in reduced worker exposure and reduced contamination spread.

Cost Savings Potential (Mortgage Reduction): 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 $1B. 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 likely be applicable at these and other similar DOE facilities.

Consequences of Not Filling Need: Current baseline techniques will be used (where possible) potentially exposing personnel to high radiation. It is also very time consuming and expensive. Failure to sufficiently characterize will result in not being able to take advantage of the potential cost savings.

Outsourcing Potential: Unlikely

End User: EM-30, EM-40, EM-60

Site Technical Points of Contact: Kim Koegler - BHI (509) 372-9294, Shannon Saget - DOE (509) 372-4029, Jim Rugg - BHI (509) 373-6585, Sue Garrett - PNNL (509) 372-4266

DOE End User/Representative Points of Contact: John Sands (509) 372-2282, Jim Goodenough (509) 376-0893

CANYON DISPOSITION INITIATIVE
TECHNOLOGY NEED STATEMENT
LIQUIDS DETECTION FOR CDI

Identification No.: RL-DD037
Date: September, 1998

Program: Decontamination and Decommissioning
OPS Office/Site: Richland Operations Office/ Hanford Site
Facility: Materials processing facilities (five processing canyons)

Site Priority Ranking: High

Need Title: Detection of freestanding liquid in equipment (e.g., tanks) and piping.

Need Description: Technology is needed to detect freestanding liquids in equipment and piping throughout the 221-U Facility. Liquids must be located so that they can be characterization.

Current Baseline Technology: Liquid detection for tanks is usually done by gaining access to the tank and using a dipstick or similar device; however, this is not always possible in the materials processing facilities due to congestion and high radioactive fields around the tanks. Liquid detection in pipes is usually accomplished by finding low points and drilling the pipe.

Functional Performance Requirements: A non-intrusive method for detecting liquids in tanks and pipes is preferred. Methods may include physical, infrared or radiography. The detection must be performed in highly congested areas, and in areas containing radionuclide contamination (up to 500 R/hr, more typical up to 10 R/hr). The detection must include the identification of the liquid level in the tank or pipe. The technology must be integrated with remote deployment platforms (if required for access). See the general information section for additional description of the 221-U Facility.

Schedule Requirements: Immediate

Problem Description: Determination of nature and extent of radionuclide and non-radionuclide contamination is required to support the evaluation of alternatives for final disposition of the 221-U Facility. The location of liquids must be identified so that they can be characterized.

PBS No.	***WBS No.***	***TIP No.***
RL-ER06	1.6.6	N/A

Justification for Need:

Technical: Characterization information is required to support the detailed analysis, including performance assessment, of 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 & Health: Improved characterization methods will result in reduced worker exposure and reduced contamination spread.

Cost Savings Potential (Mortgage Reduction): 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 $1B. 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 likely be applicable at these and other similar DOE facilities.

Consequences of Not Filling Need: Current baseline techniques will be used (where possible) potentially exposing personnel to high radiation. It is also very time consuming and expensive. Failure to sufficiently characterize will result in not being able to take advantage of the potential cost savings.

Outsourcing Potential: Unlikely

End User: EM-30, EM-40, EM-60

Site Technical Points of Contact: Kim Koegler - BHI (509) 372-9294, Shannon Saget - DOE (509) 372-4029, Jim Rugg - BHI (509) 373-6585, Sue Garrett - PNNL (509) 372-4266

DOE End User/Representative Points of Contact: John Sands (509) 372-2282, Jim Goodenough (509) 376-0893

CANYON DISPOSITION INITIATIVE
TECHNOLOGY NEED STATEMENT
LIQUIDS CHARACTERIZATION FOR CDI

Identification No.: RL-DD038
Date: September, 1998

Program: Decontamination and Decommissioning
OPS Office/Site: Richland Operations Office/Hanford Site
Facility: Materials processing facilities (five processing canyons)

Site Priority Ranking: High

Need Title: Characterization of liquids in equipment (e.g., tanks) and pipes.

Need Description: Characterization technology is needed to detect and quantify the contaminants of concern in liquids. The liquids will be shielded (i.e., inside a closed tank or pipe). Liquids must be characterized within tanks and pipes throughout the 221-U Facility.

Current Baseline Technology: Current technology is to intrusively enter tanks and pipes to collect samples of the liquid for analysis at a laboratory.

Functional Performance Requirements: The liquid characterization technology must be able to quantify the contaminants listed in Table 1 to the levels of detection also listed in Table 1. Non-intrusive characterization or in situ sampling and analysis is preferred. The technology must be cost effective and minimize exposure to personnel. It must operate in cells that are highly congested with possible high radiation fields (up to 500 R/hr). The technology must be integrated with remote deployment platforms (if required for access). See the general information section for additional description of the 221-U Facility.

Schedule Requirements: Immediate

Problem Description: Characterization of the 221-U Facility is required to support evaluation of alternatives for an end-state decision. Characterization of liquids is required.

PBS No.	***WBS No.***	***TIP No.***
RL-ER06	1.6.6	N/A

Justification for Need:

Technical: Characterization information is required to support the detailed analysis, including performance assessment, of 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 & Health: Improved characterization methods will result in reduced worker exposure and reduced contamination spread.

Cost Savings Potential (Mortgage Reduction): 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 $1B. 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 likely be applicable at these and other similar DOE facilities.

Consequences of Not Filling Need: Current baseline techniques will be used (where possible) potentially exposing personnel to high radiation. It is also very time consuming and expensive. Failure to sufficiently characterize will result in not being able to take advantage of the potential cost savings.

Outsourcing Potential: Unknown

End User: EM-30, EM-40, EM-60

Site Technical Points of Contact: Kim Koegler - BHI (509) 372-9294, Shannon Saget - DOE (509) 372-4029, Jim Rugg - BHI (509) 373-6585, Sue Garrett - PNNL (509) 372-4266

DOE End User/Representative Points of Contact: John Sands (509) 372-2282, Jim Goodenough (509) 376-0893

Table 1. Contaminants of Concern in Liquids.

Contaminant of Concern	Detection Limits*
Acids	0.1
Ammonium Fluoride - NH4F	15
Hexone	1
Nitrates - Al(NO3)3, NaNO3, NH4NO3, HNO3	10
Kerosene, Normal Paraffin Hydrocarbon	50
Lead	2
PCBs	0.5
Phosphoric Acid - H3PO4	150
Sodium Dichromate	3
Sodium Nitrite - NaNO2	10
Sulfates - HSO4, Na2SO4, Fe(NH4)2(SO4)2	150
Tributytl Phosphate	50
Am-241	1
Co-60	15
Cs-137	25
Eu-152	50
Eu-154	50
Np-237	1
Pu-238, Pu-239/240	1
Sr-90	2
Th-232	1
U-234, U-235, U-238	1
Gross alpha	3
Gross beta	4

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

CANYON DISPOSITION INITIATIVE
TECHNOLOGY NEED STATEMENT
SOLIDS (SEDIMENT/SLUDGE/DUST) CHARACTERIZATION FOR CDI

Identification No.: RL-DD039
Date: September, 1998

Program: Decontamination and Decommissioning
OPS Office/Site: Richland Operations Office/Hanford Site
Facility: Materials processing facilities (five processing canyons)

Site Priority Ranking: High

Need Title: Characterization of solids (sediments/sludge/dust) on floors and walls, and in equipment in the materials processing facilities.

Need Description: Characterization technology is needed to detect, quantify and locate (spatially) contaminants of concern in the solids on floors and walls, and in equipment in throughout the 221-U Facility.

Current Baseline Technology: Current technology is to take samples and send them to a laboratory for analysis. Current technologies may be inadequate for sampling in highly congested, highly contaminated areas (e.g., the floors of the cells).

Functional Performance Requirements: The technology must be able to detect, quantify and locate the potential contaminants listed in Table 1 to the levels of detection also listed in Table 1. Non-intrusive characterization or in situ sampling and analysis is preferred. The technology must be cost effective and minimize exposure to personnel. It must operate area that are highly congested with possible high radiation fields (up to 500 R/hr). The technology must be integrated with remote deployment platforms (if required for access). See the general information section for additional description of the 221-U Facility.

Schedule Requirements: Immediate

Problem Description: Characterization of the 221-U Facility is required to support evaluation of alternatives for an end-state decision. Characterization includes locating and quantifying contaminants in solids within the facility.

PBS No.	*WBS No.*	*TIP No.*
RL-ER06	1.6.6	N/A

Justification for Need:

Technical: Characterization information is required to support the detailed analysis, including performance assessment, of 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 & Health: Improved characterization methods will result in reduced worker exposure and reduced contamination spread.

Cost Savings Potential (Mortgage Reduction): 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 $1B. 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 likely be applicable at these and other similar DOE facilities.

Consequences of Not Filling Need: Current baseline techniques will be used (where possible) potentially exposing personnel to high radiation. It is also very time consuming and expensive.

Outsourcing Potential: Unknown

End User: EM-30, EM-40, EM-60

Site Technical Points of Contact: Kim Koegler - BHI (509) 372-9294, Shannon Saget - DOE (509) 372-4029, Jim Rugg - BHI (509) 373-6585, Sue Garrett - PNNL (509) 372-4266

DOE End User/Representative Points of Contact: John Sands (509) 372-2282, Jim Goodenough (509) 376-0893

Table 1. Contaminants of Concern in Solids.

Contaminant of Concern	Detection Limits*
Acids	0.1
Ammonium Fluoride - NH4F	0.2
Hexone	0.002
Nitrates - Al(NO3)3, NaNO3, NH4NO3, HNO3	0.1
Kerosene, Normal Paraffin Hydrocarbon	5
Lead	0.4
PCBs	0.05
Phosphoric Acid - H3PO4	2
Sodium Dichromate	0.5
Sodium Nitrite - NaNO2	0.1
Sulfates - HSO4, Na2SO4, Fe(NH4)2(SO4)2	2
Tributytl 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.

CANYON DISPOSITION INITIATIVE
TECHNOLOGY NEED STATEMENT
CONCRETE CHARACTERIZATION FOR CDI

Identification No.: RL-DD040
Date: September, 1998

Program: Decontamination and Decommissioning
OPS Office/Site: Richland Operations Office/Hanford Site
Facility: Materials processing facilities (five processing canyons)

Site Priority Ranking: High

Need Title: Characterization of concrete floors and walls in the materials processing facilities.

Need Description: Characterization technology is needed to detect, quantify and locate (spatially) contaminants of concern within concrete throughout the 221-U Facility. Concrete samples in the cells will consist of 6 inch to 8 inch deep borings of 1 inch to 2 inch diameter. Concrete samples elsewhere in the facility will consist of half-inch chip samples.

Current Baseline Technology: Current technology is to take bore samples and send them to a laboratory for analysis.

Functional Performance Requirements: The technology must be able to detect, quantify and locate the potential contaminants listed in Table 1 to the levels of detection also listed in Table 1. Non-intrusive characterization or in situ sampling and analysis is preferred. The technology must be cost effective and minimize exposure to personnel. It must operate in cells that are highly congested with possible high radiation fields (up to 500 R/hr). The technology must be integrated with remote deployment platforms (if required for access). Sampling in cells will require reaching 20 feet to 40 feet down from the deck to obtain concrete cores and samples. See the general information section for additional description of the 221-U Facility.

Schedule Requirements: Immediate

Problem Description: Characterization of the 221-U Facility is required to support evaluation of alternatives for an end-state decision. Characterization includes locating and quantifying contaminants in concrete within the facility.

PBS No.	***WBS No.***	***TIP No.***
RL-ER06	1.6.6	N/A

Justification for Need:

Technical: Characterization information is required to support the detailed analysis, including performance assessment, of 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 & Health: Improved characterization methods will result in reduced worker exposure and reduced contamination spread.

Cost Savings Potential (Mortgage Reduction): 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 $1B. 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 likely be applicable at these and other similar DOE facilities.

Consequences of Not Filling Need: Current baseline techniques will be used (where possible) potentially exposing personnel to high radiation. It is also very time consuming and expensive.

Outsourcing Potential: Unknown

End User: EM-30, EM-40, EM-60

Site Technical Points of Contact:: Kim Koegler - BHI (509) 372-9294, Shannon Saget - DOE (509) 372-4029, Jim Rugg - BHI (509) 373-6585, Sue Garrett - PNNL (509) 372-4266

DOE End User/Representative Points of Contact: John Sands (509) 372-2282, Jim Goodenough (509) 376-0893

Table 1. Contaminants of Concern in Solids.

Contaminant of Concern	Detection Limits*
Acids	0.1
Ammonium Fluoride - NH4F	0.2
Hexone	0.002
Nitrates - Al(NO3)3, NaNO3, NH4NO3, HNO3	0.1
Kerosene, Normal Paraffin Hydrocarbon	5
Lead	0.4
PCBs	0.05
Phosphoric Acid - H3PO4	2
Sodium Dichromate	0.5
Sodium Nitrite - NaNO2	0.1
Sulfates - HSO4, Na2SO4, Fe(NH4)2(SO4)2	2
Tributytl 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

CAPSULE INTEGRITY ASSESSMENT METHOD FOR WESF

Identification No.: RL-DD041
Date: September, 1998

Program: Decontamination and Decommissioning
OPS Office/Site: Richland Operations Office/Hanford Site
Operable Unit (if applicable): N/A
Waste Stream: Approximately 1900 stainless-steel capsules that contain 75 million Curies of cesium and strontium byproduct materials in the WESF pool cells (NM-15)
Waste Management Unit (if applicable): N/A
Facility: Waste Encapsulation Storage Facility (WESF)

Site Priority Ranking: Medium

Need Title: Capsule Integrity Assessment Method for WESF

Need Description: The Waste Encapsulation and Storage Facility (WESF) stores approximately one-third of the total curies of Hanford's radioactive material in the form of cesium and strontium capsules. Approximately 75 million curies of cesium-137 and strontium-90 by-product (plus and additional 75 million curies of decay product) are contained in the 1,928 capsules presently stored in the WESF basins under 13 feet of de-ionized water. There is need for an improved method to determine capsule integrity to reduce the risk of a leak occuring. (There is also a separate need for an effective monitoring system to identify a leaking capsule should a leak actually occur, which 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 both the inner and the outer container as well as their individual welds and the integrity of the annular space. Monitoring the capsule integrity over the next twenty years is required to assure worker safety and safety to the public and the environment.

Current Baseline Technology: The Inner Capsule Movement Test (ICMT) is currently the primary means of evaluating capsule integrity at WESF. During the ICMT, the capsules are approximately rotated end-to-end or quickly accelerated upwards. The inner capsule, moving freely, will impact one end of the outer capsule, which can be audibly detected and/or felt (thus providing the ICMT, a.k.a. the "clunk test"). If the impact is not detected, the capsule integrity may be compromised. The ICMT has detected capsule swelling and water within the capsule annulus. However, the sensitivity of the ICMT to detect early swelling, or the degree of swelling and the amount of water infiltration, is limited. The ability to detect radioactive material in the capsule annulus does not exist.

Functional Performance Requirements: The technology and method should allow for an underwater, and non-invasive assessment of the individual capsules (there are approximately 1900 capsules stored in 5 pools) to detect failure and determine the amount of failure. Capsule failure modes which may be experienced at WESF include inner capsule degradation, radioactive material in the annulus, damage to outer capsule, water in the capsule annulus, damage to overpacks, and preexisting or manufacturing defects. 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.)

Schedule Requirements: Immediate - long term. This technology could be deployed immediately. The current basis for the WESF facility to continue storing capsules until their final removal in 2017. Deactivation activities would begin soon thereafter.

Problem Description: WESF stores strontium and cesium capsules in pool cells that were constructed to provide shielding and cooling for approximately 1900 capsules. There are 5 pool cells that are actively storing capsules, each measuring approximately 6'x20'x13' (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.

PBS No.	***WBS No.***	***TIP No.***
RL-TP02	1.4.- WESF Sub-Project	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 manhours spent on the regularly schedule clunk tests.

Regulatory: N/A

Environmental Safety and Health: Worker safety would be improved by the provision of an improved capsule integrity assessment technology/method. Early leak detection would minimize the risk of worker exposure for pool cell decontamination.

Cost Savings Potential (Mortgage Reduction): N/A

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 as a secondary waste product.

Other: None identified.

Consequences of Not Filling Need: Current baseline methods are labor intensive, tedious and would benefit from an improved technical basis. The potential exists for a leaking capsule to contaminate a pool to the degree that worker entry is prohibited before the capsule can be identified and removed to an alternate shielded location.

Outsourcing Potential: N/A

End-User: EM-60

Site Technical Points of Contact: Gerry McCormick - BWHC (509) 372-8173, Robbin Duncan - BWHC (509) 373-2229, Fen Simmons - BWHC (509) 376-4747

Contractor Facility/Project Manager: Bill Bailey - BWHC (509) 372-4999

DOE End-User/Representative Points of Contact: Larry Romine - EM-60 (509) 376-4747

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

HOT CELL WINDOW LIFE EXTENSION FOR WESF

Identification No.: RL-DD042
Date: September, 1998

Program: Decontamination and Decommissioning
OPS Office/Site: Richland Operations Office/Hanford Site
Operable Unit (if applicable): N/A
Waste Stream: WESF Hot Cells
Waste Management Unit (if applicable): N/A
Facility: Waste Encapsulation Storage Facility (WESF)

Site Priority Ranking: Medium

Need Title: Hot Cell Window Life Extension for WESF

Need Description: The Waste Encapsulation and Storage Facility (WESF) contains a series of hot cells that have been used for radioactive materials testing and processing. Operations are performed remotely in the hot cells using "manipulators." Visibility into the hot cells is through approximately 20" thick, oil-filled windows. The windows are filled with oil to provide a compromise between shielding needs and visibility. Over time, window gaskets fail and oil leaks from the windows, resulting in decreased visibility into the hot cell.

Current Baseline Technology: Due to factors such as the seals and gaskets degrading from both age and radiation exposure and the windows aging and fogging, the windows must be removed and replaced. Currently, WESF has plans to perform routine maintenance on their hot cell windows to the best of their abilities, knowing that the components will age and visibility through the windows will be lost. The facility plan identifies replacement of all the windows as part of a pre-deactivation activity in the 2013-2017 time frame.

Functional Performance Requirements: Methods, techniques and/or materials are needed which will extend the expected life of a hot cell window, prolong their clarity and visibility and reduce the routine maintenance requirements. The technology could include, but is not limited to, the use of improved seals and gaskets and the ability to improve the visibility through currently fogged windows.

Schedule Requirements: Immediate - long term. This technology could be deployed immediately. However, the effectiveness of the technology will diminish if not deployed before about 2005.

Problem Description: Due to the radiation levels in the WESF hot cells, the gaskets surrounding the WESF Hot Cell windows continually degrade. Dose rates at 10 feet from the hot cell floors have been measured at levels greater then 3,000 rad. The degradation rate limits the functional use time period of the hot cells. Change-out of the oil and gaskets is a time-consuming, cumbersome task that has the potential for exposure of personnel and equipment to radiation and contamination.

PBS No.	***WBS No.***	***TIP No.***
RL-TP02	1.4.2	N/A

Justification for Need:

Technical: It is desirable to maintain the ability to use the WESF Hot Cells for the life of the facility. Current plans will place the hot cells into an inactive status, activating the cells only when needed. It would be desirable to identify a means of maintaining visibility into the hot cells such that they could remain active and available for use.

Regulatory: N/A

Environmental Safety and Health: Visibility into the WESF is essential for the conduct of safe operations within the cells. Loss of visibility requires the draining and replacement of the shielding oils within that window. Extensive planning and preparation are required to ensure that the replacement is conducted safely.

Cost Savings Potential (Mortgage Reduction): Elimination or reduction in the frequency of window oil change-outs will result in cost and dose savings to the WESF staff. An additional benefit is that the facility will be in a heightened state of readiness to perform newly emergent work scope within the hot cells.

Cultural/Stakeholder Concerns: Technology upgrades could reduce the quantities of materials handled, stored, or disposed of as a secondary waste.

Other: None identified.

Consequences of Not Filling Need: Baseline methods are labor intensive and costly.

Outsourcing Potential: Yes -- materials procurement

End User: EM-60

Site Technical Points of Contact: Gerry McCormick - BWHC (509) 372-8173, Robbin Duncan - BWHC (509) 373-2229, Fen Simmons - BWHC (509) 376-4747

Contractor Facility/Project Manager: Bill Bailey - BWHC (509) 372-4999
DOE End User/Representative Point(s)-of-Contact: Larry Romine - EM-60 (509) 376-4747

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

CRANE SYSTEM UPGRADES FOR HOT CELL CANYON AND CESIUM CAPSULE POOL IN WESF

Identification No.: RL-DD043
Date: September, 1998

Program: Decontamination and Decommissioning
OPS Office/Site: Richland Operations Office/Hanford Site
Operable Unit (if applicable): N/A
Waste Stream: N/A
Waste Management Unit (if applicable): N/A
Facility: Waste Encapsulation Storage Facility (WESF)

Site Priority Ranking: Medium

Need Title: Crane System Upgrades for Hot Cell Canyon and Cesium Capsule Pool in WESF

Need Description: A need exists to upgrade the two crane systems in WESF to allow the use of state-of-the-art control systems.

Current Baseline Technology: The WESF capsule pool cell crane is controlled using an umbilical cord controller, which requires the operator to be in very close proximity to the pool cells. Remote operation of the WESF hot cell canyon crane is limited to control from a very small window at the east end of the canyon with the aid of several strategically located cameras.

Functional Performance Requirements: A system is required that provides remote, camera assisted (preferably 3-D) operation of the WESF cranes. Remote capability must allow for operation behind concrete walls greater than three feet in thickness. The control unit will be in a non-contaminated area.

Operations capabilities should enable the remote placement of the pool cell cover blocks onto the pool cells. The system must be capable of withstanding high radiation fields should capsule failure occur.

Schedule Requirements: Immediate - long term. This technology could be deployed immediately. The current basis is for the WESF facility to continue storing capsules until their final removal in 2017. Deactivation activities would begin soon thereafter.

Problem Description: In the event of a capsule failure, high radiation exposure from the pool cell may prevent the pool crane from being operated with the baseline technology, which in turn would prevent the cell cover blocks from being installed. The inability to install the shielding cover blocks creates a situation where entry is not possible due to dose considerations, and dose cannot be reduced without entry to install the shielding cover blocks. The capsule storage area is placed off-limits to personnel entry at dose rates above 400 mR/hr. A means is needed to enable the remote installation of the shielding cover blocks.

PBS No.	***WBS No.***	***TIP No.***
RL-TP02	1.4.2	N/A

Justification for Need:

Technical: As the life of the WESF pool cell storage operation is extended, the potential for failure of a capsule within the pool cell increases. Response to a capsule failure would include the installation of a shielding cover block onto the cell containing the failed capsule. Remote capabilities are needed to provide protection to the responding WESF personnel.

Regulatory: N/A

Environmental Safety and Health: Remote capabilities are needed to provide protection to the WESF personnel.

Cost Savings Potential (Mortgage Reduction): Cost Savings would be indirect as a result of reduced personnel exposure in response to a capsule failure.

Cultural/Stakeholder Concerns: Potential for exposure of personnel to high levels of radiation is of general concern by all stakeholders. Steps that can improve the ability of WESF to respond to an abnormal condition are viewed favorably.

Other: None identified.

Consequences of Not Filling Need: As the average age of capsules stored in the WESF facility continues to increase, the risk of capsule failure will proportionally increase. Failure to install the ability to remotely operate the crane system assumes the risk that a capsule will not fail and that, if a failure were to occur, that the radiation fields would be at a level that would permit continued access into the pool cell area.

Outsourcing Potential: N/A

End-User: EM-60

Site Technical Points of Contact: Gerry McCormick - BWHC (509) 372-8173, Robbin Duncan - BWHC (509) 373-2229, Fen Simmons - BWHC (509) 376-4747

Contractor Facility/Project Manager: Bill Bailey - BWHC (509) 372-4999

DOE End-User/Representative Points of Contact: Larry Romine - EM-60 (509) 376-4747

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

CESIUM AND STRONTIUM REMOVAL FROM K3 DUCT AT WESF

Identification No.: RL-DD044
Date: September, 1998

Program: Decontamination and Decommissioning
OPS Office/Site: Richland Operations Office/Hanford Site
Operable Unit (if applicable): N/A
Waste Stream: Cesium and Strontium
Waste Management Unit (if applicable): N/A
Facility: Waste Encapsulation Storage Facility (WESF)

Site Priority Ranking: Medium

Need Title: Cesium and Strontium Inventory Removal from K3 Duct at WESF

Need Description: The WESF hot cells are exhausted through a common duct that exits the facility beneath the hot cells, is HEPA filtered, and then exhausted to the atmosphere. This duct is contaminated with cesium (Cs) and strontium (Sr) (i.e, holding up to 60,000 curies of material). The only access to this duct is through openings inside the hot cell.

A technology is needed which is capable of removing all the contamination from the ducting. The ultimate goal is to decontaminate this ducting to the level where the ventilation air flow can be secured without risk of contamination spread.

Current Baseline Technology: There is currently no method identified for removal of this contamination.

Functional Performance Requirements: A method is needed that will remove Cs and Sr contaminants from the WESF ducting. The technology must be easy to remotely deploy, must collect the removed material in such a manner as to not create a radiation or chemical exposure hazard to personnel, and should permit the disposal of the material as routine radioactive waste. Radiation levels of up to 2500 rad/hr and higher can be expected.

Schedule Requirements: Immediate - long term. This technology could be deployed immediately. The current basis is for the WESF facility to continue storing capsules until their final removal in 2017. Deactivation activities would begin soon thereafter.

Problem Description: Historical operation of the WESF has led to the deposition of Cs and Sr bearing materials into the WESF K3 ducting system. In an effort to reduce background radiation exposure to personnel and to improve ease of maintenance on the K3 ducting system, it is desired to reduce the quantities of radioactive Cs and Sr materials located in the K3 ducting system.

PBS No.	***WBS No.***	***TIP No.***
RL-TP02	1.4.2 - WESF Sub-Project	N/A

Justification for Need:

Technical: Removal of the Cs and Sr materials in the K3 ducting would improve the ease of maintenance for the WESF ventilation system due to reduction in the radiation levels.

Regulatory: N/A

Environmental Safety and Health: In an effort to reduce background radiation exposure to personnel, minimize potential for environmental releases, and to improve ease of maintenance on the K3 ducting system, it is desired to reduce the quantities of radioactive Cs and Sr materials located in the K3 ducting system.

Cost Savings Potential (Mortgage Reduction): A reduction in radiation driven access limitations will reduce the overall cost of maintenance to the K3 ventilation system.

Cultural/Stakeholder Concerns: Any effort that can reduce, or eliminate, the quantity of radioactive material in a facility ventilation system thus reduces the risk for release of radioactive materials to the environment.

Other: None identified.

Consequences of Not Filling Need: Continuation of the baseline response results in the continued acceptance of a slightly increased risk of radiation release to the environment and slightly increased background exposure to WESF personnel.

Outsourcing Potential: N/A

End-User: EM-60

Site Technical Points of Contact: Gerry McCormick - BWHC (509) 372-8173, Robbin Duncan - BWHC (509) 373-2229, Fen Simmons - BWHC (509) 376-4747

Contractor Facility/Project Manager: Bill Bailey - BWHC (509) 372-4999

DOE End-User/Representative Points of Contact: Larry Romine - EM-60 (509) 376-4747

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

FIXATIVES FOR K3 DUCT AT WESF

Identification No.: RL-DD045
Date: September, 1998

Program: Decontamination and Decommissioning
OPS Office/Site: Richland Operations Office/Hanford Site
Operable Unit (if applicable): N/A
Waste Stream: N/A
Waste Management Unit (if applicable): N/A
Facility: Waste Encapsulation Storage Facility (WESF)

Site Priority Ranking: Low

Need Title: Fixatives for K3 Duct at WESF

Need Description: The WESF hot cells are exhausted through a common duct that is under the hot cells, exits the facility, is HEPA filtered and then exhausted. This duct is very contaminated with Cesium and Strontium, and contains up to several million curies of material. The only access to this duct is through openings inside of the hot cell.

A technology is needed which is capable of fixing and securing the contamination in the ducting, as well as capturing and containing the contaminants in a safe and stable media.

Current Baseline Technology: There is currently no method identified to address the stabilization and/or fixing of this contamination.

Functional Performance Requirements: The fixative should have a long term (20+ years) life expectancy. The fixative must also be removable to allow final disposition of the contaminants in the future. The removal method must meet or exceed all current regulations and requirements for the disposal of highly radioactive contaminated waste and should not add any RCRA components to the waste. The ultimate goal is to secure the contamination in this ducting to the level where the ventilation air flow can be secured without risk of contamination spread.

***Schedule Requirements*:** Immediate - long term. This technology could be deployed immediately. The current basis is for the WESF facility to continue storing capsules until their final removal in 2017. Deactivation activities would begin soon thereafter.

Problem Description: Historical operation of the WESF has led to the deposition of Cs and Sr bearing materials into the WESF K3 ducting system. In an effort to reduce background radiation exposure to personnel and to improve ease of maintenance on the K3 ducting system, it is desired to minimize the spread of radioactive Cs and Sr materials that are currently located in the K3 ducting system.

PBS No.	*WBS No.*	*TIP No.*
RL-TP02	1.4.2 - WESF Sub-Project	N/A

Justification for Need:

Technical: "Fixing" of the Cs and Sr materials in the K3 ducting would improve the ease of maintenance for the WESF ventilation system due to reduction in the risk of spread of contamination from the WESF K3 ducting.

Regulatory: N/A

Environmental Safety and Health: In an effort to reduce background radiation exposure to personnel and to improve ease of maintenance on the K3 ducting system, it is desired to reduce the potential for spread of radioactive Cs and Sr materials located in the K3 ducting system.

Cost Savings Potential (Mortgage Reduction): Minimizing the potential for spread of radioactive contamination will reduce the overall cost of maintenance to the K3 ventilation system.

Cultural/Stakeholder Concerns: Any radioactive materials located within a facility ventilation ducting system increase the facility risk for release of radioactive materials to the environment.

Other: None identified.

Consequences of Not Filling Need: Continuation of the baseline response results in the continued acceptance of a slightly increased risk of radiation release to the environment.

Outsourcing Potential: N/A

End-User: EM-60

Site Technical Points of Contact: Gerry McCormick - BWHC (509) 372-8173, Robbin Duncan - BWHC (509) 373-2229, Fen Simmons - BWHC (509) 376-4747

Contractor Facility/Project Manager: Bill Bailey - BWHC (509) 372-4999

DOE End-User/Representative Points of Contact: Larry Romine - EM-60 (509) 376-4747

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

CLEAN-OUT OF ISOLATED PIPING SYSTEMS IN BUILDING 324

Identification No.: RL-DD046
Date: September, 1998

Program: Decontamination and Decommissioning
OPS Office/Site: Richland Operations Office/Hanford
Operable Unit (if applicable): N/A
Waste Stream: Waste Transfer Piping
Waste Management Unit (if applicable): N/A
Facility: Building 324

Site Priority Ranking: Medium

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

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

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 at an acceptable level.

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 U.S. Department of Energy.

Schedule Requirements: Immediate - long term. Selection of the technology should occur in 2003 and deployment should be complete by 2005.

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 one-half to two inches.

PBS No.	***WBS No.***	***TIP No.***
RL-TP08	1.4.10 - 324/327 FT Project	Candidate

Justification for Need:

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

Regulatory: TPA Milestone 89: Close 324 non-permitted areas by October 2005. The 324 and 327 buildings are presently scheduled to transfer to EM-40 in October 2007.

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

Cost Savings Potential (Mortgage Reduction): There is an opportunity to significantly reduce the secondary waste volumes that would result from repeatedly flushing with water or other cleaning solution.

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.

Consequences of Not Filling Need: Potentially high secondary-waste volumes and schedule impacts.

Outsourcing Potential: N/A

End User: EM-60

Site Technical Points of Contact: Gerry McCormick - BWHC (509) 372-8173, Robbin Duncan - BWHC (509) 373-2229, Rich Hobart - BWHC (509) 373-2316

Contractor Facility/Project Manager: George Hayner - BWHC (509) 372-8135

DOE End-User/Representative Point of Contact: Larry Romine - EM-60 (509) 376-4747

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

REMOTE VIEWING FOR HOT CELLS IN BUILDINGS 324 AND 327

Identification No.: RL-DD047
Date: September, 1998

Program: Decontamination and Decommissioning
OPS Office/Site: Richland Operations Office/Hanford
Operable Unit (if applicable): N/A
Waste Stream: Mixed/TRU
Waste Management Unit (if applicable): N/A
Facility: Buildings 324 and 327

Site Priority Ranking: Medium

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

Need Description: Technologies, techniques and methods are needed to provide low-cost upgrades to improve the remote visibility in hot cells. Upgrades would provide hot cell operators with improved control and the ability to expedite work activities

Current Baseline Technology: The hot cells currently utilize a minimal number of black & white, radiation hardened, video cameras.

Functional Performance Requirements: It is desired to upgrade the existing systems to a high resolution, 3-D, 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 (up to 25,000 rad/hr), chemical contamination, and provide remote viewing from up to 150 feet outside of the hot cell.

Schedule Requirements: Immediate: Equipment removal from B-Cell is already underway and is scheduled for completion in November 2000.

Problem Description: The presently deployed remote camera system provides low resolution, black and white imaging and does not reach all hot cell regions. Improved optics could greatly ease the planning and execution of hot cell dismantlement activities.

PBS No.	*WBS No.*	*TIP No.*
RL-TP08	1.4.10 - 324/327 FT Project	N/A

Justification for Need:

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

Regulatory: TPA Milestone 89: Close 324 non-permitted areas by October 2005. The 324 and 327 buildings are presently scheduled to transfer to EM-40 in October 2007.

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.

Cost Savings Potential (Mortgage Reduction): Improved visibility should allow for remotely controlled cleanup activities to be accomplished at a higher rate and with finer control.

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

Other: Improved camera system(s) can be transferred to other facilities and applications.

Consequences of Not Filling Need: Hot cell regions may not get fully characterized and/or decontaminated.

Outsourcing Potential: Yes

End User: EM-60

Site Technical Points of Contact: Gerry McCormick - BWHC (509) 372-8173, Robbin Duncan - BWHC (509) 373-2229, Rich Hobart - BWHC (509) 373-2316

Contractor Facility/Project Manager: George Hayner - BWHC (509) 372-8135

DOE End-User/Representative Point of Contact: Larry Romine - EM-60 (509) 376-4747

DECONTAMINATION & DECOMMISSIONING SCIENCE NEEDS

ID #	NEEDS TITLE
RL-DD22-S	Photon Assisted Decontamination Chemistry
RL-DD23-S	Cesium Source Identification
RL-DD25-S	Effluent Capture
RL-DD26-S	Contaminant Binding Science Need
RL-DD27-S	Cesium Integrity Assessment
RL-DD28-S	Hot Cell Window Gasket and Seal Degradation

Hanford Site Science Need
Decontamination and Decommissioning Subgroup
PHOTON ASSISTED DECONTAMINATION CHEMISTRY

Identification No.: RL-DD022-S

Site Priority Ranking: Medium

I. Functional Need:

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.

II. 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 has used CO_2 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.

III. Science Need Description:

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.

IV. Benefit:

Dry decontamination technologies will reduce worker exposures and contamination, secondary waste volumes, and the risk of contamination migration. Laser systems are a promising technology to meet these needs and require a better basic science foundation in order to select laser systems and implementation techniques.

✓ Cost Savings ✓ Risk Reduction ✓ Enabling Knowledge

V. Corresponding Technology Needs
RL-DD03, RL-DD06, RL-DD013, RL-DD029

VI. Technical POC -- Suzanne Garrett, PNNL (509) 372-4266

Hanford Site Science Need
Decontamination and Decommissioning Subgroup
CESIUM SOURCE IDENTIFICATION

Identification Number: RL-DD023-S

Site Priority Ranking: High

I. Functional Need:
Underwater leaking cesium capsules must be identified so that a potential problem may be corrected.

II. Problem Description:
Cesium chloride is stored in double stainless steel containers (called capsules) in a basin of water for shielding and for cooling. A leaking capsule (there has been no leak to date) could cause contamination of the surrounding water and would be difficult to identify. The current method to identify a possible "leaker" (leaking capsule) is a "clunk" test where capsules are picked up off the basin floor and quickly raised and lowered so that an inner container clunks the outer container. Capsules that have lost integrity will not clunk because of water in the container. This method is time consuming and, in the presence of a leaking capsule, could involve high dose rates.

The containers that make up the capsules are constructed of the same stainless steel as is used for the basin liner.

III. Science Need Description:
An understanding of processes to locate a leak from the cesium chloride capsules is needed in order to develop a means of identifying leaking capsules quickly. Since cesium is highly soluble, some other material may act as a leaker identifying agent.

IV. Benefit:

The quicker a leaking capsule can be identified, the less contaminated material will leak into the basin. The result is less clean up at lower dose rates and lower costs.

✓ Cost Savings ✓ Risk Reduction Enabling Knowledge

V. Corresponding Technology Need

RL-DD01

VI. Technical POC -- Suzanne Garrett, PNNL (509) 372-4266

Hanford Site Science Need
Decontamination and Decommissioning Subgroup
EFFLUENT CAPTURE

Identification Number: RL-DD025-S

Site Priority Ranking: High

I. Functional Need:

Smoke from cutting tools needs to be captured in a safe and efficient manner to maximize clarity in the cutting area and to minimize secondary contamination.

II. Problem Description:

Different cutting tools generate smoke and particles of different particle sizes. These smoke and particles have been known to foul High Efficiency Particulate (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.

III. Science Need Description:

An understanding is needed of the particle sizes associated with the smoke from alternative cutting methods (e.g., laser cutting, plasma torch, gasoline torch). 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 particles sizes.

IV. Benefit:

A better understanding of the particle sizes associated with the smoke from various cutting techniques would allow for optimal capture technologies to be used. This would reduce worker exposure, reduce cost, and reduce secondary contamination.

✓ Cost Savings ✓ Risk Reduction Enabling Knowledge

V. Corresponding Technology Needs

RL-DD02, RL-DD08, RL-DD015

VI. Technical POC -- Suzanne Garrett, PNNL (509) 372-4266

Hanford Site Science Need
Decontamination and Decommissioning Subgroup
CONTAMINANT BINDING SCIENCE NEED

Identification Number: RL-DD026-S

Site Priority Ranking: High

I. Functional Need:

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.

II. 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 relatively high in cost 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 elctropolishing for metals; and wipes and strippable coatings/gels for glove boxes.

III. Science Need Description:

An understanding is needed of contamination chemistry and their binding mechanism to contaminated surfaces, decontaminants and fixatives to allow for optimal methods to be developed.

IV. Benefit

Contamination would be contained where current fixatives are ineffective and worker safety and maintenance and decontamination costs and waste volumes would be reduced with improved fixatives and decontaminants.

✓ Cost Savings ✓ Risk Reduction ✓ Enabling Knowledge

V. Corresponding Technology Needs

RL-DD02, RL-DD03, RL-DD04, RL-DD06, RL-DD07, RL-DD09, RL-DD013, RL-DD017, RL-DD029, RL-DD030.

VI. Technical POC -- Suzanne Garrett, PNNL (509) 372-4266

Hanford Site Science Need
Decontamination and Decommissioning Subgroup
CESIUM INTEGRITY ASSESSMENT

Identification Number: RL-DD027-S

Site Priority Ranking: Medium

I. Functional Need:

A technology is needed that will better assess and monitor the structural integrity of both the inner and outer container, the welds, and the annular space of each of the WESF capsules.

II. Problem Description:

Cesium chloride is stored in double stainless steel containers (called capsules) in a basin of water for shielding and for cooling. It is desirable to identify capsule failures for remediation before a capsule leaks. A leaking capsule (there has been no leak to date) could cause contamination of the surrounding water and would be difficult to identify. Capsule failure modes that should be detected prior to leaking to the pool include inner capsule degradation, radioactive material in the annulus, damage to the outer capsule, damage to overpacks and preexisting or manufacturing defects.

III. Science Need Description:

The physical and/or chemical effects of each of the failure modes identified above need to be analyzed and defined so that a technology can be developed to detect when an effect occurs and identify the specific mode based on the effect.

IV. Benefit:

The major benefit would be to avert a potential leak into the pool by identifying and defining problems early so that proper corrective actions may be taken. This results in less worker exposure, less potential for a release to the environment and reduced manhours spent looking for potential problems.

Cost Savings √ Risk Reduction Enabling Knowledge

V. Corresponding Technology Need:
RL-DD026

VI. Technical POC - Suzanne Garrett - PNNL (509) 372-4266

Hanford Site Science Need
Decontamination and Decommissioning Subgroup
HOT CELL WINDOW GASKET AND SEAL DEGRADATION

Identification Number: RL-DD028-S

Site Priority Ranking: Medium

I. Functional Need:

A technology is needed that will provide visibility into hot cells at a low life-cycle cost (current window maintenance is very expensive). One potential means of accomplishing the need is improved gaskets and seals that have life expectancies of at least 15 years.

II. Problem Description:

The Waste Encapsulation and Storage Facility (WESF) contains a series of hot cells that have been used for radioactive materials testing and processing. Visibility into the hot cells is through approximately 20" thick, oil-filled windows. The oil filling provides a compromise between shielding needs and visibility. Over time, the window seals and gaskets deteriorate, causing window fogging and drainage of the oil.

III. Science Need Description:

An understanding of the effects of radiation and time on alternative materials is needed in order to develop the optimal long-lived, low life-cycle cost gaskets and seals.

IV. Benefit:

The major benefit would be to avert replacement of the windows (estimated in the millions of dollars). Other benefits include the maintaining of the shielding over time, the ability to continue using the cells and reduced costs related to preventive and corrective maintenance on the windows.

√ Cost Savings   Risk Reduction   Enabling Knowledge

V. Corresponding Technology Need:

RL-DD027

VI. Technical POC -- Suzanne Garrett - PNNL (509) 372-4266

Commentary on FY 1999 Science and Technology Needs Process

The FY 1999 Science and Technology Needs were updated and developed as a result of reviews by Fluor Daniel Hanford, Inc. (FDH) and its major subcontractor, B&W Hanford Company (BWHC), for the Facility Transition work scope with the PHMC. Similarly, Bechtel Hanford, Inc. (BHI) reviewed, updated and documented the needs for the D&D project scope within the ERC. This revision for FY 1999 includes thirty-two technology needs and six science needs (up from the twenty-one technology needs and five science needs as reported in FY 1998). Each of the needs for FY 1999 is linked to a specific project as defined by the Hanford Project Baseline.

In summary, three of FY 1998 technology needs and one of the FY 1998 science needs were transferred to a new category entitled "Spent Nuclear Fuel." The Mixed Waste Focus Area Subgroup reviewed the needs. Five of the FY 1998 technology needs were satisfied, combined with other needs, or removed as low priority; these are therefore not included in the FY 1999 Summary. Thirteen of the FY 1998 technology needs and four of the science needs are carried over into the FY 1999 listing. Nineteen new technology needs and two science needs were added for FY 1999. All of these changes are noted in the FY 1998 - FY 1999 Crosswalk Table on the following page.

FY 1998/FY 1999 DECONTAMINATION AND DECOMMISSIONING SCIENCE AND TECHNOLOGY NEEDS CROSSWALK

Old (FY98)	New (FY99)	Need Title	Changes in FY 1999 Revision
Technology Needs			
RL-DD01	RL-DD01	Cesium Capsule Leak Detection System for WESF	Updated
RL-DD02	RL-DD02	Glove Box Size Reduction System at PFP	Updated
RL-DD03	RL-DD03	Terminal Clean-Out and TRU Waste Decontamination of PFP	Updated and expanded
RL-DD04	RL-DD04	TRU Waste Fixatives for PFP	Updated
RL-DD05	RL-DD05	Characterization of Buildings 324 and 327	Updated
RL-DD06	RL-DD06	Decontamination of Buildings 324 and 327	Updated
RL-DD07	RL-DD07	Fixatives for Buildings 324 and 327	Updated
RL-DD08	RL-DD08	Remote Cutting Technologies for Buildings 324 and 327	Updated
RL-DD09	RL-DD09	Tank Remediation for Building 324	Updated
RL-DD010	RL-DD010	Radiation Hardened Robotics for Building 324	Updated
RL-DD011	RL-DD011	Structural Integrity Inspection -- 324/327 Buildings Hot Cell Liners	Updated
RL-DD012	RL-SNF01	Contaminant Mapping of K-Basin	Transferred from D&D to new SNF category. Reviewed through MWFA Subgroup
RL-DD013	RL-SNF02	Decontamination of K-Basin Pool	Transferred from D&D to new SNF category. Reviewed through MWFA Subgroup

Old (FY98)	New (FY99)	Need Title	Changes in FY 1999 Revision
RL-DD014	RL-SNF03	Fixatives for K-Basin	Transferred from D&D to new SNF category. Reviewed through MWFA Subgroup
RL-DD015		Concrete Fuel Basin Decontamination	Satisfied
RL-DD016		Characterization Technologies	Included in needs for CDI
RL-DD017	RL-DD017	Segregation of Waste for the D&D Program	Updated
RL-DD018		Reactor Core Stabilization	Satisfied
RL-DD019		Physical Stress Monitors	Satisfied
RL-DD020		Bio-Control Technologies	Removed and held as low priority
RL-DD021	RL-DD021	Metal Decontamination and Recycling for the D&D Program	Updated
	RL-DD029	Critically Safe Vacuum System for 233-S	New
	RL-DD030	Cutting Plutonium-Contaminated Pipe for 233-S	New
	RL-DD031	Non-Intrusive Detection of Pipe Contents for 233-S	New
	RL-DD032	Contamination Fixative for 233-S	New
	RL-DD033	Field Screening for Hazardous Materials for 105-F and 105-DR Reactors	New
	RL-DD034	Remote/Robotic Technologies for CDI	New
	RL-DD035	Visual/Spatial Imaging for CDI	New
	RL-DD036	Radiation Survey for CDI	New
	RL-DD037	Liquids Detection for CDI	New
	RL-DD038	Liquids Characterization for CDI	New

Old (FY98)	New (FY99)	Need Title	Changes in FY 1999 Revision
	RL-DD039	Solids (Sediment/Sludge/Dust) Characterization for CDI	New
	RL-DD040	Concrete Characterization for CDI	New
	RL-DD041	Capsule Integrity Assessment Method for WESF	New
	RL-DD042	Hot Cell Window Life Extension for WESF	New
	RL-DD043	Crane System Upgrades for Hot Cell Canyon and Cesium Capsule Pool in WESF	New
	RL-DD044	Cesium and Strontium Removal from K3 Duct At WESF	New
	RL-DD045	Fixatives for K3 Duct at WESF	New
	RL-DD046	Clean-Out of Isolated Piping Systems in Building 324	New
	RL-DD047	Remote Viewing for Hot Cells in Buildings 324 and 327	New
RL-DD022-S	RL-DD022-S	Photon-Assisted Decontamination Chemistry	Unchanged
RL-DD023-S	RL-DD023-S	Cesium Source Identification	Unchanged
RL-DD024-S		Colloidal Chemistry of Basin Wastes	Transferred from D&D to new SNF category. Reviewed by MWFA subgroup.
RL-DD025-S	RL-DD025-S	Effluent Capture	Unchanged
RL-DD026-S	RL-DD026-S	Contaminant Binding Science Need	Unchanged
	RL-DD027-S	Cesium Integrity Assessment	New
	RL-DD028-S	Hot Cell Window Gasket and Seal Degradation	New

FY 1999 MIXED WASTE TECHNOLOGY NEEDS

ID #	NEEDS TITLE
RL-MW01	Remote Macroencapsulation of RH MLLW Debris
RL-MW02	Remotely Controlled Volume Reduction Techniques for RH MLLW and RH TRUW
RL-MW03	Remote Characterization to Distinguish TRUW from Non-TRUW Portions of Various-Sized Debris in a High Beta/Gamma Field
RL-MW04	Remote Decontamination of RH TRUW Debris to Support Reclassification into Non-TRUW Category
RL-MW05	Remote Treatment of RH Soils and Other Solid Wastes Contaminated with Organics
RL-MW06	Treatment of CH TRUW Liquid Wastes Contaminated with PCBs and Ignitables
RL-MW013	Non-Destructive Assay (NDA) of RH TRUW (High Beta/Gamma field) to meet WIPP Requirements
RL-MW014	Technology to Dispose of 12 Drums of Pu238 (500 g/drum)
RL-MW015	System to Determine the Integrity of TRUW Drums During Retrieval
RL-MW016	System to Retrieve RH TRUW from Caissons
RL-MW017	Treatment of MLLW Batteries
RL-MW018	Treatment of MLLW Mercury Wastes
RL-MW019	Stabilization Mixing System (T-Plant)
RL-MW020	Solidification of High Salt Wastes
RL-MW021	Control of Equipment Corrosion Caused by Chloride
RL-MW022	Identification and Control of Biological Foulants
RL-MW023	Tritium Removal from Wastewater
RL-MW024	Screening of Materials for PCB Content

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

REMOTE MACROENCAPSULATION OF RH MLLW DEBRIS

Identification No.: RL-MW01
Date: September, 1998

Program: Mixed Waste
OPS Office/Site: Richland Operations Office/Hanford
Operable Unit (if applicable): N/A
Waste Stream: RH MLLW
Waste Management Unit (if applicable): N/A
Facility: Future M-91 facility

Site Priority Ranking: Very High

Need Title: Remote Macroencapsulation of RH MLLW Debris

Need Description: Develop and demonstrate remote macroencapsulation systems for various sizes and shapes of RH debris (i.e. failed equipment) contaminated with MLLW. Selecting a macroencapsulation technology from existing technologies may require substantial development as well as regulatory review and/or approval.

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.

Schedule Requirements: Technology needs to be established by the end of FY 2001, to support the M-91 facility commitments. Conceptual design of the M-91 milestone facility is projected to begin July 1999.

Problem Description: Technology is needed to support macroencapsulation of RH MLLW for the M-91 facility.

PBS No.	***WBS No.***	***TIP No.***
WM-04	1.2.2	Candidate

Justification For Need:

Technical: Macroencapsulation technologies for various sizes of RH MLLW debris have not been developed or demonstrated (except for selected TWRS LLE).

Regulatory: The M-91 Milestone requires submittal of a Management Plan which is to be completed in June 1999. The plan will include 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.

Cost Savings Potential (Mortgage Reduction): Not yet established. After defining RH macroencapsulation systems and their regulatory impact, costs savings can be determined.

Cultural/Stakeholder Concerns: Facilitate the cleanup effort and reduce worker exposure to radiation.

Other: - None identified

Consequences Of Not Filling Need: Higher life-cycle cost to manage large-sized equipment RH MLLW.

Outsourcing Potential: Good candidate.

Current Baseline Technology: Macroencapsulation technology exists only for CH debris and selected TWRS LLE.

End User: Waste Management

Site Technical Point(s)-of-Contact: Larbi Bounini, WMH, (509) 376-4650 and Norman Olson, FDH, (509) 372-4810

Contractor Facility/Project Manager: TBD

DOE End User/Representative Point(s)-of-Contact: Ellen Dagan, DOE, (509) 376-3811

Waste Volume, m3	Current: 211 m3; Forecasted (5 yrs): 3,797 m^3
Waste Form	Large sizes and shapes of debris (e.g. failed equipment)
Waste Stream I.D.	RL-MLLW-07
Contaminants and co-contaminants	Beta and gamma radiation, EPA Codes D001-D043, F001-F005, PXXX, and UXXX
Function of technology	Processing (Meet LDR)
Source Category	Various Hanford Programs

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

REMOTELY CONTROLLED VOLUME REDUCTION TECHNIQUES FOR RH MLLW AND RH TRUW

Identification: RL-MW02
Date: September, 1998

Program: Mixed Waste
OPS Office/Site: Richland Operations Office/Hanford
Operable Unit (if applicable): N/A
Waste Stream: RH MLLW and RH TRUW
Waste Management Unit (if applicable): N/A
Facility: Future M-91 facility

Site Priority Ranking: High

Need Title: Remotely Controlled Volume Reduction Techniques for RH MLLW and RH TRUW.

Need Description: Develop a remotely operated volume/size reduction system for RH MLLW and TRUW items over a wide range of sizes, shapes, weights, materials of construction and types/levels of contamination. This technology will be used to reduce the void volume associated with debris. Selecting a volume reduction technology from existing technologies such as compaction, metal melting, and shredding, and converting it to remote operation may require substantial development.

Functional Performance Requirements: Provide volume reduction capability for RH MLLW and RH TRUW such as compaction, metal melting or shredding. The system should be highly reliable, and easy to maintain and clean.

Schedule Requirements: Technology needs to be established by the end of FY 2001, to support the M-91 facility commitments. Conceptual design of the M-91 milestone facility is projected to begin July 1999.

Problem Description: There is a current inventory of 211 m^3 of RH MLLW and 204 m^3 of RH TRUW. An additional 3,797 m^3 of RH MLLW and 1690 m^3 of RH TRUW is forecast. Furthermore, 1,672 m^3 of failed equipment presently stored in the Purex tunnel may need to be retrieved and processed. A volume reduction technology could significantly reduce these quantities.

PBS No.	*WBS No.*	*TIP No.*
WM-04	1.2.2	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 requires 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.

Cost Savings Potential (Mortgage Reduction): Not yet established. After defining RH volume reduction systems and their regulatory impact, costs savings can be determined.

Cultural/Stakeholder Concerns: Facilitate cleanup and increase the cost effectiveness of the cleanup effort.

Other: None identified

Consequences of Not Filling Need: Higher cost to treat a greater volume of RH waste.

Outsourcing Potential: Good candidate.

Current Baseline Technology: Treat/dispose of RH MLLW and RH TRUW will be treated and disposed of without reduction in volume.

End User: Waste Management

Site Technical Point(s)-of-Contact: Larbi Bounini, WMH, (509) 376-4650 and Norman Olson, FDH, (509) 372-4810

Contractor Facility/Project Manager: TBD

DOE End User/Representative Point(s)-of-Contact: Ellen Dagan, DOE, (509) 376-3811

	RH MLLW	RH TRUW
Waste Volume, m^3	Existing: 211 m^3 Projected (5 years): 3,797 m^3 Total: 4,008 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	RL-MLLW-07	HAN05 (Waste Stream Disposition), PUREX Tunnels (WHC-SD-EN-ES-003, Rev.0)
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 Programs

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

REMOTE CHARACTERIZATION TO DISTINGUISH TRUW FROM NON-TRUW PORTIONS OF VARIOUS-SIZED DEBRIS IN A HIGH BETA/GAMMA FIELD

Identification: RL-MW03
Date: September, 1998

Program: Mixed Waste
OPS Office/Site: Richland Operations Office/Hanford
Operable Unit (if applicable): N/A
Waste Stream: RH TRU from D&D and Tank Waste Programs
Waste Management Unit (if applicable): N/A
Facility: Future M-91 facility

Site Priority Ranking: Very High

Need Title: Remote Characterization to Distinguish TRUW from Non-TRUW Portions of Various-Sized Debris in a High Beta/Gamma Field

Need Description: A large fraction of stored and future generated debris from the various Hanford programs is expected to be a mixture of TRU and non-TRU contaminated items. Developing a detection capability for TRUW will allow separation and consolidation of TRU items. As a consequence, the total processing cost may be reduced since the treatment cost for non-TRU may be significantly lower than for TRUW processing. In addition, reducing TRU debris volume will help keep the total volume of Hanford TRU waste within the planned disposal capacity at WIPP.

Functional Performance Requirements: The TRU non-destructive sorting capability must be able to determine TRU contamination levels in a high beta-gamma dose rate environment and remotely handle TRU items over a wide range of sizes, shapes, weights, materials of construction and types and levels of contamination. Debris may include pieces up to 22 meters long and five meters wide. The system must generate high quality data (precise and accurate) to allow identification of TRU items with a high degree of confidence. Near real-time detection capability would be a plus, as it could support segregation during equipment removal/retrieval operations.

Schedule Requirements: Technology needs to be established by the end of FY 2001, to support the M-91 facility commitments. Conceptual design of the M-91 milestone facility is projected to begin July 1999.

Problem Description: Much of the equipment and other debris from some facilities has been or may be categorized as RH TRU waste although significant portions many be non-TRU. It is likely that the total volume of RH TRU waste from Hanford (including tank debris waste) may approach the RH capacity at WIPP.

PBS No.	***WBS No.***	***TIP No.***
WM-04	1.2.2	Candidate

Justification For Need:

Technical: Presently no fast and safe characterization system exists to support volume reduction of RH TRUW.

Regulatory: The M-91 Milestone requires 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.

Cost Savings Potential (Mortgage Reduction): Baseline technology not established.

Cultural/Stakeholder Concerns: Increase the cost effectiveness of the cleanup. Recycle and/or reuse materials and equipment.

Other: None identified

Consequences of Not Filling Need: Higher cost to treat a greater volume of RH TRUW.

Outsourcing Potential: Good candidate.

Current Baseline Technology: No technology currently exists for this need. RH TRUW is presently not planned to be segregated to concentrate the volume of the RH TRUW fraction. Some RH MLLW and CH MLLW will be treated and disposed along with the RH TRUW.

End User: Waste Management.

Site Technical Point(s)-of-Contact: Larbi Bounini, WMH, (509) 376- 4650 and Norman Olson, FDH, (509) 372-4810

Contractor Facility/Project Manager: TBD

DOE End User/Representative Point(s)-of-Contact: Ellen Dagan, DOE, (509) 376-3811

	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.	HAN05 (Waste Stream Disposition), PUREX Tunnels (WHC-SD-EN-ES-003, Rev. 0)
Contaminants and co-contaminants	High alpha, beta, and gamma radiation
Function of technology	Separate TRU and non-TRU in high dose rate gamma fields (100,000 R/hr total gamma at contact)
Source Category	Various Hanford Programs

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

REMOTE DECONTAMINATION OF RH TRUW DEBRIS TO SUPPORT RECLASSIFICATION INTO NON-TRUW CATEGORY

Identification: RL-MW04
Date: September, 1998

Program: Mixed Waste
OPS Office/Site: Richland Operations Office/Hanford
Operable Unit (if applicable): N/A
Waste Stream: RH TRU
Waste Management Unit (if applicable): N/A
Facility: Future M-91 facility

Site Priority Ranking: High

Need Title: Remote Decontamination of RH TRUW Debris to Support Reclassification into Non-TRUW Category

Need Description: Another approach to the volume reduction of RH TRUW materials is to decontaminate the items. The objective is to remove the TRU contamination to a level acceptable level for disposal as CH TRUW or non-TRUW. In addition, some decontaminated materials may be recycled. Remote decontamination techniques may require substantial development as well as regulatory review and/or approval.

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 which produce liquid secondary waste streams would be inconsistent with the site-wide effort to eliminate liquid waste. The system/equipment should have a high degree of reliability and must be easy to maintain and clean.

Schedule Requirements: Technology needs to be established by the end of FY 2001, to support the M-91 facility commitments. Conceptual design of the M-91 milestone facility is projected to begin July 1999.

Problem Description: The anticipated sources of RH TRUW are the LLE from Hanford HLW tanks (pumps, jumpers and other ancillary equipment), tank waste disposal program and R&D waste.

PBS No.	***WBS No.***	***TIP No.***
WM-04	1.2.2	Candidate

Justification For Need:

Technical: Remote handling decontamination does not exist, and development of a system is needed.

Regulatory: M-91 Milestone requires that a TRU/TRUM Project Management Plan be completed by June 2000, and specifies a target date of September 2003 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.

Cost Savings Potential (Mortgage Reduction): Baseline technology not established.

Cultural/Stakeholder Concerns: Increase the cost effectiveness of the cleanup. Recycle and/or reuse materials and equipment.

Other: None identified

Consequences of Not Filling Need: Higher cost to treat a greater volume of RH waste.

Outsourcing Potential: Good candidate.

Current Baseline Technology: RH TRU wasté 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.

Site Technical Point(s)-of-Contact: Larbi Bounini, WMH, (509) 376-4650 and Norman Olson, FDH, (509) 372-4810

Contractor Facility/Project Manager: TBD

DOE End User/Representative Point(s)-of-Contact: Ellen Dagan, DOE, (509) 376-3811

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.	HAN05 (Waste Stream Disposition), PUREX Tunnels (WHC-SD-EN-ES-003, Rev. 0)
Contaminants and co-contaminants	High alpha, beta, and gamma radiation
Function of technology	Decontamination
Source Category	Various Hanford Programs

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

REMOTE TREATMENT OF RH SOILS AND OTHER SOLID WASTES CONTAMINATED WITH ORGANICS

Identification: RL-MW05
Date: September, 1998

Program: Mixed Waste
OPS Office/Site: Richland Operations Office/Hanford
Operable Unit (if applicable): N/A
Waste Stream: RH MLLW Organic Wastes
Waste Management Unit (if applicable): N/A
Facility: Future M-91 facility

Site Priority Ranking: High

Need Title: Remote Treatment of RH Soils and Other Solid Wastes Contaminated With Organics

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 wastes to meet the land disposal restrictions (LDR). Adding the remote handling capability to existing or emerging organic treatment technologies will require substantial development.

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 wastes 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 must be easy to maintain and clean. The system design should allow for construction of a mobile treatment unit.

Schedule Requirements: Technology needs to be established by the end of FY 2001, to support M-91 facility commitments. Conceptual design of the M-91 milestone facility is projected to begin July 1999.

Problem Description: Small volumes of RH waste containing organics are expected. Since the wastes are remote handled and the volumes are low, it is unlikely that there will be a commercial capacity for treatment of the wastes.

PBS No.	*WBS No.*	*TIP No.*
WM-04	1.2.2	N/A

Justification For Need:

Technical: No available technology to treat RH soils contaminated with hazardous organics.

Regulatory: The M-91 Milestone requires submittal of a Management Plan which is to be completed in June 1999. The plan will include 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.

Cost Savings Potential (Mortgage Reduction): Not yet available. There is no baseline plan to treat RH MLLW organic waste.

Cultural/Stakeholder Concerns: Complete the cleanup of Hanford, including small difficult waste streams.

Other: None identified.

Consequences of Not Filling Need: The RH MLLW organic waste will remain untreated and in storage.

Outsourcing Potential: Good candidate.

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.

Site Technical Point(s)-of-Contact: Larbi Bounini, WMH, (509) 376-4650 and Norman Olson, FDH, (509) 372-4810

Contractor Facility/Project Manager: TBD

DOE End User/Representative Point(s)-of-Contact: Ellen Dagan, DOE, (509) 376-3811

Waste Volume, m^3	Small quantities (TBD)
Waste Form	RH MLLW soils contaminated with organics
Waste Stream I.D.	RL-MLLW-07
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 Programs

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

TREATMENT OF CH TRUW LIQUID WASTES CONTAMINATED WITH PCBS AND IGNITABLES

Identification: RL-MW06
Date: September, 1998

Program: Mixed Waste
OPS Office/Site: Richland Operations Office/Hanford
Operable Unit (if applicable): N/A
Waste Stream: Contact Handled (CH) TRUW with PCBs and Ignitables (D001 waste codes)
Waste Management Unit (if applicable): N/A
Facility: Future M-91 facility

Site Priority Ranking: High

Need Title: Treatment of CH TRUW Liquid Wastes Contaminated With PCBs and Ignitables

Need Description: Develop a technology to treat organic liquid TRUW (mostly hydraulic fluids) to destroy PCBs, 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.

Functional Performance Requirements: The technology must be able to remove the Ignitable Characteristic from ignitable wastes 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.

Schedule Requirements: Technology needs to be established by the end of FY 2001, to support M-91 facility commitments. Conceptual design of the M-91 milestone facility is projected to begin July 1999.

Problem Description: The WIPP Waste Acceptance Criteria prohibits the disposal of TRUW that contains either PCBs or ignitable characteristics (D001) and therefore wastes with these characteristics must be processed to remove the PCBs or ignitables prior to packaging and transporting to WIPP. The bulk of these wastes are PCB-contaminated hydraulic fluids which were generated in 1989 from the Plutonium Finishing Plant.

PBS No.	***WBS No.***	***TIP No.***
WM-04	1.2.2	N/A

Justification For Need:

Technical: No treatment capability exists for TRUW ignitable or PCB wastes.

Regulatory: WIPP Waste Acceptance Criteria does not allow PCBs and ignitables. The M-91 Milestone requires 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.

Cost Savings Potential (Mortgage Reduction): Not yet available. There is no baseline plan to treat this waste.

Cultural/Stakeholder Concerns: Complete the cleanup of Hanford, including small difficult waste streams.

Other: None identified.

Consequences of Not Filling Need: The TRUW with PCBs and ignitables will remain untreated and cannot go to WIPP.

Outsourcing Potential: Good candidate.

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(s)-of-Contact: Larbi Bounini, (509) 376-4650 and Norman Olson, FDH, (509) 372-4810

Contractor Facility/Project Manager: TBD

DOE End User/Representative Point(s)-of-Contact: Ellen Dagan, DOE, (509) 376-3811

Waste Volume, m^3	Existing: 73 m^3 Projected: 0 m^3 Total 73 m^3
Waste Form	Mostly PCB contaminated hydraulic fluids
Waste Stream I.D.	RL-TRUM-03
Contaminants and co-contaminants	Alpha
Function of technology	Destroy PCBs and remove ignitables
Source Category	Various Hanford Programs

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

NON-DESTRUCTIVE ASSAY (NDA) OF RH TRUW (HIGH BETA/GAMMA FIELD) TO MEET WIPP REQUIREMENTS

Identification: RL-MW013
Date: September, 1998

Program: Mixed Waste
OPS Office/Site: Richland Operations Office/Hanford
Operable Unit (if applicable): N/A
Waste Stream: RH TRU from D&D and Tank Waste Programs
Waste Management Unit (if applicable): N/A
Facility: Future M-91 facility

Site Priority Ranking: Very High

Need Title: Non-Destructive Assay (NDA) of RH TRUW (High Beta/Gamma field) to meet WIPP Requirements

Need Description: Develop NDA technology to assay RH TRUW in high beta/gamma fields that will meet WIPP requirements.

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.

Schedule Requirements: Technology needs to be established by the end of FY 2001, to support the M-91 facility commitments. Conceptual design of the M-91 milestone facility is projected to begin July 1999.

Problem Description: RH-TRUW must be assayed in a certifiable manner before transporting to WIPP.

PBS No.	*WBS No.*	*TIP No.*
WM-04	1.2.2	Candidate

Justification For Need:

Technical: Presently no certifiable NDA technology is known to exist for high beta-gamma fields.

Regulatory: The M-91 Milestone requires 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.

Cost Savings Potential (Mortgage Reduction): This is an enabling technology.

Cultural/Stakeholder Concerns: Increase the cost effectiveness of the cleanup. Meet milestones.

Other: None identified

Consequences of Not Filling Need: Missed milestones.

Outsourcing Potential: Good candidate.

Current Baseline Technology: No technology currently exists for this need.

End User: Waste Management

Site Technical Point(s)-of-Contact: Larbi Bounini, WMH, (509) 376- 4650 and Norman Olson, FDH, (509) 372-4810

Contractor Facility/Project Manager: TBD

DOE End User/Representative Point(s)-of-Contact: Ellen Dagan, DOE, (509) 376-3811

	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.	HAN05 (Waste Stream Disposition), PUREX Tunnels (WHC-SD-EN-ES-003, Rev. 0)
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 Programs

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

TECHNOLOGY TO DISPOSE OF 12 DRUMS OF PU238 (500 G/DRUM)

Identification No.: RL-MW014
Date: September, 1998

Program: Mixed Waste
OPS Office/Site: Richland Operations Office/Hanford
Operable Unit (if applicable): N/A
Waste Stream: High Pu waste from SRS
Waste Management Unit (if applicable): N/A
Facility: Future M-91 facility

Site Priority Ranking: High

Need Title: Technology to Dispose of 12 Drums of Pu238 (500 g/drum)

Need Description: Develop methods to retrieve, package, treat and dispose of 12 drums of Pu238 (500g/drum) from the Hanford LLBG.

Functional Performance Requirements: The systems must be capable of safely retrieving, packaging, treating, and transporting the 12 drums of Pu238 for disposal.

Schedule Requirements: Technology needs to be established by the end of FY 2001, to support M-91 facility commitments. Conceptual design of the M-91 milestone facility is projected to begin July 1999.

Problem Description: Currently no methods exist for retrieving, packaging and disposing of the 12 drums of Pu238. The material is currently identified on the EM-30 Disposition Maps (alternative case) as being shipped to SRS for disposal.

PBS No.	***WBS No.***	***TIP No.***
WM-04	1.2.2	N/A

Justification For Need:

Technical: Currently no methods exist for retrieving, packaging, treating and disposing of the 12 drums of Pu238.

Regulatory: TBD

Environmental Safety & Health: TBD

Cost Savings Potential (Mortgage Reduction): TBD

Cultural/Stakeholder Concerns: TBD

Other: TBD

Consequences of Not Filling Need: Missed milestone.

Outsourcing Potential: Limited

Current Baseline Technology: Repackaging to meet WIPP criteria for allowable Pu238 would result in thousands of drums.

End User: Waste Management.

Site Technical Point(s)-of-Contact: Larbi Bounini, WMH, (509) 376-4650 and Norman Olson, FDH, (509) 372-4810

Contractor Facility/Project Manager: TBD

DOE End User/Representative Point(s)-of-Contact: Ellen Dagan, DOE, (509) 376-3811

Waste Volume, m^3	12 drums of Pu238
Waste Form	Solid
Waste Stream I.D.	RL-TRUM-02
Contaminants and co-contaminants	Alpha
Function of technology	Disposal of Pu238 waste
Source Category	Came from SRS

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

SYSTEM TO DETERMINE THE INTEGRITY OF TRUW DRUMS DURING RETRIEVAL

Identification No.: RL-MW015
Date: September, 1998

Program: Mixed Waste
OPS Office/Site: Richland Operations Office/Hanford
Operable Unit (if applicable): N/A
Waste Stream: TRUW
Waste Management Unit (if applicable): N/A
Facility: Low Level Burial Ground (LLBG)

Site Priority Ranking: Very High

Need Title: System to Determine the Integrity of TRUW Drums During Retrieval

Need Description: Develop remote systems to nondestructively determine the integrity of TRUW drums during the retrieval process. The primary need is to confirm the structural integrity of drums before they are moved. This information will identify the need for special handling of suspect drums and reduce risks.

Functional Performance Requirements: The system must be able to remotely determine the integrity of the drum during retrieval. The system must have a high degree of measurement accuracy and precision.

Schedule Requirements: The system must be available by the end FY 1999 to support TRUW retrieval operations.

Problem Description: No remote technology exists to nondestructively determine the integrity of TRUW drums in situ.

PBS No.	*WBS No.*	*TIP No.*
WM-04	1.2.2	N/A

Justification For Need:

Technical: The retrieval process design will utilize this technology to identify this technology for alternative processing.

Regulatory: Retrieval supports Federal Facility Consent Order Commitment and the Hanford cleanup mission.

Environmental Safety & Health: There are significant worker safety and environmental risks with drum retrieval. Worker safety will be enhanced by minimizing worker exposure to hazardous and radioactive materials.

Cost Savings Potential (Mortgage Reduction): This technology will enhance worker safety and minimize cost of the retreival process by identifying failed or likely to fail drums prior to retrieval.

Cultural/Stakeholder Concerns: The objective must be successful retrieval and cleanup.

Other: N/A

Consequences of Not Filling Need: The retrieval process will incur higher costs due to longer retrieval time frames and additional precautions will be required to protect the workers.

Outsourcing Potential: Moderate

Current Baseline Technology: Nondestructive examination systems are available but would require adaptation for remote use in the field.

End User: Waste Management.

Site Technical Point(s)-of-Contact: Larbi Bounini, WMH, (509) 376-4650 and Norman Olson, FDH, (509) 372-4810

Contractor Facility/Project Manager: TBD

DOE End User/Representative Point(s)-of-Contact: Ellen Dagan, DOE, (509) 376-3811

Waste Volume m^3	Current: 274 m^3
Waste Form	55 gallon drums
Waste Stream I.D.	TRUM-01, TRUM-02, TRUM-03
Contaminants and co-contaminants	Alpha, beta and gamma radiation
Function of technology	Determine TRUW Drum Integrity in situ
Source Category	Various Hanford Programs

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

SYSTEM TO RETRIEVE RH TRUW FROM CAISSONS

Identification No.: RL-MW016
Date: September, 1998

Program: Mixed Waste
OPS Office/Site: Richland Operations Office/Hanford
Operable Unit (if applicable): N/A
Waste Stream: RH TRU
Waste Management Unit (if applicable): N/A
Facility: Future M-91 facility/caissons

Site Priority Ranking: Very High

Need Title: System to retrieve RH TRUW from caissons

Need Description: Alpha caissons are cylindrical, underground receptacles used to store RH-TRUW. There are five alpha caissons in the Hanford 218-W-4B/200 W Area Burial Ground. The alpha caissons, located 14 ft below grade, are accessed by a 3-ft-dia fill chute and a 1-ft-dia 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 wastes were packaged in 1-gal cans (approximately 97% of the caissons inventory), but some 5-gal containers, 2-gal 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 alternate processing, and 3) packaging systems is required.

Functional Performance Requirements: Retreival equipment must meet access limitations of caissons and be capable of remotely removing, screening and packaging various caisson RH-TRU waste forms.

Schedule Requirements: Technology needs to be established by the end of FY 2003, to support the planned retreival of TRUW from the alpha caissons in 2006.

Problem Description: No technology currently exists to retreive, screen, and package RH-TRUW from the caissons for eventual treatment at the M-91 facility.

PBS No.	*WBS No.*	*TIP No.*
WM-04	1.2.2	N/A

Justification For Need:

Technical: No technology currently exists to retreive, screen, and package RH-TRUW from the caissons for eventual treatment at the M-91 facility.

Regulatory: TRUW material to be disposed at WIPP.

Environmental Safety & Health: There are occupational health concerns associated with retrieving, screening and packaging RH-TRUW.

Cost Savings Potential (Mortgage Reduction): No baseline.

Cultural/Stakeholder Concerns: The RH-TRUW in caissons is expected to be retrieved.

Other: N/A

Consequences of Not Filling Need: The RH-TRUW would have to be left in the caissons until it can safely and economically be removed.

Outsourcing Potential: Moderate

Current Baseline Technology: None

End User: Waste Management.

Site Technical Point(s)-of-Contact: Larbi Bounini, WMH, (509) 376-4650 and Norman Olson, FDH, (509) 372-4810

Contractor Facility/Project Manager: TBD

DOE End User/Representative Point(s)-of-Contact: Ellen Dagan, DOE, (509) 376-3811

Waste Volume, m^3	25 m^3
Waste Form	RH-TRUW solids
Waste Stream I.D.	TRUM-02 and TRUM-03
Contaminants and co-contaminants	Alpha, beta and gamma radiation
Function of technology	Retreive, screen and package caisson RH-TRUW
Source Category	Various Hanford Programs

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

TREATMENT OF MLLW BATTERIES

Identification No.: RL-MW017
Date: September, 1998

Program: Mixed Waste
OPS Office/Site: Richland Operations Office/Hanford
Operable Unit (if applicable): N/A
Waste Stream: MLLW
Waste Management Unit (if applicable): N/A
Facility: Future M-91 facility

Site Priority Ranking: Medium

Need Title: Treatment of MLLW batteries

Need Description: Develop and demonstrate a technology for treatment of MLLW lead acid and cadmium batteries to meet Landfill Disposal Requirements (LDRs).

Functional Performance Requirements: The technology must be able to treat MLLW batteries to meet LDR. Current non-radioactive RCRA treatment requires recovery of battery metals by thermal treatment.

Schedule Requirements: Technology needs to be established by the end of FY 2001, to support M-91 facility commitments. DOE is currently exempt from the one year storage prohibition for mixed waste. If the EPA removes this exemption then DOE would have one year to meet requirements.

Problem Description: Currently not permitted to dispose of MLLW batteries.

PBS No.	***WBS No.***	***TIP No.***
WM-04	1.2.2	N/A

Justification For Need:

Technical: Technology does not exist to treat MLLW batteries to meet LDR.

Regulatory: Currently not allowed to dispose of MLLW batteries.

Environmental Safety & Health: There are occupational and health concerns associated with storing and handling the MLLW batteries.

Cost Savings Potential (Mortgage Reduction): N/A

Cultural/Stakeholder Concerns: Disposal or treatment of batteries is an expected outcome.

Other: N/A

Consequences of Not Filling Need: Inability to dispose of MLLW batteries will prolong the storage of a chemically active waste.

Outsourcing Potential: Poor due to small quantity

Current Baseline Technology:

End User: Waste Management.

Site Technical Point(s)-of-Contact: Larbi Bounini, WMH, (509) 376-4650 and Norman Olson, FDH, (509) 372-4810

Contractor Facility/Project Manager: TBD

DOE End User/Representative Point(s)-of-Contact: Ellen Dagan, DOE, (509) 376-3811

Waste Volume, m^3	Current Inventory- Two drum equivalents of lead acid batteries and two drum equivalents of cadmium batteries
Waste Form	MLLW batteries
Waste Stream I.D.	RL-MLLW-05
Contaminants and co-contaminants	Lead acid and cadium, low levels of alpha, beta and gamma radiation
Function of technology	Processing (Meet LDR)
Source Category	Various Hanford Programs

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

TREATMENT OF MLLW MERCURY WASTES

Identification No.: RL-MW018
Date: September, 1998

Program: Mixed Waste
OPS Office/Site: Richland Operations Office/Hanford
Operable Unit (if applicable): N/A
Waste Stream: MLLW
Waste Management Unit (if applicable): N/A
Facility: Future M-91 facility

Site Priority Ranking: High

Need Title: Treatment of MLLW Mercury Wastes

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 2/3 of existing mercury is amalgamated, but does not meet RCRA treatment standards within the Landfill Disposal Requirements (LDR).

Functional Performance Requirements: The technology must be able to treat CH MLLW mercury to meet LDR.

Schedule Requirements: Technology needs to be established by the end of FY 2001, to support M-91 facility commitments.

Problem Description: The mercury waste stream does not meet established Landfill Disposal Requirements (LDR) treatment standards and requires treatment prior to disposal.

PBS No.	***WBS No.***	***TIP No.***
WM-04	1.2.2	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, and is part of M-91 TPA commitments.

Environmental Safety & Health: Hg is a hazardous material.

Cost Savings Potential (Mortgage Reduction): No baseline technology available.

Cultural/Stakeholder Concerns: Disposal or treatment of CH MLLW mercury waste is an expected outcome.

Other: N/A

Consequences of Not Filling Need: Inability to dispose of CH MLLW mercury waste. TPA M-91 milestone commitments would not be met.

Outsourcing Potential: Limited

Current Baseline Technology: No capability exists to treat CH MLLW mercury waste to meet LDR.

End User: Waste Management.

Site Technical Point(s)-of-Contact: Larbi Bounini, WMH, (509) 376-4650 and Norman Olson, FDH, (509) 372-4810

Contractor Facility/Project Manager: TBD

DOE End User/Representative Point(s)-of-Contact: Ellen Dagan, DOE, (509) 376-3811

Waste Volume, m^3	Current- 2 m^3
Waste Form	Mercury subcategory and partially amalgamated waste streams
Waste Stream I.D.	RL-MLLW-06
Contaminants and co-contaminants	Alpha, beta and gamma
Function of technology	Dispose of Hg waste
Source Category	Various Hanford Programs

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

STABILIZATION MIXING SYSTEM (T-PLANT)

Identification No.: RL-MW019
Date: September, 1998

Program: Mixed Waste
OPS Office/Site: Richland Operations Office/Hanford
Operable Unit (if applicable): N/A
Waste Stream: MLLW
Waste Management Unit (if applicable): N/A
Facility: T-Plant

Site Priority Ranking: High

Need Title: Stabilization Mixing System (T-Plant)

Need Description: A stationary mixing system (e.g. paddle type mixer) to be used for chemical stabilization of particulate MLLW (e.g. soil, fly ash, sludges) for RCRA heavy metals, as well as for treatment (neutralization) to remove D002 (corrosive) characteristics from applicable MLLW materials.

Functional Performance Requirements: The mixing system would be required to handle materials ranging from larger particulate material (e.g. soil with up to ½" size rocks) to fine particulate material such as fly ash. Mixing bin would have to be contained/covered to help control spread of radioactive contamination during material transfer to/from mixer. Mixer would require automatic and accurate measurement of waste, stabilization agents, and water (as necessary) added. The mixer system shall be capable of unloading batch into a 55 gallon drum.

Schedule Requirements: System is required for processing (stabilization) of any/all future particulate waste streams.

Problem Description: Current equipment used at T Plant has proven unsatisfactory for this/these type(s) of stabilization activities. Therefore, this mixing system will be required for any and all future chemical stabilization of particulate waste.

PBS No.	***WBS No.***	***TIP No.***
WM-04	1.2.2	N/A

Justification For Need:

Technical: Current equipment used at T Plant for chemical stabilization does not promote adequate or thorough mixing of the waste with the stabilizing agents, and is also not designed to handle the volumes of waste requiring stabilization; as a result, use of said equipment significantly limits WMH's capacity to treat (stabilize) for RCRA heavy metals. A suitable mixing system will allow a wider variety of waste matrices to be processed more efficiently, which will allow WMH to establish themselves as the leader on the Hanford Site (as well as other DOE sites) for chemical stabilization.

Regulatory: A significant amount of waste at the Hanford Site, as well as waste from offsite Generators requires chemical stabilization.

Environmental Safety & Health: Use of a new mixing system will significantly reduce employee exposure to hazardous chemical and radiological constituents due to significantly reduced time for processing (as compared to current methods), thereby keeping exposure As Low As Reasonably Achievable (ALARA).

Cost Savings Potential (Mortgage Reduction): It is estimated that the volume of waste processed in one week (5 shifts) using the current equipment can be processed in one shift using the H.C. Davis Model UD 10 (as listed above). Based on this increased processing capacity, the UD 10 can pay for itself in just one and a half shifts.

Cultural/Stakeholder Concerns: Facilitate a more efficient waste processing capability and reduce worker exposure. Maintains the waste on-site and eliminates the need to move the waste on public highways.

Other:

Consequences of Not Filling Need: Eliminates for the most part the need to chemically stabilize particulate waste (both in volume and waste stream type).

Outsourcing Potential: Good candidate.

Current Baseline Technology: Technology for RCRA heavy metal MLLW stabilization is limited at the Hanford Site, as well as other DOE complexes.

End User: Waste Management Projects and Technical Operations

Site Technical Point(s)-of-Contact: Larbi Bounini, WMH, (509) 376-4650, Jeff Ahlers, WMH, (509) 373-5067 and Norman Olson, FDH, (509) 372-4810

Contractor Facility/Project Manager: L. Ty Blackford - WMH (509) 373-1713

DOE End User/Representative Point(s)-of-Contact: Ellen Dagan, DOE, (509) 376-3811

Waste Volume, m^3	Current: 2,700 m^3
Waste Form	Various inorganic particulate material such as soils, ashes and sludges
Waste Stream I.D.	RL-MLLW-02
Contaminants and co-contaminants	Alpha, beta and gamma radiation
Function of technology	Processing of waste to meet LDR for disposal
Source Category	Hanford and other DOE/DOD sources

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

SOLIDIFICATION OF HIGH SALT WASTES

Identification No.: RL-MW020
Date: September, 1998

Program: Mixed Waste
OPS Office/Site: Richland Operations Office/Hanford
Operable Unit (if applicable): N/A
Waste Stream: N/A
Waste Management Unit (if applicable): N/A
Facility: 200 Area Effluent Treatment Facility (ETF)

Site Priority Ranking: High

Need Title: Solidification of High Salt Wastes

Need Description: The treatment of wastewaters 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. A method for the solidification of the secondary waste is needed that meets the regulatory requirements for the disposal of mixed and low-level wastes, along with the disposal site's Waste Acceptance Criteria.

Functional Performance Requirements: Cost effective technology to solidify a waste stream with greater than 50% salt concentration.

Schedule Requirements: Implemented by 2002.

Problem Description: The waste waters being treated in the 200 Area Effluent Treatment Facility (ETF) contain 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 wastes. 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 Waste Acceptance Criteria for the disposal site, it will be necessary for some of the ETF secondary wastes to be solidified. Without solidification, the potential exists for the secondary waste to be above the Land Disposal Requirements treatment standards.

PBS No.	***WBS No.***	***TIP No.***
WM-05	1.2.3	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

Cost Savings Potential (Mortgage Reduction): TBD

Cultural/Stakeholder Concerns: N/A

Other: Addition of excess caustic and sulfuric acid results in unnecessary costs.

Consequences of Not Filling Need: Secondary wastes that exceed regulatory requirements or disposal site waste acceptance criteria will need to be stored until additional treatment is provided.

Outsourcing Potential: Good candidate.

Current Baseline Technology: Secondary wastes are 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

Site Technical Point(s)-of-Contact: Larbi Bounini, WMH (509) 376-4650, Donald Flyckt, WMH (509) 372-2142, Norman Olson, FDH (509) 372-4810

Contractor Facility/Project Manager: Robert R. Bloom - WMH (509) 373-4574

DOE End User/Representative Point(s)-of-Contact: Ellen Dagan, DOE, (509) 376-3811

Waste Volume, m^3	TBD
Waste Form	Brine
Waste Stream I.D.	N/A
Contaminants and Co-contaminants	TBD
Function of Technology	Produce waste form to meet ERDF requirements
Source Category	Multiple wastewater sources

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

CONTROL OF EQUIPMENT CORROSION CAUSED BY CHLORIDE

Identification No.: RL-MW021
Date: September, 1998

Program: Mixed Waste
OPS Office/Site: Richland Operations Office/Hanford
Operable Unit (if applicable): N/A
Waste Stream: N/A
Waste Management Unit (if applicable): N/A
Facility: 200 Area Effluent Treatment Facility (ETF)

Site Priority Ranking: TBD

Need Title: Control of Equipment Corrosion Caused by Chloride

Need Description: Several of the wastewater streams on the Hanford Site contain elevated levels of chloride. Stainless steel materials are used extensively in the ETF. Treatment of wastewaters with high concentrations of chloride may result in accelerated corrosion of the stainless steel components.

Functional Performance Requirements: A method to control and measure the amount of corrosion resulting from the treatment of wastewaters with elevated levels of chloride.

Schedule Requirements: Implemented by FY 2000.

Problem Description: Stainless steel materials are subject to increased corrosion rates in the presence of chloride.

PBS No.	***WBS No.***	***TIP No.***
WM-05	1.2.3	N/A

Justification For Need:

Technical: Chlorides are known to cause corrosion of stainless steel materials.

Regulatory: Wastewaters 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

Cost Savings Potential (Mortgage Reduction): N/A

Cultural/Stakeholder Concerns: N/A

Other: N/A

Consequences of Not Filling Need: Higher equipment replacement cost and more downtime.

Outsourcing Potential: Good candidate.

Current Baseline Technology: Test processing of wastewater containing elevated levels of chloride in the ETF at reduced flow rates is planned for 1999.

End User: Waste Management Project

Site Technical Point(s)-of-Contact: Larbi Bounini, WMH (509) 376-4650, Donald Flyckt, WMH (509) 372-3142, Norman Olson, FDH (509)-372-4810.

Contractor Facility/Project Manager: Robert R. Bloom - WMH (509) 373-4574

DOE End User/Representative Point(s)-of-Contact: Ellen Dagan, DOE, (509) 376-3811

Waste Volume, m^3	TBD
Waste Form	Liquid
Waste Stream I.D.	N/A
Contaminants and Co-contaminants	Chloride
Function of Technology	Remove Chloride
Source Category	Multiple wastewater sources

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

IDENTIFICATION AND CONTROL OF BIOLOGICAL FOULANTS

Identification No.: RL-MW022
Date: September, 1998

Program: Mixed Waste
OPS Office/Site: Richland Operations Office/Hanford
Operable Unit (if applicable): N/A
Waste Stream: N/A
Waste Management Unit (if applicable): N/A
Facility: 200 Area Effluent Treatment Facility (ETF)

Site Priority Ranking: TBD

Need Title: Identification and Control of Biological Foulants

Need Description: Wastewaters resulting from the cleanup of the Hanford Site typically have 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 wastewaters.

Functional Performance Requirements: A system to identify when biological foulants are present in a wastewater. A technology to control the growth of these foulants.

Schedule Requirements: Implemented by 2000.

Problem Description: Biological foulants interfere with the operation of wastewater treatment systems. These foulants need to be identified and controlled.

PBS No.	***WBS No.***	***TIP No.***
WM-05	1.2.3	N/A

Justification For Need:

Technical: Throughput of the ETF has been impacted by biological growth in the process systems.

Regulatory: Wastewaters 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

Cost Savings Potential (Mortgage Reduction): N/A

Cultural/Stakeholder Concerns: N/A

Other: N/A

Consequences of Not Filling Need: Higher cost to manage wastewaters containing elevated levels of biological foulants.

Outsourcing Potential: Good candidate.

Current Baseline Technology: Wastewaters containing biological foulants have previously been treated in the ETF. Significant downtime for equipment cleaning and maintenance was experienced and overall throughput was reduced.

End User: Waste Management Project

Site Technical Point(s)-of-Contact: Larbi Bounini, WMH (509) 376-4650, Donald Flyckt, WMH (509) 372-3142, Norman Olson, FDH (509) 372-4810

Contractor Facility/Project Manager: Robert R. Bloom - WMH (509) 373-4574

DOE End User/Representative Point(s)-of-Contact: Ellen Dagan, DOE, (509) 376-3811

Waste Volume, m^3	TBD
Waste Form	Liquids
Waste Stream I.D.	TBD
Contaminants and Co-contaminants	Biological foulants
Function of Technology	Remove biological foulants
Source Category	Various wastewater sources

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

TRITIUM REMOVAL FROM WASTEWATER

Identification No.: RL-MW023
Date: September, 1998

Program: Mixed Waste
OPS Office/Site: Richland Operations Office/Hanford
Operable Unit (if applicable): N/A
Waste Stream: N/A
Waste Management Unit (if applicable): N/A
Facility: 200 Area Effluent Treatment Facility (ETF)

Site Priority Ranking: TBD

Need Title: Tritium Removal from Wastewater

Need Description: Wastewaters are currently treated at Hanford and disposed of to the soil column. Some wastewaters contain 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 wastewater would greatly improve the public acceptance of the efforts to clean up the Hanford Site.

Functional Performance Requirements: Reduce the concentration of tritium in a wastewater stream from 2-3 million pCi/L to less than 20,000 pCi/L.

Schedule Requirements: Cost effective technology implemented by 2004.

Problem Description: A cost effective technology does not exist for the reduction of low levels of tritium in wastewaters.

PBS No.	***WBS No.***	***TIP No.***
WM-05	1.2.3	N/A

Justification For Need:

Technical: Cost effective method for removing dilute amounts of tritium from water

Regulatory: N/A

Environmental Safety & Health:

Cost Savings Potential (Mortgage Reduction): N/A

Cultural/Stakeholder Concerns: Stakeholders have recently shown increased concern with protecting the groundwater. Public sentiment may outweigh the fact 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

Consequences of Not Filling Need: Adverse public perception may result in additional oversight, taking funding away from cleanup activities.

Outsourcing Potential: Good candidate.

Current Baseline Technology: No cost effective technology currently exists to remove tritium from wastewater streams. The ETF treatment process is not effective on tritium contamination.

End User: Waste Management Project

Site Technical Point(s)-of-Contact: Larbi Bounini, WMH, (509) 376-4650, Donald Flyckt, WMH, (509) 372-3142, Norman Olson, FDH, (509) 372-4810

Contractor Facility/Project Manager: Robert R. Bloom - WMH (509) 373-4574

DOE End User/Representative Point(s)-of-Contact: Ellen Dagan, DOE, (509) 376-3811

Waste Volume, m^3	1 to 4 million gallons per year
Waste Form	Liquid
Waste Stream I.D.	N/A
Contaminants and Co-contaminants	Tritium
Function of Technology	To remove Tritium from Water
Source Category	Various wastewater sources

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

SCREENING OF MATERIALS FOR PCB CONTENT

Identification No.: RL-MW024
Date: September, 1998

Program: Mixed Waste
OPS Office/Site: Richland Operations Office/Hanford
Operable Unit: N/A
Waste Stream: Sludges and Supernatants
Waste Management Unit: N/A
Facility: Hanford Analytical Laboratory Operations

Site Priority Ranking: High

Need Title: Screening of Materials for PCB Content

Need Description: A field deployable, rapid screening technique for the presence of the full range of PCB compounds (aroclors) in highly radioactive samples is required. This technique will replace the current process of taking a sample, transporting it to the laboratory, and performing analysis. Test kits, currently available commercially, have severe limitations for use on DOE installations because they only indicate the concentration of congeners with high chloride content. They cannot detect PCBs in organic matrices, and are not quantitative in establishing concentration.

Functional Performance Requirements: This technology must detect PCBs in organic matrices, it must function on radioactive samples, it must be field deployable, and it must be operated by trained but non-technical persons. This technology should also be approved as an alternative to laboratory analyses and included in the EPA "Manual of Test Methods for Evaluating Solid Waste, SW 846."

Schedule Requirements: As soon as possible.

Problem Description: All Hanford Programs have the requirement to identify and segregate PCB wastes from either non-radioactive and radioactive mixed wastes. This segregation leads to high costs in storage and disposal of PCB contaminated materials. Laboratory analyses, including analysis of results, frequently require more than one week to accomplish and are expensive.

PBS No.	*WBS No.*	*TIP No.*
WM-06	1.2.4	N/A

Justification of Need:

Technical: N/A

Regulatory: This technology, if qualified by EPA, would replace the current approved methods of laboratory analyses.

Environmental Safety and Health: The current method requires packaging and transportation of samples to a qualified laboratory. The laboratory analysis results in the creation of a laboratory test waste stream (containing PCBs). The replacement method would lower the personnel risk and exposure resulting from these operations.

Cost Savings Potential: Cost savings are possible through the reduction of laboratory analyses and associated handling costs, a faster response on the presence of PCBs and the elimination of laboratory waste streams.

Cultural/Stakeholder Concerns: More complete screening of materials resulting from remediation sites can be made that more accurately reduces the potential of PCB waste being disposed improperly.

Other: None Identified

Consequences of Not Filling Need: Current methods will continue to be used, resulting in continued high costs due to laboratory analyses, additional handling and additional waste disposal requirements.

Outsourcing Potential: N/A

Current Baseline Technology: Laboratory analysis with no screening.

End User: Analytical Laboratories, Field Analysis Units, Process Operations

Site Technical Points of Contact: David Dodd, NHC, (509) 373-2154 and Donald Engelman, FDH, (509) 372-6536

Contractor Facility/Project Manager: Jeannette E. Hyatt - WMH (509) 376-7923

DOE End User/Representative Point of Contact: James A. Poppiti (509) 376-4550

FY 1999 MIXED WASTE SCIENCE NEEDS

ID #	NEEDS TITLE
RL-MW07-S	Nonintrusive, Nondestructive Characterization Methods for Nonradionuclide Hazardous Chemical Components of Mixed Low-Level Waste
RL-MW08-S	Develop Nondestructive TRU/Non-TRU Characterization/Radionuclide Mapping Methods for Contaminated Remotely Handled (RH) TRU Waste
RL-MW09-S	Fundamental Understanding of the Mechanism for Encapsulation of Radionuclides and Hazardous Components during Microencapsulation or Stabilization
RL-MW010-S	Development of Analytical Techniques that Extract Information about a Waste Stream or Sample without Extracting Any Material
RL-MW011-S	Methods to Remove Ingested or Inhaled Radioactivity from an Individual
RL-MW12-S	Concepts/Methods for the Prevention of Migration of Radionuclides and Hazardous Components from Buried Radioactive Wastes

Listing of Science Needs
For the Mixed Waste Subgroup

High Priority Mixed Waste Needs

1. Non-intrusive, non-destructive characterization methods for non-radionuclide hazardous chemical components of mixed low-level waste
2. Develop non-destructive TRU/non-TRU characterization/radionuclide mapping methods for contaminated remotely handled (RH) TRU waste

Medium Priority Mixed Waste Needs

1. Fundamental understanding of the mechanism for encapsulation of radionuclides and hazardous components during microencapsulation or stabilization

General Needs Broader than Mixed Waste Treatment, but that could Significantly Impact Mixed Waste Management

High Priority General Needs

1. Development of analytical techniques that extract information about a waste stream or sample without extracting any material
2. Methods to remove ingested or inhaled radioactivity from an individual

Medium Priority General Needs

Concepts/methods for the prevention of migration of radionuclides and hazardous components from buried radioactive wastes

Hanford Site Science Need
Mixed Waste Subgroup

Identification No.: RL-MW07-S

Need Title: Non-intrusive, non-destructive characterization methods for non-radionuclide hazardous chemical components of mixed low-level waste.

Site Priority Ranking: High

I. Functional Need:

Cost-effective characterization/verification methods for MLLW prior to LDR treatment.

II. Problem Description:

Much of Hanford's MLLW will be treated by off-site commercial vendors. There is a high cost associated with the present baseline of opening drums for sampling and characterizing the waste prior to treatment.

III. Science 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 PCBs in solid materials at RCRA hazard levels. Contaminates that are of primary interest include: acretonitrile, 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.

Timing of Need: 1-3 Years

IV. Benefit:

Minimize the cost for waste characterization prior to treatment and verification of treated waste. Estimated cost reduction of $3.8 million through FY 2006 based upon a 30% decrease in sampling and analysis costs. There would also be a reduction in the exposure risk to worker as a result of the avoidance of drum opening.

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)

V. Contacts:

Ellen Dagan, DOE-RL (509) 376-3811
Waste Programs Division
ellen_b_dagan@rl.gov

Norman Olson, PNNL (509) 372-4810
FDH-Technology Management Project
norm.olson@pnl.gov

Hanford Site Science Need
Mixed Waste Subgroup

Identification No.: RL-MW08-S

Need Title: Develop non-destructive TRU/non-TRU characterization/radionuclide mapping methods for contaminated remotely handled (RH) TRU waste.

Site Priority Ranking: High

I. Functional Need:

Development of a robust TRU NDA detection capability to 1) map TRU contamination levels in a high beta-gamma dose rate environment, and 2) handle segregated pieces of remote-handled TRU items over a wide range of sizes, shapes, weights, materials of construction and types and levels of contamination.

II. Problem Description:

Much of the equipment and other waste from certain facilities has been or will be categorized as RH-TRU waste upon retrieval or classification as a waste. In addition to volume reduction methods, the segregation of items or parts of items may make it possible to separate the RH-TRU fraction, leaving some proportion as RH-LLMW and/or CH-LLMW. Total processing cost could be reduced accordingly because the cost of processing RH or CH-LLMW is significantly less than RH-TRU processing. In addition, reducing RH-TRU waste volumes from TWRS tanks will reduce the likelihood that the total volume of RH-TRU waste from Hanford will approach the RH capacity at WIPP.

III. Science Need Description:

Development of robust non-destructive TRU/non-TRU characterization/radionuclide mapping methods for contaminated remotely handled (RH) TRU waste in a high beta-gamma dose rate environment. High beta-gamma dose rates interfere with existing non-destructive methods for TRU characterization.

Timing of Need: 4-10 Years

IV. Benefit:

The major benefits are 1) the reduction of the volume and cost of treating of RH-TRU, and 2) the likelihood that the volume of RH-TRU waste from Hanford (including tank waste) exceeds the

RH capacity at WIPP. Estimated life cycle cost reduction of $10.8 million assuming that 30% of the RH-TRU from TWRS tanks can be segregated and treated as RH-LLMW. Additional cost savings potential are from the difference in disposal costs (WIPP vs. the Mixed waste trench) and transportation costs to the disposal site.

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)

V. Contacts:

For more information, contact:

Ellen Dagan, DOE-RL — (509) 376-3811
Waste Programs Division
ellen_b_dagan@rl.gov

Norman Olson, PNNL — (509) 372-4810
FDH-Technology Management Project
norm.olson@pnl.gov

Hanford Site Science Need
Mixed Waste Subgroup

Identification No.: RL-MW09-S

Need Title: Fundamental understanding of the mechanism for encapsulation of radionuclides and hazardous components during microencapsulation or stabilization.

Site Priority Ranking: Medium

I. Functional Need:

Fundamental information on the long-term stability and durability of waste constitutions within waste forms is needed to aid in projections of the impacts of disposal of waste materials and to provide greater understanding of how to further improve the immobilization of radioactive and hazardous components within waste materials.

II. Problem Description:

Continued incremental progress is being made on the ability to make meaningful projections of the long-term performance of various waste materials and waste forms. However, there is not universal agreement on how various waste constituents will behave in the environment over the long term and in how the variation of waste components within a waste form can change its behavior. A fundamental understanding of the materials involved and the release and migration of hazardous and radioactive components should increase the confidence in the long term success of waste management activities.

III. Science Need Description:

The identification of fundamental behavior of various radioactive and hazardous components so that their release and migration from waste forms and disposal environments can be more accurately projected and defended. There is also a need to provide further reduction in the impacts of waste disposal on the environment through better understanding of how wastes can be retained within waste forms and within waste containment barriers.

Timing of Need: 4-10 Years

IV. Benefit:

The availability of a stronger science base on the behavior of radioactive and hazardous constitutions should increase the acceptance of projections of the waste management impact on the environment and on public. This could increase the acceptance of waste management activities by the general public. This could lead to reduced costs for waste management, since more extreme measures may not be needed.

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)

V. Contacts:

For more information, contact:

Ellen Dagan, DOE-RL (509) 376-3811
Waste Programs Division
ellen_b_dagan@rl.gov

Norman Olson, PNNL (509) 372-4810
FDH-Technology Management Project
norm.olson@pnl.gov

Hanford Site Science Need
Mixed Waste Subgroup

Identification No.: RL-MW10-S

Need Title: Development of analytical techniques that extract information about a waste stream or sample without extracting any material.

Site Priority Ranking: High

I. Functional Need:

Analytical techniques that function by analyzing the bulk material without the need for extraction of a sample of material for analysis.

II. Problem Description:

Typically, samples of waste or material must be extracted from the bulk material to allow analysis in the laboratory. An ideal analytical method would be able to analyze the material in the bulk form without the need for sampling. This avoids the costs of sampling and reduces the secondary waste that is generated from the sampling operations and the analysis activities. It also avoids changes in the sample that may occur between the time of sampling and the time of analysis.

III. Science Need Description:

Analytical techniques or methods that can be taken to the field, placed into or near the solid waste materials, and that can provide information on chemical composition without the need for extracting physical samples of the material from the bulk material. The special needs are for the detection of volatile and semi-volatile organic materials that exceed the RCRA regulatory minimal levels. Some of the important RCRA components that need detection include: acretonitrile, 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.

Timing of Need: 4-10 Years

IV. Benefit:

The avoidance of sampling provides many benefits. In increases the representativeness of the sample, allows sampling of more material, and avoid the generation of additional wastes with all of its associated costs and needs. With the secondary benefits in-place analysis could offer cost savings as well.

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)

V. Contacts:

For more information, contact:

Ellen Dagan, DOE-RL (509) 376-3811
Waste Programs Division
ellen_b_dagan@rl.gov

Ted Anderson, BHI (509) 376-3638
Theodore_D_Anderson@apec.rl.gov

Hanford Site Science Need
Mixed Waste Subgroup

Identification No.: RL-MW11-S

Need Title: Methods to remove ingested or inhaled radioactivity from an individual.

Site Priority Ranking: High

I. Functional Need:

Additional methods are needed that will remove radioactive materials from an individual.

II. Problem Description:

During the increased handling and waste management activities with a large number of waste containers, it becomes increasing likely that an individual will be exposed to radioactive materials. Historical methods have been developed that can remove some of these material from the skin surface, but removal of ingested or inhaled materials from the body is still a difficult activity.

III. Science Need Description:

Identify the location and varying degree of strength by which different isotopes are held within the body, and identify how to remove isotopes in the case of accidental inhalation or ingestion.

Timing of Need: 4-10 Years

IV. Benefit:

This will reduce the risk to the individual in the case of accidental exposure during waste management activities.

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)

V. Contacts:

For more information, contact:

Ellen Dagan, DOE-RL (509) 376-3811
Waste Programs Division
ellen_b_dagan@rl.gov

Norman Olson, PNNL (509) 372-4810
FDH-Technology Management Project
norm.olson@pnl.gov

Hanford Site Science Need
Mixed Waste Subgroup

Identification No.: RL-MW12-S

Need Title: Concepts/methods for the prevention of migration of radionuclides and hazardous components from buried radioactive wastes.

Site Priority Ranking: Medium

I. Functional Need:

Materials or systems that can reduce or prevent the migration of radionuclides and/or hazardous components in the waste.

II. Problem Description:

Large quantities of radioactive and mixed wastes have previously been buried at Hanford and other DOE sites. Many of these materials are to be left in their current locations for permanent disposal. The impacts of the wastes on future generations may be reduced if the mobility of the radioactive and hazardous components in the wastes is reduced to allow the radioactivity to decay in place. Surface barriers have been designed and developed for capping of the waste sites and appear to be generally effective. Alternative designs or approaches may be more effective or may be implemented at lower cost.

III. Science Need Description:

The identification and development of approaches that will further enhance the stability of wastes in their current disposal environment.

The highest risk appears to be from the leaching of radionuclides by rain or ground water and then the migration of that radionuclides in the ground water to the public environments. Approaches that have been typically considered 1) eliminate or reduce the water that can penetrate the wastes, 2) increasing the leach resistance of the wastes by treating with a materials such a grout or polymers, or 3) limiting the flow of radionuclides by inclusion of an ion exchange media or other physical barrier to reduce migration of the water containing the radionuclides. As noted above the first approach (capping) is the currently planned method for Hanford disposal sites. Methods or materials that can enhance the stability and performance of the caps can be given special attention.

Timing of Need: 4-10 Years

IV. Benefit:

The reduction of the migration of the radionuclides from the burial grounds will reduce the risk to the public from any migration of radionuclides. The current caps are anticipated to cost in excess of $0.5 million per acre, with an estimated total area in excess of 2000 acres of waste sites to cover at Hanford. Thus, there may be some opportunities to reduce the costs of barriers by evaluating of alternative designs or modifications in waste form.

If a sufficiently effective method is identified and developed, it may allow the disposal of GTCIII or TRU wastes at the current DOE sites.

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)

V. Contacts:

For more information, contact:

Ellen Dagan, DOE-RL (509) 376-3811
Waste Programs Division
ellen_b_dagan@rl.gov

Norman Olson, PNNL (509) 372-4810
FDH-Technology Management Project
norm.olson@pnl.gov

Glendon Gee, PNNL (509) 372-6096
glendon.gee@pnl.gov

Commentary on FY 1999 Technology Needs Process

The FY 1999 Technology Needs were reviewed by Fluor Daniel Hanford, Inc (FDH) and its major subcontractor, Waste Management Federal Services of Hanford, Inc (WMH). All six needs from last year were carried over with updated descriptions of the technology needs and the waste streams. Twelve (12) new technology needs were added for FY 1999 for a total of 18. The six FY 1998 Science Needs were carried over to FY 1999. All changes are noted in the FY 1998-FY 1999 Crosswalk table below.

MIXED WASTE FY 1998 - FY 1999 CROSSWALK

Old (FY98)	New (FY99)	NEED TITLE	Changes in FY 1999 Revision
RL-MW01	RL-MW01	Remote Macroencapsulation of RH MLLW Debris	Facility defined, new title and need description (EPA standard for treatment is macroencapsulation) and new waste volume estimates.
RL-MW02	RL-MW02	Remotely Controlled Volume Reduction Techniques for RH MLLW and RH TRUW	Facility defined, improved need description, and improved waste volume estimate.
RL-MW03	RL-MW03	Remote Characterization to Distinguish TRUW from Non-TRUW Portions of Various-Sized Debris in a High Beta/Gamma Field	Facility defined, improved need description, and improved waste volume estimate.
RL-MW04	RL-MW04	Remote Decontamination of RH TRUW Debris to Support Reclassification into Non-TRUW Category	Facility defined, improved need description, and improved waste volume estimate.
RL-MW05	RL-MW05	Remote Treatment of RH Soils and Other Solid Wastes Contaminated with Organics	Facility defined, improved need description, and improved waste volume estimate.

Old (FY98)	New (FY99)	NEED TITLE	Changes in FY 1999 Revision
RL-MW06	RL-MW06	Treatment of CH TRUW Liquid Wastes Contaminated with PCBs and Ignitables	Facility defined, improved need description, and improved waste volume estimate.
N/A	RL-MW013	Non-Destructive Assay (NDA) of RH TRUW (High Beta/Gamma field) to meet WIPP Requirements	New
N/A	RL-MW014	Technology to Dispose of 12 Drums of Pu238 (500 g/drum)	New
N/A	RL-MW015	System to Determine the Integrity of TRUW Drums During Retrieval	New
N/A	RL-MW016	System to Retrieve RH TRUW from Caissons	New
N/A	RL-MW017	Treatment of MLLW Batteries	New
N/A	RL-MW018	Treatment of MLLW Mercury Wastes	New
N/A	RL-MW019	Stabilization Mixing System (T-Plant)	New
N/A	RL-MW020	Solidification of High Salt Wastes	New (Liquid Effluent Facility)
N/A	RL-MW021	Control of Equipment Corrosion Caused by Chloride	New (Liquid Effluent Facility)
N/A	RL-MW022	Identification and Control of Biological Foulants	New (Liquid Effluent Facility)
N/A	RL-MW023	Tritium Removal from Wastewater	New (Liquid Effluent Facility)

Old (FY98)	New (FY99)	NEED TITLE	Changes in FY 1999 Revision
N/A	RL-MW024	Screening of Materials for PCB Content	New (222-S Labs)
RL-MW07-S	RL-MW07-S	Non-intrusive, Non-destructive Characterization Methods for Non-radionuclide Hazardous Chemical Components of Mixed Low-Level Waste	No change
RL-MW08-S	RL-MW08-S	Develop Non-destructive TRU/non-TRU Characterization/ Radionuclide Mapping Methods for Contaminated Remotely Handled (RH) TRU Waste	No change
RL-MW09-S	RL-MW09-S	Fundamental Understanding of the Mechanism for Encapsulation of Radionuclides and Hazardous Components During Microencapsulation or Stabilization	No change
RL-MW10-S	RL-MW10-S	Development of Analytical Techniques that Extract Information about a Waste Stream or Sample Without Extracting any Material	No change
RL-MW11-S	RL-MW11-S	Methods to Remove Ingested or Inhaled Radioactivity from an Individual	No change
RL-MW12-S	RL-MW12-S	Concepts/Methods for the Prevention of Migration of Radionuclides and Hazardous Components from Buried Radioactive Wastes	No change

FY 1999 SUBSURFACE CONTAMINANTS TECHNOLOGY NEEDS STATEMENTS

ID #	NEED TITLE
Groundwater Project	
RL-SS01	Cost-Effective, In Situ Remediation of Carbon Tetrachloride in the Vadose Zone and Groundwater
RL-SS02	Improved, Real-Time, In-Line Detection of Carbon Tetrachloride in Process Water
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-SS23	Improved, Ex Situ Remediation of Chromium in Groundwater
RL-SS05	Improved, Real-Time, In-Line Detection of Hexavalent Chromium in Process Water
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-SS08	Improved, Real-Time, In-Line Detection of Strontium-90 in Process Water
RL-SS09	Improved, Real-Time, In Situ Detection of Strontium-90 in Groundwater
Remedial Action and Waste Disposal Project	
RL-SS10	Improved Technologies for Detection/Delineation of Burial Ground Contents and Subsurface Geological Boundaries
RL-SS11	Cost-Effective, In Situ Remediation of Hexavalent Chromium in the Vadose Zone
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-SS24	Improved Ex Situ Treatment of Soils Contaminated with Lead and Other TCLP Metals

ID #	NEED TITLE
RL-SS13	Improved, Real-Time Field Screening During Excavation for Heavy Metals with Emphasis on the Following: Lead, Chromium, Mercury, and Barium
RL-SS14	Improved, Real-Time Field Screening During Excavation for Radionuclides with Emphasis on the Following: Uranium, Plutonium, 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, and 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
RL-SS17	Long-Life Waste Isolation Surface Barrier
RL-SS18	Improved Handling and Segregation of TRU Waste (Debris)
RL-SS19	Detection, Handling and Treatment of Pyprophoric Materials in Burial Grounds
RL-SS20	Improved Methods for Debris Handling and Segregation

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

COST-EFFECTIVE, IN SITU REMEDIATION OF CARBON TETRACHLORIDE IN THE VADOSE ZONE AND GROUNDWATER

Identification No.: RL-SS01
Date: September, 1998

OPS Office/Site: DOE-RL/Hanford
Operable Unit(s): 200-ZP-1, 200-ZP-2
Waste Stream: Groundwater (200-ZP-1) (Disposition Map Designation: MLLW GW 100/200 Area), Soils (200-ZP-2) (Disposition Map Designation: LLW Soils 200 Area)
Waste Management Unit: N/A
Facility: N/A

Site Priority Ranking: Medium

Need Title: Cost-effective, In Situ Remediation of Carbon Tetrachloride in the Vadose Zone and Groundwater

Need Description: In situ remediation of carbon tetrachloride (CCl_4) into simpler elements or compounds to reduce the risk to human health and the environment. In situ processes need to be more efficient than current baseline operations.

Functional Performance Requirements: Concentration of carbon tetrachloride in groundwater is not to exceed 5 ppb at the 200 Area Plateau boundary. The functional performance requirements for the vadose zone are general and include maximizing mass removal and protection of groundwater.

Schedule Requirements: Pump and treat operations are ongoing for groundwater. The interim record of decision (ROD) will be reviewed in FY 2000 for the potential identification of a final remedy. 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.

Technology Insertion Point: Potential alternative technology for groundwater remediation must be identified and evaluated prior to reevaluation of the interim ROD in FY 2002 for potential subsequent deployment.

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 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. 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.bhi-erc.com/technology/tech.htm.

An interim ROD has been issued requiring an interim remedial measure (IRM) to start treating 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.

Operable unit 200-ZP-2 represents the source sites and underlying unsaturated soils in the northern half of the 200 West Area. Co-contaminants include Pu, Am, and other radionuclides. The 200-ZP-2 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 CCl_4, 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-ZP-2 area because removal efficiencies are declining while as much as 50% of the estimated initial inventory remains 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 CCl_4 indicate that free phase is possible. Therefore, DNAPL detection and potentially treatment in both the vadose zone and aquifer are also concerns.

PBS No.	***WBS No.:***	***TIP No.***
RL-ER08	WBS: 1.4.10.1.1.08.06.17.01 (Groundwater) 1.4.10.1.1.08.06.17.01 (Soils)	Candidate

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 is expected to migrate and exceed the Safe Drinking Water Act standard of 5 ppb at compliance wells at 200 Area Plateau boundary.

Environmental Safety and Health: Possible exposure to carbon tetrachloride.

Cost Savings Potential (Mortgage Reduction): Eliminate O&M costs of the existing groundwater pump and treat, and soil vapor extraction systems.

Cultural/Stakeholder Concerns: Stakeholders may be sensitive to introduction of chemicals into the subsurface to accomplish in situ remediation.

Other: None.

Consequences of Not Filling Need: Continued operation of groundwater pump and treat, and soil vapor extraction systems to remediate carbon tetrachloride contamination.

Privatization Potential: Potential may exist to employ in situ technology at other carbon tetrachloride-contaminated sites nationwide.

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: FY 1999, $1.0M; FY 2000, $1.0M; FY 2001, $1.0M. Costs for complete remediation have not been calculated. However, initial modeling indicates that complete remediation will require 33 to 56 years and significant expansion of the IRM. Rough estimates for building and operating the expanded pump and treat system for this length of time range from $50M to $70M.

Soil vapor extraction budget forecast is: FY 1999, $0.5M; FY 1999, $0.5M; FY 2001, $0.5M.

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 33 to 56 years.

End-User: Richland Environmental Restoration Project

Site Technical Point(s)-of-Contact: John April, BHI, (509) 372-9126; Jared D. Isaacs, BHI, (509) 372-9162; George C. Henckel III, BHI, (509) 372-9381; Larry M. Bagaasen, PNNL, (509) 375-6452

DOE End-User/Representative Point(s)-of-Contact: Fred R. Serier DOE, (509) 376-8517; Arlene C. Tortoso DOE, (509) 373-9631; K. M. (Mike) Thompson DOE, (509) 373-0750; Richard A. Holten DOE, (509) 376-7277

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

IMPROVED, REAL-TIME, IN-LINE DETECTION OF CARBON TETRACHLORIDE IN PROCESS WATER

Identification No.: RL-SS02
Date: September, 1998

OPS Office/Site: DOE-RL/Hanford
Operable Unit(s): 200-ZP-1
Waste Stream: Groundwater (Disposition Map Designation: MLLW GW 100/200 Area)
Waste Management Unit: N/A
Facility: N/A

Site Priority Ranking: Low

Need Title: Improved, Real-Time, In-line Detection of Carbon Tetrachloride in Process Water

Need Description: Monitoring carbon tetrachloride 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 substantially reduce operating costs.

Functional Performance Requirements: The new technology must measure contaminant concentrations as process water passes through pipes at the influent and/or effluent ends of treatment processes. Results must be real-time and output must be transmittable through standard computer connections. In-line carbon tetrachloride detection must be sensitive to less than 5 ppb, which is the regulatory standard.

Schedule Requirements: Pump and treat operations are ongoing. The interim record of decision (ROD) will be reviewed in FY 2002 for the potential identification of a final remedy for groundwater.

Problem Description: There are two operable units (200-ZP-1 and 200-ZP-2) in the 200 Area at the Z Plant and T Plant Aggregate Areas. Operable unit 200-ZP-1 underlies the Z Plant and T Plant Aggregate Areas located in the northern half of the 200 West Area. Source operable unit 200-ZP-2 addresses contaminated soils. Contaminants of concern in the operable units are carbon tetrachloride, chloroform, and trichlorethylene. A groundwater pump and treat system is in operation at 200-ZP-1 and a vapor extraction system is in operation at 200-ZP-2.

At present, concentrations of carbon tetrachloride 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 air stripping/carbon adsorption treatment systems.

PBS No.	***WBS No.:***	***TIP No.***
RL-ER08	1.4.10.1.1.08.06.17.01	N/A

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.

Regulatory: There is no regulatory requirement for this technology need.

Environmental Safety and Health: There are no environmental safety and health issues of concern with this technology need.

Cost Savings Potential (Mortgage Reduction): Improved analytical techniques may reduce baseline laboratory costs and would support fully automated treatment systems.

Cultural/Stakeholder Concerns: None.

Other: None.

Consequences of Not Filling Need: Continued use of quick-turnaround laboratory analytical methods. At present, these methods produce satisfactory analytical results but are time consuming and expensive and do not support design changes to allow for fully automated operation of the pump-and-treat systems.

Privatization Potential: Potentially high.

Current Baseline Technology: Laboratory analysis.

Cost: Pump and treat sampling costs for carbon tetrachloride are less than $50K per year.

Waste: None.

How Long It Will Take: Operations scheduled beyond FY 2000.

End-User: Richland Environmental Restoration Project

Site Technical Point(s)-of-Contact: John April, BHI, (509) 372-9126; George C. Henckel III, BHI, (509) 372-9381; Jared D. Isaacs, BHI, (509) 372-9162; Larry M. Bagaasen, PNNL, (509) 375-6452

DOE End-User/Representative Point(s)-of-Contact: Fred R. Serier DOE, (509) 376-8517; Arlene C. Tortoso DOE, (509) 373-9631; K. M. (Mike) Thompson, DOE, (509) 373-0750; Richard A. Holten DOE, (509) 376-7277

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

IMPROVED, REAL-TIME, IN-SITU DETECTION OF CARBON TETRACHLORIDE IN GROUNDWATER

Identification No.: RL-SS03
Date: September, 1998

OPS Office/Site: DOE-RL/Hanford
Operable Unit(s): 200-ZP-1
Waste Stream: Groundwater (Disposition Map Designation: MLLW GW 100/200 Area)
Waste Management Unit: N/A
Facility: N/A

Site Priority Ranking: Medium

Need Title: Improved, Real-Time, In-Situ Detection of Carbon Tetrachloride in Groundwater

Need Description: Monitoring carbon tetrachloride by discrete sampling is costly and time consuming. In situ monitoring would reduce the labor-intensive process of sampling, handling, and shipping samples for analysis. Purge water production and associated disposal or treatment requirements would be minimized or eliminated. In situ monitoring would also aid in 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 would provide real-time monitoring of contaminant concentrations. In combinations of horizontal and vertical profiling, this will provide highly accurate isopleths of contaminant concentrations to aid in fate and transport modeling and construction of remediation systems.

Functional Performance Requirements: The new technology must measure contaminant concentrations in situ in extraction, injection or monitoring wells. Results must be near real-time and output must be transmittable by hardwire or telemetry to standard computer connections for data reduction and processing. In situ carbon tetrachloride detection must be sensitive to less than 5 ppb, which is the regulatory standard. In situ detectors must be of robust design and capable of operating for long periods without maintenance in the specified environments.

Schedule Requirements: Pump and treat systems are presently in operation. The interim record of decision (ROD) will be reviewed in FY 2002 for the potential identification of a final remedy. Initial modeling indicates that pump and treat will need to be expanded and operated for 33 to 56 years to meet stated objectives. Long-term monitoring will be required to support either pump and treat continuation 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-ZP-2) in the 200 Area at the Z Plant and T Plant Aggregate Areas. Operable unit 200-ZP-1 underlies the Z Plant and T Plant Aggregate Areas located in the northern half of the 200 West Area. The operable unit addresses contamination in the groundwater and saturated zone soils. Source operable unit 200-ZP-2 addresses contaminated unsaturated soils associated with Z Plant operations. Contaminants of concern in the operable units are carbon tetrachloride, chloroform, and trichlorethylene. 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-ZP-2.

At present, concentrations of carbon tetrachloride are measured by discrete sampling from wells 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 are considered to be significant drawbacks. In situ monitoring could lower the analytical chemistry cost of remediation projects and fate and transport studies. The possibility also exists to incorporate in situ monitoring with existing pump and treat remediation systems. This would support design changes to allow fully automated operation of the pump and treat systems.

PBS	***WBS No.:***	***TIP No.***
RL-ER08	200-ZP-1 = 1.4.10.1.1.08.06.17.01 200-ZP-2 = 1.4.10.1.1.08.06.17.02	N/A

Justification for Need:

Technical: In situ measurement in extraction, injection or monitoring wells 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 and Health: There are no environmental safety and health issues of concern with this technology need.

Cost Savings Potential (Mortgage Reduction): Cost benefit analysis of increased capital costs versus lower operating costs should be performed.

Cultural/Stakeholder Concerns: In situ monitoring could reduce the "traffic" around monitoring locations situated in or near culturally and environmentally sensitive areas.

Other: None.

Consequences of Not Filling Need: Continued use of laboratory analytical methods. At present, these methods are producing satisfactory analytical results but are time consuming and expensive.

Privatization Potential: Potentially high.

Current Baseline Technology: Laboratory 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 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: Beyond FY 2000.

End-User: Richland Environmental Restoration Project

Site Technical Point(s)-of-Contact: John April, BHI, (509) 372-9126; Jared D. Isaacs, BHI, (509) 372-9162; George C. Henckel III, BHI, (509) 372-9381; Larry M. Bagaasen, PNNL, (509) 375-6452

DOE End-User/Representative Point(s)-of-Contact: Fred R. Serier DOE, (509) 376-8517; Arlene C. Tortoso DOE, (509) 373-9631; K. M. (Mike) Thompson, DOE, (509) 373-0750; Richard A. Holten DOE, (509) 376-7277

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

COST-EFFECTIVE, IN SITU REMEDIATION OF HEXAVALENT CHROMIUM IN GROUNDWATER

Identification No.: RL-SS04
Date: September, 1998

OPS Office/Site: DOE-RL/Hanford
Operable Unit(s): 100-HR-3, 100-KR-4
Waste Stream: Groundwater (Disposition Map Designation: MLLW GW 100/200 Area)
Waste Management Unit: N/A
Facility: N/A

Site Priority Ranking: High

Need Title: Cost-Effective, In Situ Remediation of Hexavalent Chromium in Groundwater

Need Description: Cost-effective, environmentally safe and compliant in situ remediation of Hexavalent chromium to reduce the risk to juvenile salmon in the Columbia River

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.

Schedule Requirements: Pump and treat operations are ongoing. The interim record of decision (ROD) will be reviewed in FY 2002 for the potential identification of a final remedy.

Technology Insertion Point: Potential alternative technology for groundwater remediation must be identified and evaluated prior to reevaluation of the interim ROD in FY 2002 for potential subsequent deployment.

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 feet x 4,000 feet and the south plume is about 2,000 feet x 2,000 feet. 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.bhi-erc.com/technology/tech.htm.

Hexavalent chromium has been identified as a contaminant of concern for juvenile salmon 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 juvenile salmon in the river substrate from exposure to hexavalent chromium.

A technology that is currently under development and targeted at this need is the In Situ Redox Manipulation barrier technology that injects dithionite into the aquifer to modify the oxidation/reduction potential of the aquifer and immobilize the chromium. The ongoing treatability study for this barrier technology has recently undergone a peer review that recommends further testing. This barrier technology may be deployed to treat a portion of the plumes.

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.*)

PBS No.	***WBS No.***	***TIP No.***
RL-ER08	100-HR-3 = 1.4.10.1.1.08.02.08.03 100-KR-4 = 1.4.10.1.1.08.02.06.04	N/A

Justification for Need:

Technical: Testing has shown that hexavalent chromium is migrating to the Columbia River in sufficient concentration to pose a risk to juvenile salmon; 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 and Health: Possible worker safety issues regarding handling of reducing chemicals, etc., although proper safety protocols should mitigate these concerns.

Cost Savings Potential (Mortgage Reduction): Eliminate O&M costs of the pump and treat system.

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.

Consequences of Not Filling Need: Continued operation of groundwater pump and treat systems to remediate hexavalent chromium contamination.

Privatization Potential: Potentially high.

Current Baseline Technology: Extraction of groundwater and ex situ ion exchange treatment.

Cost: Combined Budget forecast for pump and treat IRMs at 100-HR-3 and 100-KR-4 is: FY 1999, $4.0M; FY 2000, $4.0M; FY 2001, $4.0M. Complete cost estimates for out years have not been completed. However, using O&M costs for pump & treat of about $4.0M per year for the remaining 4 years of the IRM with a discount rate of 5%, the remaining cost of the IRM is on the order of $15 M. Although the IRM pump and treat systems are removing significant quantities of Cr, the planned 5 year IRM time periods will probably need to be extended to reduce the inventory to the point that these would represent permanent solutions.

The ISRM is also scheduled for deployment to treat a portion of the 100-HR-3 plume. The budget forecast for the next two years is FY 1999, $0.6M EM-40 and $0.3M EM-50; FY 2000, $0.9M EM-40 and $1.2 EM-50

Waste: Spent ion exchange resin disposed on site.

How Long It Will Take: Pump and treat operations are scheduled beyond FY 2000.

End-User: Richland Environmental Restoration Project

Site Technical Point(s)-of-Contact: John April, BHI, (509) 372-9126; Jared D. Isaacs, BHI, (509) 372-9162; George C. Henckel III, BHI, (509) 372-9381; Larry M. Bagaasen, PNNL, (509) 375-6452

DOE End-User/Representative Point(s)-of-Contact: Fred R. Serier DOE, (509) 376-8517; Arlene C. Tortoso DOE, (509) 373-9631; K. M. (Mike) Thompson, DOE, (509) 373-0750; Richard A. Holten DOE, (509) 376-7277

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

IMPROVED, EX SITU TREATMENT OF CHROMIUM IN GROUNDWATER

Identification No.: RL-SS23
Date: September, 1998

OPS Office/Site: DOE-RL/Hanford
Operable Unit(s): 100-HR-3, 100-KR-4
Waste Stream: Groundwater (Disposition Map Designation: MLLW GW 100/200 Area)
Waste Management Unit: N/A
Facility: N/A

Site Priority Ranking: High

Need Title: Improved, Ex Situ Treatment of Chromium in Groundwater

Need Description: Ex situ treatment methods for chromium contaminated groundwater that are more cost effective than ion exchange.

Functional Performance Requirements: Must treat water to obtain an outlet concentration of less than 50 micrograms total chromium per liter.

Schedule Requirements: Pump and treat operations are ongoing and will continue until at least FY 2002 when the interim record of decision (ROD) is reviewed. Improved treatment technologies that can demonstrate costs savings for implementations through FY 2002 are desirable. Deployments of technologies requiring pay back periods that extend beyond FY 2002 may be contingent on decisions to continue pump and treat operations past FY 2002.

Technology Insertion Point: There are two potential technology insertion points. Mature technologies could be deployed in the near term if operations through FY 2002 justify the capital expenditure. Other, less mature or more capital intensive technologies must be identified and evaluated prior to reevaluation of the interim ROD in FY 2002 in order to be considered for deployment.

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 feet x 4,000 feet and the south plume is about 2,000 feet x 2,000 feet. 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.

Hexavalent chromium has been identified as a contaminant of concern for juvenile salmon 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 juvenile salmon in the river substrate from exposure to hexavalent chromium.

Water extracted in these pump-and-treat systems is currently passed through ion exchange resins (Dowex-21). Ion exchange is effective and treats the groundwater to required levels. If the resin contains only Cr, it is regenerated and reused. The regeneration costs for resin from both systems that is clean enough for recycle is about $150K per year. However, the resin is not highly specific for Cr and, in some portions of the plume, other minor contaminants such as technetium are removed and concentrated to the point that the resin becomes a mixed waste and must be disposed. Resin purchase and disposal costs for Tc contaminated portions of the plume are $175K per year.

PBS No.	***WBS No.***	***TIP No.***
RL-ER08	100-HR-3 = 1.4.10.1.1.08.02.08.03 100-KR-4 = 1.4.10.1.1.08.02.06.04	N/A

Justification for Need:

Technical: Pump and treat operations have been effective in reducing the amount of contamination entering the Columbia River. However, this strategy may take several years to reduce groundwater concentrations to required levels. Therefore, more cost effective ex situ groundwater treatment is one way to reduce the total cost.

Regulatory: Federal Clean Water Act Ambient Water Quality Criteria of 11 μg/L; 40 CFR 141 drinking water standard of 100 ppb.

Environmental Safety and Health: None

Cost Savings Potential (Mortgage Reduction): Reduce O&M costs of the baseline pump and treat system.

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.

Other: None.

Consequences of Not Filling Need: Higher life cycle costs for operation of baseline groundwater treatment system.

Privatization Potential: Potentially high.

Current Baseline Technology: Extraction of groundwater and ex situ ion exchange treatment.

Cost: Combined Budget forecast for pump and treat IRMs at 100-HR-3 and 100-KR-4 is: FY 1999, $4.0M; FY 2000, $4.0M; FY 2001, $4.0M. Rough estimates of the O&M costs for just the ex situ treatment portions of the systems are on the order of $3.5M per year. Using O&M costs for the ex situ portion of the pump & treat of about $3.5M per year for the remaining 4 years of the IRM with a discount rate of 5%, the remaining cost of the ex situ portion of the IRM is on the order of $13M. Although the IRM pump and treat systems are removing significant quantities of Cr, the planned 5 year IRM time periods will probably need to be extended to reduce the inventory to the point that these would represent permanent solutions.

Waste: Spent ion exchange resin disposed on site.

How Long It Will Take: Pump and treat operations are scheduled beyond FY 2000.

End-User: Richland Environmental Restoration Project

Site Technical Point(s)-of-Contact: John April, BHI, (509) 372-9126; Jared D. Isaacs, BHI, (509) 372-9162; George C. Henckel III, BHI, (509) 372-9381; Larry M. Bagaasen, PNNL, (509) 375-6452

DOE End-User/Representative Point(s)-of-Contact: Fred R. Serier DOE, (509) 376-8517; Arlene C. Tortoso DOE, (509) 373-9631; K. M. (Mike) Thompson, DOE, (509) 373-0750; Richard A. Holten DOE, (509) 376-7277

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

IMPROVED, REAL-TIME, IN-LINE DETECTION OF HEXAVALENT CHROMIUM IN PROCESS WATER

Identification No.: RL-SS05
Date: September, 1998

OPS Office/Site: DOE-RL/Hanford
Operable Unit(s): 100-HR-3, 100-KR-4
Waste Stream: Groundwater (Disposition Map Designation: MLLW GW 100/200 Area)
Waste Management Unit: N/A
Facility: N/A

Site Priority Ranking: Low

Need Title: Improved, Real-Time, In-line Detection of Hexavalent Chromium in Process Water

Need Description: Monitoring hexavalent chromium 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 also reduce operating costs.

Functional Performance Requirements: The new technology must measure contaminant concentrations as process water passes through pipes at the influent and/or effluent ends of treatment processes. Results must be real-time and output must be transmittable through standard computer connections. In-line chromium detection must be sensitive to less than 50 micrograms total chromium per liter.

Schedule Requirements: Pump and treat operations are ongoing. The interim record of decision (ROD) will be reviewed in FY 2002 for the potential identification of a final remedy for groundwater.

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. To mitigate this contamination, interim remedial measures were initiated at operable units 100 KR-4, and 100-HR-3. Pump-and-treat operations are costly, hence the desire to investigate the potential for advanced technologies to improve efficiency. At present, chromium concentrations at 100 KR-4 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. A new in-line monitoring system was added to the 100-HR-3 pump and treat system this year. This system is expected to reduce operations costs for Cr monitoring. Although this is believed to be the best system currently available, the system does not supply fully automated analysis and was expensive to purchase and install. This system may be added to the 100 KR-4 if it proves to be reliable at 100-HR-3 but systems that offered fully automated analysis or cost less than $25K to purchase and install would be considered.

PBS No.	***WBS No.***	***TIP No.***
RL-ER08	100-KR-4 = 1.4.10.1.1.08.02.06.04 100-HR-3 = 1.4.10.1.1.08.02.08.03	N/A

Justification for Need:

Technical: In-line sampling with real-time monitoring of contaminant concentrations may support the construction of fully automated treatment systems that could reduce 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 and Health: There are no environmental safety and health issues of concern with this technology need.

Cost Savings Potential (Mortgage Reduction): Improved analytical techniques may reduce baseline laboratory costs and could support fully automated treatment systems.

Cultural/Stakeholder Concerns: There are serious stakeholder concerns that 50 micrograms per liter is not protective of the ambient water quality standard.

Other: None.

Consequences of Not Filling Need: Continued use of slow-turnaround laboratory analytical methods and/or existing in-line equipment.

Privatization Potential: Potentially high.

Current Baseline Technology: Laboratory analysis. In-line equipment has been installed in one of the pump and treat systems but has not been operated long enough to determine the baseline costs.

Cost: Pump and treat sampling costs for chromium are less than $50K per year.

Waste: None.

How Long It Will Take: Operations scheduled beyond FY 2000.

End-User: Richland Environmental Restoration Project

Site Technical Point(s)-of-Contact: John April, BHI, (509) 372-9126; Jared D. Isaacs, BHI, (509) 372-9162; George C. Henckel III, BHI, (509) 372-9381; Larry M. Bagaasen, PNNL, (509) 375-6452

DOE End-User/Representative Point(s)-of-Contact: Fred R. Serier DOE, (509) 376-8517; Arlene C. Tortoso DOE, (509) 373-9631; K. M. (Mike) Thompson, DOE, (509) 373-0750; Richard A. Holten DOE, (509) 376-7277

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

IMPROVED, REAL-TIME, IN-SITU DETECTION OF HEXAVALENT CHROMIUM IN GROUNDWATER

Identification No.: RL-SS06
Date: September, 1998

OPS Office/Site: DOE-RL/Hanford
Operable Unit(s): 100-HR-3, 100-KR-4
Waste Stream: Groundwater (Disposition Map Designation: MLLW GW 100/200 Area)
Waste Management Unit: N/A
Facility: N/A

Site Priority Ranking: Medium

Need Title: Improved, Real-Time, In-Situ Detection of Hexavalent Chromium in Groundwater

Need Description: Monitoring hexavalent chromium by discrete sampling is costly and time consuming. In situ monitoring would reduce the labor-intensive process of sampling, handling, and shipping samples for analysis. Purge water production and associated disposal or treatment requirements would be minimized or eliminated. In situ monitoring would also aid in 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 would provide real-time monitoring of contaminant concentrations. In combinations of horizontal and vertical profiling, this will provide highly accurate isopleths of contaminant concentrations to aid in fate and transport modeling and construction of remediation systems.

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 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.

Schedule Requirements: Pump and treat operations are ongoing. The interim record of decision (ROD) will be reviewed in FY 2002 for the potential identification of a final remedy. 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 are considered to be significant drawbacks. In situ monitoring would lower the analytical chemistry cost of remediation projects and fate and transport studies. The possibility also exists to incorporate in situ monitoring with existing pump-and-treat remediation systems. This objective would support design changes to allow fully automated operation of the pump-and-treat systems.

PBS No.	***WBS No.***	***TIP No.***
RL-ER08	100-KR-4 = 1.4.10.1.1.08.02.06.04	N/A
	100-HR-3 = 1.4.10.1.1.08.02.08.03	

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 and Health: There are no environmental safety and health issues of concern with this technology need.

Cost Savings Potential (Mortgage Reduction): Cost benefit analysis of increased capital costs versus lower operating costs should be performed.

Cultural/Stakeholder Concerns: In situ monitoring could reduce the "traffic" around monitoring locations situated in or near culturally and environmentally sensitive areas.

Other: None.

Consequences of Not Filling Need: Continued use of laboratory analytical methods. At present, these methods are producing satisfactory analytical results but are time consuming and expensive.

Privatization Potential: Potentially high.

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 CT 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(s)-of-Contact: John April, BHI, (509) 372-9126; Jared D. Isaacs, BHI, (509) 372-9162; George C. Henckel III, BHI, (509) 372-9381; Larry M. Bagaasen, PNNL, (509) 375-6452

DOE End-User/Representative Point(s)-of-Contact: Fred R. Serier DOE, (509) 376-8517; Arlene C. Tortoso DOE, (509) 373-9631; K. M. (Mike) Thompson, DOE, (509) 373-0750; Richard A. Holten DOE, (509) 376-7277

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

COST-EFFECTIVE, IN SITU REMEDIATION OF STRONTIUM-90 IN GROUNDWATER

Identification No.: RL-SS07
Date: September, 1998

OPS Office/Site: DOE-RL/Hanford
Operable Unit(s): 100-NR-2
Waste Stream: Groundwater (Disposition Map Designation: MLLW GW 100/200 Area)
Waste Management Unit: N/A
Facility: N/A

Site Priority Ranking: High

Need Title: Cost-Effective, In Situ Remediation of Strontium-90 in Groundwater

Need Description: Remediation of soluble strontium-90 in the groundwater to reduce risk to human health and the environment.

Functional Performance Requirements: Reduce strontium-90 activity to the Safe Drinking Water Act criteria of 8 pCi/L.

Schedule Requirements: Pump and treat operations are ongoing as an expedited action. An interim record of decision (ROD) is expected to be issued in late 1998 selecting an interim remedy. The interim ROD is expected to include a requirement to continue evaluation of other technologies. The interim ROD will be reviewed in FY 2007 for the potential identification of a final remedy.

Technology Insertion Point: Potential alternative technology for groundwater remediation must be identified and evaluated prior to reevaluation of the interim ROD in FY 2007 for potential subsequent deployment.

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. 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 FY 1999. Interim results of this process will be posted on the internet but the exact location has not been established.

PBS No.	***WBS No.***	***TIP No.***
RL-ER08	1.4.10.1.1.08.03.09.02	Candidate

Justification for Need:

Technical: Remediation of strontium-90 in the groundwater is presently in progress at 100-N Area with an ion exchange process accomplished via pump and treat. An in situ remediation process will negate the need for ex situ extraction and treatment.

Regulatory: Strontium-90 in groundwater exceeds the Safe Drinking Water Act standard of 8 pCi/L.

Environmental Safety and Health: Possible exposure to strontium-90

Cost Savings Potential (Mortgage Reduction): Reduce operating costs of the existing pump and treat system.

Cultural/Stakeholder Concerns: Stakeholders may not accept immobilization or precipitation methods that do not actually remove strontium-90 from the aquifer.

Other: None.

Consequences of Not Filling Need: Continued operation of groundwater pump and treat to prevent strontium-90 movement to the Columbia River.

Privatization Potential: Potentially high.

Current Baseline Technology: Extraction of groundwater and ex situ ion exchange treatment. Clean process water is reinjected into the aquifer.

Cost: Budget forecast for pump and treat at 100-NR-2 is: FY 1999, $0.6M; FY 2000, $0.6M; FY 2001, $0.6M. Cost estimates for out years have not been completed. Assuming the pump and treat system must contain the plume for 280 years and the O&M costs remain constant, the total cost for remediation (discounted at a rate of 5%) is in excess of $12M.

Waste: Spent ion exchange resin 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(s)-of-Contact: John April, BHI, (509) 372-9126; Jared D. Isaacs, BHI, (509) 372-9162; George C. Henckel III, BHI, (509) 372-9381; Larry M. Bagaasen, PNNL, (509) 375-6452

DOE End-User/Representative Point(s)-of-Contact: Fred R. Serier DOE, (509) 376-8517; David E. Olson, DOE, (509) 376-7142; K. M. (Mike) Thompson, DOE, (509) 373-0750; Richard A. Holten DOE, (509) 376-7277

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

IMPROVED, REAL-TIME, IN-LINE DETECTION OF STRONTIUM-90 IN PROCESS WATER

Identification No.: RL-SS08
Date: September, 1998

OPS Office/Site: DOE-RL/Hanford
Operable Unit(s): 100-NR-2
Waste Stream: Groundwater (Disposition Map Designation: MLLW GW 100/200 Area)
Waste Management Unit: N/A
Facility: N/A

Site Priority Ranking: Low

Need Title: Improved, Real-Time, In-line Detection of Strontium-90 in Process Water

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.

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.

Schedule Requirements: Pump and treat operations are ongoing as an expedited action. An interim record of decision (ROD) is expected to be issued in late 1998 selecting an interim remedy. The interim ROD is expected to include a requirement to continue evaluation of other technologies. The interim record ROD will be reviewed in FY 2007 for the potential identification of a final remedy.

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.

PBS No.	***WBS No.***	***TIP No.***
RL-ER08	1.4.10.1.1.08.02.09.02	N/A

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 and Health: There are no environmental safety and health issues of concern with this technology need.

Cost Savings Potential (Mortgage Reduction): Improved analytical techniques may reduce baseline laboratory costs and would support fully automated treatment systems.

Cultural/Stakeholder Concerns: There are serious stakeholder concerns that detection limits above the regulatory standard may not be protective of the ambient water quality standard.

Other: None.

Consequences of Not Filling Need: Continued use of quick-turnaround laboratory analytical methods. At present, these methods produce satisfactory analytical results but are time consuming and expensive and do not support design changes to allow for fully automated operation of the pump-and-treat systems.

Privatization Potential: Potentially high.

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 FY 2000.

End-User: Richland Environmental Restoration Project

Site Technical Point(s)-of-Contact: John April, BHI, (509) 372-9126; Jared D. Isaacs, BHI, (509) 372-9162; George C. Henckel III, BHI, (509) 372-9381; Larry M. Bagaasen, PNNL, (509) 375-6452

DOE End-User/Representative Point(s)-of-Contact: Fred R. Serier DOE, (509) 376-8517; David E. Olson, DOE, (509) 376-7142; K. M. (Mike) Thompson, DOE, (509) 373-0750; Richard A. Holten DOE, (509) 376-7277

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

IMPROVED, REAL-TIME, IN-SITU DETECTION OF STRONTIUM-90 IN GROUNDWATER

Identification No.: RL-SS09
Date: September, 1998

OPS Office/Site: DOE-RL/Hanford
Operable Unit(s): 100-NR-2
Waste Stream: Groundwater (Disposition Map Designation: MLLW GW 100/200 Area)
Waste Management Unit: N/A
Facility: N/A

Site Priority Ranking: Medium

Need Title: Improved, Real-Time, In-Situ Detection of Strontium-90 in Groundwater

Need Description: Monitoring strontium-90 by discrete sampling is costly and time consuming. In situ monitoring would reduce the labor-intensive process of sampling, handling, and shipping samples for analysis. Purge water production and associated disposal or treatment requirements would be minimized or eliminated. In situ monitoring would also aid in 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 would provide real-time monitoring of contaminant concentrations. In combinations of horizontal and vertical profiling, this will provide highly accurate isopleths of contaminant concentrations to aid in fate and transport modeling and construction of remediation systems.

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 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.

Schedule Requirements: Pump and treat operations are ongoing as an expedited action. An interim record of decision (ROD) is expected to be issued in late 1998 selecting an interim remedy. The interim ROD is expected to include a requirement to continue evaluation of other technologies. The interim ROD will be reviewed in FY 2007 for the potential identification of a final remedy. 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 are considered to be significant drawbacks. In situ monitoring would lower the analytical chemistry cost of remediation projects and fate and transport studies. The possibility also exists to incorporate in situ monitoring with existing pump-and-treat remediation systems. This objective would support design changes to allow fully automated operation of the pump-and-treat systems.

PBS No.	***WBS No.***	***TIP No.***
RL-ER08	1.4.10.1.1.08.02.09.02	N/A

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 and Health: There are no environmental safety and health issues of concern with this technology need.

Cost Savings Potential (Mortgage Reduction): Cost benefit analysis of increased capital costs versus lower operating costs should be performed.

Cultural/Stakeholder Concerns: In situ monitoring could reduce the "traffic" around monitoring locations situated in or near culturally and environmentally sensitive areas.

Other: None.

Consequences of Not Filling Need: Continued use of laboratory analytical methods. At present, these methods are producing satisfactory analytical results but are time consuming and expensive.

Privatization Potential: Potentially high.

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 CT 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(s)-of-Contact: John April, BHI, (509) 372-9126; Jared D. Isaacs, BHI, (509) 372-9162; George C. Henckel III, BHI, (509) 372-9381; Larry M. Bagaasen, PNNL, (509) 375-6452

DOE End-User/Representative Point(s)-of-Contact: Fred R. Serier DOE, (509) 376-8517; David E. Olson, DOE, (509) 376-7142; K. M. (Mike) Thompson, DOE, (509) 373-0750; Richard A. Holten DOE, (509) 376-7277

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

IMPROVED TECHNOLOGIES FOR DETECTION/DELINEATION OF BURIAL GROUND CONTENTS AND SUBSURFACE GEOLOGICAL BOUNDARIES

Identification No.: RL-SS10
Date: September, 1998

OPS Office/Site: DOE-RL/Hanford
Operable Unit: All burial ground sites in the 100, 200 and 300 Areas and liquid waste disposal sites in the 200 Areas
Waste Stream: Soil (Disposition Map Designations: MLLW Debris, LLW Debris, HAZ Debris, TRU Debris, LLW Soils 200 Area)
Waste Management Unit: N/A
Facility: N/A

Site Priority Ranking: High

Need Title: Improved Technologies for Detection/Delineation of Burial Ground Contents and Subsurface Geological Boundaries

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. Documentation of materials that were placed in the burial grounds and exact location of some sites is incomplete. These non-intrusive or minimally intrusive methods are also needed to identify geological 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. 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.

Functional Performance Requirements: Technology must be a remote-sensing design capable of non-intrusive or minimally-intrusive methods for physical and radiological identification of burial ground contents. Also, sensing of different soil characteristics 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. Also, high resolution, real-time imaging systems would be useful (even if the penetration depth was only 4-5 feet) to support lift-by-lift excavation 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. Radiological sensing should be directed toward segregation of transuranic debris from non-transuranic debris and identification of other radionuclides if possible. 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.

Schedule Requirements: Variable. 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 FY 1998. 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. Strategies for characterization and remediation of the 200 Area burial ground sites are being revised but are scheduled to begin in 2003 and will extend several years past 2006. Characterization and remediation of the 200 Area liquid waste sites are scheduled to start FY 1999 and extend several years past 2006.

Technology Insertion Point: Consideration of new technology is ongoing but a few key insertion points are available for burial grounds in different areas. The remedial design activities for 45 burial grounds in the 100 area are currently scheduled to begin in FY 2001. The remedial alternative assessment activities for initial burial grounds in the 200 area are currently scheduled to begin in FY 2001. The remedial design activities for burial grounds in the 300-FF-2 Operable Unit are currently scheduled to begin in FY 2006.

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. 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. These tools are also 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.

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 reflectively 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 matrix interference of the overlying soils.

PBS No.	*WBS No.*	*TIP No.*
RL-ER01	1.4.10.1.1.01.01 1.4.10.1.1.02.05 1.4.10.1.1.03.07	Candidate

Justification for Need:

Technical: Enhanced detection and delineation methods could provide accurate information for characterization and remedial action planning and negate the requirement for invasive sampling.

Regulatory: There is no regulatory requirement for this technology.

Environmental Safety and Health: Successful non-invasive, or minimally-invasive, 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 will also reduce the chances of excavation workers encountering unexpected items that require work stoppages and upgrades in personnel protective equipment.

Cost Savings Potential (Mortgage Reduction): Unexpected wastes 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 45-100 buried wastes sites that may eventually require excavation would result in significant cost savings.

Cultural/Stakeholder Concerns: There are serious concerns that inadequate waste site characterization will be used to support decisions to leave waste in place.

Other: None.

Consequences of Not Filling Need: Continued use of ground penetrating radar and other remote detection methods, along with invasive sampling as required.

Privatization Potential: Possible high potential in Department of Energy, Department of Defense, and private applications.

Current Baseline Technology: Ground penetrating radar, electric magnetic induction, trenching, and visual examination.

Cost: Budget forecast for 300 Area burial ground activities is: FY 1999, $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 FY 1999 and are likely to extend well beyond the ten year time period.

End-User: Richland Environmental Restoration Project

Site Technical Point(s)-of-Contact: John April, BHI, (509) 372-9126; Greg B. Mitchem (509) 372-9632; Ashur R. Michael, BHI, (509) 372-9074; V. R. (Vern) Dronen, BHI, (509) 372-9075; Larry M. Bagaasen, PNNL, (509) 375-6452

DOE End-User/Representative Point(s)-of-Contact: Fred R. Serier DOE, (509) 376-8517; Bryan L. Foley, DOE, (509) 376-7087; Owen Robertson, DOE, (509) 373-6295; Richard A. Holten DOE, (509) 376-7277

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

COST-EFFECTIVE, IN SITU REMEDIATION OF HEXAVALENT CHROMIUM IN THE VADOSE ZONE

Identification No.: RL-SS11
Date: September, 1998

OPS Office/Site: DOE-RL/Hanford
Operable Unit: Selected soil sites in 100 Area
Waste Stream: Soil (Disposition Map Designations: LLW Soils 100/300 Area, MLLW Soils)
Waste Management Unit: N/A
Facility: N/A

Site Priority Ranking: High

Need Title: Cost-Effective, In Situ Remediation of Hexavalent Chromium in the Vadose Zone

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.

Functional Performance Requirements: In soils deeper than 15 ft, reduce concentrations or mobilities 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) is 2.2 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.

Schedule Requirements: Soil Remediation is ongoing. Goals established in the Hanford Ten Year Challenge would have all soil sites and burial grounds in the 100 Area completed by 2006.

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. The 100 Area sites are located close to the Columbia River and therefore are also scheduled for completion prior to 2006. These areas will be cleaned up to meet residential land-use requirements. Soils with contamination in the top 15 feet that exceed established cleanup goals must be treated 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. 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.

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.

PBS No.	*WBS No.*	*TIP No.*
RL-ER01	1.4.10.1.1.01.01	N/A

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 and Health: The contaminants pose a potential risk to human health and the environment. Remediation by conventional methods such as excavation and capping may result in exposure to workers. There is also the potential for offsite releases during soil handling operations.

Cost Savings Potential (Mortgage Reduction): In situ treatments could (1) reduce excavation/disposal costs (especially for deeper soils) and (2) prevent future groundwater contamination problems.

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 heath risk from groundwater pathways may not be fully protective for food chain pathways, particularly under acid conditions.

Other: None.

Consequences of Not Filling Need: Limited options for deeper soil contamination. Also, there is a potential for future groundwater contamination.

Privatization Potential: Potentially high. These types of wastes are common at DOE, DOD, and industrial sites.

Current Baseline Technology: Excavate and dispose.

Cost: Estimated cost to excavate and dispose is $105/Cubic meter for surface soils. There is no experience with excavation of soils much deeper than 15 ft.

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(s)-of-Contact: John April, BHI, (509) 372-9126; Ashur R. Michael, BHI, (509) 372-9074; V. R. (Vern) Dronen, BHI, (509) 372-9075; Larry M. Bagaasen, PNNL, (509) 375-6452

DOE End-User/Representative Point(s)-of-Contact: Fred R. Serier DOE, (509) 376-8517; Owen Robertson, DOE, (509) 373-6295; Richard A. Holten DOE, (509) 376-7277

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

COST EFFECTIVE, IN SITU REMEDIATION IN THE VADOSE ZONE OF ONE OR MORE OF THE FOLLOWING RADIONUCLIDES: URANIUM, PLUTONIUM, CESIUM, COBALT, OR STRONTIUM

Identification No.: RL-SS12
Date: September, 1998

OPS Office/Site: DOE-RL/Hanford
Operable Unit: All soil sites
Waste Stream: Soil (Disposition Map Designations: LLW Soils 100/300 Area, LLW Soils 200 Area, MLLW Soils)
Waste Management Unit: N/A
Facility: N/A

Site Priority Ranking: High

Need Title: Cost Effective, In Situ Remediation in the Vadose Zone of One or More of the Following Radionuclides: Uranium, Plutonium, Cesium, Cobalt, or Strontium-90

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 ($105/cubic meter) are needed to treat the top 15 feet of soil. In situ treatment technologies may also be required if soil contamination extends beyond the 15 feet to depths were excavation costs become prohibitive. Primary radionuclides of concern include Uranium, Plutonium, Cesium, Cobalt, Strontium-90, and Technetium-99.

Functional Performance Requirements: Reduce concentrations or mobilities of radioactive contaminants to the point that remediation goals are met. 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, 34.7 pCi/g; Pu-239/240, 33.9 pCi/g; Cs-137, 6.2 pCi/g; Co-60, 1.4 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 goals are anticipated to be no more stringent than the ones presented for the 100 Area sites.

Schedule Requirements: Soil Remediation is 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 sites will begin in FY 1999 and will extend several years past 2006.

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. The 300 Area sites are located close to the Columbia River and therefore are scheduled for completion prior to 2006. 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 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 technologies that are more cost effective than the baseline excavation/disposal costs ($105/cubic meter) are needed to treat the top 15 feet of soil. In situ treatment technologies may also 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. The 100 Area sites are located close to the Columbia River and therefore are also scheduled for completion prior to 2006. These areas will be cleaned up to meet residential land-use requirements. Soils with contamination in the top 15 feet that result in a dose of greater than 15 millirem must be treated to reduce the risk potential from the direct exposure pathway. Cobalt and Strontium-90 are the main radioactive contaminants of concern. 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 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 technologies that are more cost effective than the baseline excavation/disposal costs ($105/cubic meter) are needed to treat the top 15 feet of soil. In situ treatment technologies may also be required if soil contamination extends beyond the 15 feet to depths were 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 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 ($105/cubic meter) are needed to treat surface soils. Other potential concerns in the 200 Area include contamination (primarily uranium) that has been driven into low permeability layers deep (>150 ft) in the vadose zone, and near surface hot spots that prevent capping of some sites 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.

PBS No.	***WBS No.***	***TIP No.***
RL-ER01	1.4.10.1.1.01.01	N/A
	1.4.10.1.1.02.05	
	1.4.10.1.1.03.07	

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 and Health: The contaminants pose a potential risk to human health and the environment. Remediation by conventional methods such as excavation and capping may result in exposure to workers. There is also the potential for offsite releases during soil handling operations.

Cost Savings Potential (Mortgage Reduction): In situ treatments could (1) reduce excavation/disposal costs (especially for deeper soils), (2) allow less costly, hot spot treatment/capping alternatives and (3) prevent future groundwater contamination problems.

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.

Consequences of Not Filling Need: Limited options for deeper soil contamination and treatment of hot spots. Also potential for groundwater contamination.

Privatization Potential: Potentially high. These types of wastes typically occur at DOE sites.

Current Baseline Technology: Excavate and dispose.

Cost: Estimated cost to excavate and dispose is $105/Cubic meter.

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 likely to extend well beyond the ten year time period.

End-User: Richland Environmental Restoration Project

Site Technical Point(s)-of-Contact: John April, BHI, (509) 372-9126; Ashur R. Michael, BHI, (509) 372-9074; V. R. (Vern) Dronen, BHI, (509) 372-9075; Larry M. Bagaasen, PNNL, (509) 375-6452

DOE End-User/Representative Point(s)-of-Contact: Fred R. Serier DOE, (509) 376-8517; Owen Robertson, DOE, (509) 373-6295; Richard A. Holten DOE, (509) 376-7277

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

IMPROVED EX SITU TREATMENT OF SOILS CONTAMINATED WITH LEAD AND OTHER TCLP METALS

Identification No.: RL-SS24
Date: September, 1998

OPS Office/Site: DOE-RL/Hanford
Operable Unit: All soil sites
Waste Stream: Soil (Disposition Map Designations: LLW Soils 100/300 Area, LLW Soils 200 Area, MLLW Soils)
Waste Management Unit: N/A
Facility: N/A

Site Priority Ranking: High

Need Title: Improved Ex Situ Treatment of Soils Contaminated with Lead and Other TCLP Metals

Need Description: An ex situ treatment that is more cost effective than the baseline cementation process is required to treat lead contaminated soils. Although lead is the only contaminant that has resulted in large volumes of contaminated soil, the occurrence of barium contaminated soils indicates that disposal problems with other hazardous metals is a potential concern. Alternate cost effective treatment technologies for other metals or technologies that can treat multiple heavy metals may also be needed.

Functional Performance Requirements: Waste acceptance criteria for cost effective disposal options for excavated Hanford soils require that these soils do not leach hazardous metals as defined by the Toxicity Characteristic Leaching Procedure (TCLP). The limits for lead and barium in the TCLP extract are 5 and 100 mg/liter.

Schedule Requirements: Soil remediation is ongoing and will extend well beyond 2006. Lead contaminated soils that failed the TCLP were discovered in the first two landfill/burial ground sites excavated in the 300 area. Barium contaminated soils were also discovered in one of these sites. There is little characterization data available to determine the exact number of sites that have hazardous metal contamination issues. However, lead and other heavy metals were used extensively at the Hanford site and may be an issue in several of the landfills and burial grounds. If accepted, low cost technologies were available for heavy metal treatment, they would be applied on an as needed basis as new areas of heavy metal contamination were discovered.

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 and burial grounds. The 300 Area sites are located close to the Columbia River and therefore are scheduled for completion prior to 2006. 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. During excavation of Landfill 1D and Burial Ground 618-4 in the 300 Area, soils contaminated with leachable forms of lead were discovered. These soils failed the TCLP test and excavation operations had to be altered to assure that lead contaminated soils were identified before disposal. The discovery of lead not only delayed excavations at these sites but also tied up 35 disposal transportation boxes that has impacted remediation efficiencies in other areas. 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. The baseline treatment technology for metal contaminated soils is cementation. This baseline treatment has a cost of about $140/cubic meter, increases the volume of the waste, and may require that large debris is removed from the soil prior to treatment. Ex situ technologies that are more cost effective than the baseline cementation process are required.

The 100 Area also contains a large number of soil and burial ground sites. The 100 Area sites are located close to the Columbia River and therefore are also scheduled for completion prior to 2006. These areas will be cleaned up to meet residential land-use requirements. Soils with contamination in the top 15 feet that result in a dose of greater than 15 millirem must be treated to reduce the risk potential from the direct exposure pathway. Cobalt and Strontium-90 are the main radioactive contaminants of concern. The baseline strategy for soil sites is to excavate the top 15 feet of contaminated soil and ship to on site disposal facilities. Excavation operations in the 100 area have turned up only small quantities of contaminated lead debris in the form of bricks and sheets. The volume of this material was small and did not lead to large quantities of contaminated soil. This debris was treated by macroencapsulation in cement. Excavations in the 100 area to date have not resulted in the need for ex situ soil treatments but the presence of lead at a few of the sites indicates that heavy metals are a potential concern.

The 200 Area contains approximately 1000 different soil and burial ground sites. 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 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. The potential extent of heavy metal contamination will be established during characterization activities.

PBS No.	*WBS No.*	*TIP No.*
RL-ER01	1.4.10.1.1.01.01	N/A
&	1.4.10.1.1.02.05	
RL-ER03	1.4.10.1.1.03.07	

Justification for Need:

Technical: Cementation has been shown to be effective for treating heavy metals but will significantly increase remediation costs.

Regulatory: If soils fail the TCLP test, they must be treated prior to disposal or a treatability variance must be requested and approved.

Environmental Safety and Health: Cementation requires more handling of the contaminated soil and may increase the potential for worker exposure.

Cost Savings Potential (Mortgage Reduction): The volume of excavated soil that will not pass TCLP and may require treatment prior to disposal is not known. However, remediation costs double if the baseline treatment technology is added to the current excavation/disposal costs. If heavy metal contamination is as prevalent in all the burial grounds, as indicated in the early 300 Area experience, substantial cost savings may result if more cost effective ex situ treatments are available.

Cultural/Stakeholder Concerns: Stakeholders are sensitive to granting large numbers of treatment variances for soils that fail TCLP tests.

Other: None.

Consequences of Not Filling Need: Continued reliance on cementation technology.

Privatization Potential: Potentially high. Heavy metal wastes are common at DOE, DOD and industrial sites.

Current Baseline Technology: Cementation.

Cost: Estimated costs for cementation is $140/cubic meter.

Waste: Cementation would increase the volume of the waste by 10 to 30%.

How Long It Will Take: Criteria not applicable.

End-User: Richland Environmental Restoration Project

Site Technical Point(s)-of-Contact: John April, BHI, (509) 372-9126; Ashur R. Michael, BHI, (509) 372-9074; V. R. (Vern) Dronen, BHI, (509) 372-9075; Larry M. Bagaasen, PNNL, (509) 375-6452

DOE End-User/Representative Point(s)-of-Contact: Fred R. Serier DOE, (509) 376-8517; Owen Robertson, DOE, (509) 373-6295; Richard A. Holten DOE, (509) 376-7277

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

IMPROVED, REAL-TIME FIELD SCREENING DURING EXCAVATION FOR HEAVY METALS WITH EMPHASIS ON THE FOLLOWING: LEAD, CHROMIUM, MERCURY, AND BARIUM

Identification No.: RL-SS13
Date: September, 1998

OPS Office/Site: DOE-RL/Hanford
Operable Unit: Selected soil sites in the 100 and 300 Areas
Waste Stream: Soil (Disposition Map Designations: LLW Soils 100/300 Area, MLLW Soils)
Waste Management Unit: N/A
Facility: N/A

Site Priority Ranking: Medium

Need Title: Improved, Real-Time Field Screening During Excavation for Heavy Metals with emphasis on the Following: Lead, Chromium, Mercury, and Barium

Need Description: Rapid, field screening techniques are needed to assure that excavated materials meet waste acceptance criteria prior to disposal. Primary metal contaminants of concern include lead, chromium, mercury, and barium.

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. Techniques that would allow accelerated (e.g. less than two days) TCLP results are also desired.

Schedule Requirements: Soil Remediation is 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 sites will begin in FY 1999 and will extend several years past 2006.

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, 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 soil must now be excavated, sampled, stockpiled and loaded into disposal transportation containers only after TCLP results have been 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 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 has less than these levels, they cannot fail the TCLP test. Detection techniques that could accurately detect concentrations at this level 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.

PBS No.	***WBS No.***	***TIP No.***
RL-ER01 & RL-ER03	1.4.10.1.1.01.01	N/A

Justification for Need:

Technical: Current technology (XRF technology) can measure high-end concentrations but new technology is needed to accurately measure concentrations near the 20x TCLP limits.

Regulatory: None.

Environmental Safety and Health: Rapid screening techniques will reduce worker exposure times and help assure that soils that do not meet LDR are properly managed.

Cost Savings Potential (Mortgage Reduction): Rapid field screening techniques would improve excavation efficiency and reduce costs.

Cultural/Stakeholder Concerns: None.

Other: None.

Consequences of Not Filling Need: Continued reliance on XRF screening technology and slow turnaround TCLP testing.

Privatization Potential: Good potential, common industry and government contaminants.

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 several years past 2006.

End-User: Richland Environmental Restoration Project

Site Technical Point(s)-of-Contact: John April, BHI, (509) 372-9126; Ashur R. Michael, BHI, (509) 372-9074; V. R. (Vern) Dronen, BHI, (509) 372-9075; Larry M. Bagaasen, PNNL, (509) 375-6452

DOE End-User/Representative Point(s)-of-Contact: Fred R. Serier DOE, (509) 376-8517; Owen Robertson, DOE, (509) 373-6295; Richard A. Holten DOE, (509) 376-7277

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

IMPROVED, REAL-TIME FIELD SCREENING DURING EXCAVATION FOR RADIONUCLIDES WITH EMPHASIS ON THE FOLLOWING: URANIUM, PLUTONIUM, STRONTIUM-90, AND TECHNETIUM-99

Identification No.: RL-SS14
Date: September, 1998

OPS Office/Site: DOE-RL/Hanford
Operable Unit: All soil sites
Waste Stream: Soil (Disposition Map Designations: LLW Soils 100/300 Area, LLW Soils 200 Area, MLLW Soils)
Waste Management Unit: N/A
Facility: N/A

Site Priority Ranking: Medium

Need Title: Improved, Real-Time Field Screening During Excavation for Radionuclides with emphasis on the Following: Uranium, Plutonium, Strontium-90, and Technetium-99

Need Description: Rapid, field screening techniques are needed to direct characterization, delineation, and excavation operations. 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.

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): 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, but goals are anticipated to be no more stringent than the ones presented for the 100 Area sites.

Schedule Requirements: Soil Remediation is 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 sites will begin in FY 1999 and will extend several years past 2006.

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.

PBS No.	***WBS No.***	***TIP No.***
RL-ER01	1.4.10.1.1.01.01	N/A
& RL-ER02	1.4.10.1.1.02.05	
& RL-ER03	1.4.10.1.1.03.07	

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.

Cost Savings Potential (Mortgage Reduction): Rapid field screening techniques would improve excavation efficiency and reduce costs. Accurate field screening may also reduce the amount of soil that must be removed to assure that all contaminated soils are excavated thereby reducing disposal volumes and costs. Substantial cost savings could result if site characterization activities are optimized to reduce the number of full suite laboratory analyses required to fully characterize soil sites.

Cultural/Stakeholder Concerns: None.

Other: None.

Consequences of Not Filling Need: Continued reliance on gamma detectors and discrete sampling.

Privatization Potential: Good potential, common DOE contaminants.

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 likely to extend well beyond the ten year time period.

End-User: Richland Environmental Restoration Project

Site Technical Point(s)-of-Contact: John April, BHI, (509) 372-9126; Ashur R. Michael, BHI, (509) 372-9074; V. R. (Vern) Dronen, BHI, (509) 372-9075; Larry M. Bagaasen, PNNL, (509) 375-6452

DOE End-User/Representative Point(s)-of-Contact: Fred R. Serier DOE, (509) 376-8517; Owen Robertson, DOE, (509) 373-6295; Richard A. Holten DOE, (509) 376-7277

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

IMPROVED, IN SITU CHARACTERIZATION TO DETERMINE THE EXTENT OF SOIL CONTAMINATION OF ONE OR MORE OF THE FOLLOWING HEAVY METALS: HEXAVALENT CHROMIUM, MERCURY, AND LEAD

Identification No.: RL-SS15
Date: September, 1998

OPS Office/Site: DOE-RL/Hanford
Operable Unit(s): 100, 200, and 300 Areas
Waste Stream: Soil (Disposition Map Designations: LLW Soils 100/300 Area, LLW Soils 200 Area, MLLW Soils)
Waste Management Unit: N/A
Facility: N/A

Site Priority Ranking: Medium

Need Title: Improved, In Situ Characterization to Determine the Extent of Soil Contamination of One or More of the Following Heavy Metals: Hexavalent Chromium, Mercury, and Lead

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, and lead) at depth is required.

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. The following remediation goals can be found in the Remedial Design Report/Remedial Action Work Plan for the 100 Area (DOE/RL-96-17): Cr (VI), 2.2 mg/kg; Hg, 24 mg/kg; and Pb, 353 mg/kg. 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 elimination of the requirement for sample collection and analysis.

Schedule Requirements: Soil Remediation is ongoing. Goals established in the Hanford Ten Year Challenge would have all soil sites and burial grounds in the 100 and 300 Areas completed by 2006. Characterization and remediation of the 200 Area sites will begin in FY 1999 and will extend several years past 2006.

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.

The 200 Area is undertaking significant characterization efforts in FY 1999. 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.

PBS No.	***WBS No.***	***TIP No.***
RL-ER01 & RL-ER02 & RL-ER03	1.4.10.1.1.01.01	N/A

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: None

Environmental Safety and Health: There are no specific environmental safety and health issues with respect to this technology need.

Cost Savings Potential (Mortgage Reduction): Substantial cost savings may result if vadose zone contaminant source areas are located and treated before they migrate to ground water. Advance knowledge of major contaminants in burial grounds could also improve project planning and reduce costly excavation inefficiencies.

Cultural/Stakeholder Concerns: None

Other: None

Consequences of Not Filling Need: Continued use of current methods that includes costly boring, labor intensive sampling, and laboratory analysis.

Privatization Potential: Potentially high.

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 likely to extend well beyond the ten year time period.

End-User: Richland Environmental Restoration Project

Site Technical Point(s)-of-Contact: John April, BHI, (509) 372-9126; Ashur R. Michael, BHI, (509) 372-9074; V. R. (Vern) Dronen, BHI, (509) 372-9075; Larry M. Bagaasen, PNNL, (509) 375-6452

DOE End-User/Representative Point(s)-of-Contact: Fred R. Serier DOE, (509) 376-8517; Owen Robertson, DOE, (509) 373-6295; Richard A. Holten DOE, (509) 376-7277

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

IMPROVED, IN SITU CHARACTERIZATION TO DETERMINE THE EXTENT OF SOIL CONTAMINATION OF ONE OR MORE OF THE FOLLOWING RADIONUCLIDES: URANIUM, PLUTONIUM, CESIUM, COBALT, OR STRONTIUM-90

Identification No.: RL-SS16
Date: September, 1998

OPS Office/Site: DOE-RL/Hanford
Operable Unit(s): All soil sites
Waste Stream: Soil (Disposition Map Designations: LLW Soils 100/300 Area, LLW Soils 200 Area, MLLW Soils)
Waste Management Unit: N/A
Facility: N/A

Site Priority Ranking: Medium

Need Title: Improved, In Situ Characterization to Determine the Extent of Soil Contamination of One or More of the Following Radionuclides: Uranium, Plutonium, Cesium, Cobalt, or Strontium-90

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, and strontium-90) in soils at depth is required.

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. 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; Pu-239/240, 33.9 pCi/g; Cs-137, 6.2 pCi/g; Co-60, 1.4 pCi/g; and Sr-90, 4.5 pCi/g. Analyses down to 200+ feet would be useful in some areas but deployment to depths of greater than 15 ft would help supply missing information.

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.

Schedule Requirements: Soil Remediation is ongoing and 200 Area site characterization activities are planned for FY 1999. 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 sites will begin in FY 1999 and will extend several years past 2006.

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 barrier placement strategies. The target/indicator contaminants will be developed for the 200 Area as part of the characterization activities. However, plutonium, uranium, cesium, cobalt, and strontium are likely to be the key indicator contaminants for many of the contaminated sites.

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. In situ characterization technologies may also help support cost effective means of making remedial alternative decisions including whether burial grounds and portions of soil sites can be left in place.

PBS No.	***WBS No.***	***TIP No.***
RL-ER01	1.4.10.1.1.01.01	N/A
& RL-ER02	1.4.10.1.1.02.05	
& RL-ER03	1.4.10.1.1.03.07	

Justification for Need:

Technical: Highly accurate and easily operated instrumentation to measure the concentrations 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: There is no regulatory requirement for soils remediation at this time.

Environmental Safety and Health: There are no specific environmental safety and health issues with respect to this technology need.

Cost Savings Potential (Mortgage Reduction): Substantial cost savings could result if select burial grounds and portions of soil sites could be treated in place instead of excavated and disposed. Substantial cost savings could result if site characterization activities can be performed without the need to conduct full suite laboratory analyses on soil samples.

Cultural/Stakeholder Concerns: None

Other: None

Consequences of Not Filling Need: Continued use of current methods that includes costly boring, labor intensive sampling, and laboratory analysis.

Privatization Potential: Potentially high.

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 drill cuttings may be subjected to 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: The remediation effort is ongoing and will last for at least the next 20 years.

End-User: Richland Environmental Restoration Project

Site Technical Point(s)-of-Contact: John April, BHI, (509) 372-9126; Ashur R. Michael, BHI, (509) 372-9074; V. R. (Vern) Dronen, BHI, (509) 372-9075; Larry M. Bagaasen, PNNL, (509) 375-6452

DOE End-User/Representative Point(s)-of-Contact: Fred R. Serier DOE, (509) 376-8517; Owen Robertson, DOE, (509) 373-6295; Richard A. Holten DOE, (509) 376-7277

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

LONG-LIFE WASTE ISOLATION SURFACE BARRIER

Identification No.: RL-SS17
Date: September, 1998

OPS Office/Site: DOE-RL/Hanford
Operable Unit(s): 200 Area Remedial Action and Waste Management Units and Burial Grounds in 100 and 300 Areas
Waste Stream: Soil (Disposition Map Designations: LLW Soils 200 Area)
Waste Management Unit: N/A
Facility: N/A

Site Priority Ranking: Medium

Need Title: Long-Life Waste Isolation Surface Barrier

Need Description: Surface barriers are remediation options for Hanford waste sites contaminated with low-level radionuclides 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.

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 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).

Schedule Requirements: 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

100/300 Areas and selected burial ground and liquid waste disposal sites in the 200 Area. 200 Area remedial alternative decision making will require barrier performance data in the FY 1998 - FY 2000 time frame.

Technology Insertion Point: Consideration of new technology is ongoing but a few key insertion points are available for burial grounds in different areas. The remedial design activities for 45 burial grounds in the 100 area are currently scheduled to begin in FY 2001. The remedial alternative assessment activities for initial burial grounds in the 200 area are currently scheduled to begin in FY 2001. The remedial design activities for burial grounds in the 300-FF-2 Operable Unit are currently scheduled to begin in FY 2006.

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. 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 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 on site 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.

In FY 1997, Bechtel Hanford Inc. and Pacific Northwest National Laboratory completed three-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 this four-year period 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 ER Project during FY 1998-FY 2000 to finalize the treatability testing are:

(1) 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 assure that this component will not degrade during it's proposed design life;

(2) Evaluating the differential settlement of soils beneath the surface barrier and the impacts of this differential settlement on barrier integrity are required to establish maximum allowable settlement criteria;

(3) 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/warning systems will need to be addressed.

Areas that are presently not funded that require further study (FY 1999-FY 2000 preferably) prior to deployment of barriers at waste sites include:

(1) Development of a model for extrapolating short-term data to address long-term performance that is acceptable to the DOE and regulators;

(2) Evaluation of alternate materials and reduced thicknesses including alternatives to fluid applied asphalt and the use of geoclay to allow a graded approach to barrier application;

(3) 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;

(4) Evaluation of 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.

PBS No.	*WBS No.*	*TIP No.*
RL-ER01	1.4.10.1.1.01.01	Candidate
& RL-ER02	1.4.10.1.1.02.05	
& RL-ER03	1.4.10.1.1.03.07	

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 requirements for environmental remediation. DOE Order 5820.2A for tank waste performance assessment.

Environmental Safety and Health: A properly installed barrier will significantly reduce risk to human health and the environment at uncontrolled surface waste sites.

Cost Savings Potential (Mortgage Reduction): Information from the 10-year plan indicates a potential saving of $500 M 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 on site facilities. Barriers are a significant part of the baseline strategy for many sites in the 200 area.

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.

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.

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.

Privatization Potential: Potentially high.

Current Baseline Technology: Excavate and dispose.

Cost: Budget forecast for 300 Area burial ground activities is: FY 1999, $3.1M. Estimates to complete excavation and disposal of all the burial grounds in the 100 and 300 Areas is nearly $700M.

Waste: None

How Long It Will Take: Burial ground remediation activities in the 100 and 300 Areas 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(s)-of-Contact: John April, BHI, (509) 372-9126; Greg B. Mitchem (509) 372-9632; Ashur R. Michael, BHI, (509) 372-9074; V. R. (Vern) Dronen, BHI, (509) 372-9075; Larry M. Bagaasen, PNNL, (509) 375-6452

DOE End-User/Representative Point(s)-of-Contact: Fred R. Serier DOE, (509) 376-8517; Bryan L. Foley, DOE, (509) 376-7087; Owen Robertson, DOE, (509) 373-6295; Richard A. Holten DOE, (509) 376-7277

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

IMPROVED DETECTION AND SEGREGATION OF TRU WASTE (DEBRIS)

Identification No.: RL-SS18
Date: September, 1998

OPS Office/Site: DOE-RL/Hanford
Operable Unit: Selected burial ground sites in the 200 and 300 Areas
Waste Stream: Soil (Disposition Map Designations: TRU Debris)
Waste Management Unit: N/A
Facility: N/A

Site Priority Ranking: High

Need Title: Improved Detection and Segregation of TRU Waste (Debris)

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 and would need to be segregated.

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.

Schedule Requirements: Burial sites that potentially contain TRU waste are not scheduled for remediation in the 300 area for the next 5-10 years and are not scheduled for remediation in the 200 area 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 high level 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.

PBS No.	***WBS No.***	***TIP No.***
RL-ER02	1.4.10.1.1.02.05	N/A
& RL-ER03	1.4.10.1.1.03.07	

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.

Cost Savings Potential (Mortgage Reduction): Potential savings depend on excavation inefficiencies introduced by baseline handling strategy.

Cultural/Stakeholder Concerns: No stakeholder concerns are likely.

Other: None.

Consequences of Not Filling Need: Continued use of baseline handling strategy for suspected TRU waste.

Privatization Potential: Possible high potential in Department of Energy, Department of Defense, and private applications.

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 $100M. 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(s)-of-Contact: John April, BHI, (509) 372-9126; Ashur R. Michael, BHI, (509) 372-9074; V. R. (Vern) Dronen, BHI, (509) 372-9075; Larry M. Bagaasen, PNNL, (509) 375-6452

DOE End-User/Representative Point(s)-of-Contact: Fred R. Serier DOE, (509) 376-8517; Owen Robertson, DOE, (509) 373-6295; Richard A. Holten DOE, (509) 376-7277

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

DETECTION, HANDLING, AND TREATMENT OF PYROPHORIC MATERIALS IN BURIAL GROUNDS

Identification No.: RL-SS19
Date: September, 1998

OPS Office/Site: DOE-RL/Hanford
Operable Unit: Selected burial grounds in the 300 Area
Waste Stream: Soil (Disposition Map Designations: HAZ Debris, LLW Debris, MLLW Debris)
Waste Management Unit: N/A
Facility: N/A

Site Priority Ranking: High

Need Title: Detection, Handling, and Treatment of Pyrophoric Materials in Burial Grounds

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.

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 handing 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.

Schedule Requirements: Three hundred and fifty drums of uranium chips are scheduled for treatment next year. As many as 1200 additional drums will require subsequent treatment. Remediation of other burial grounds is scheduled through 2006 but the quantity of pyrophoric materials in these burial grounds is not known.

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.

PBS No.	***WBS No.***	***TIP No.***
RL-ER03	1.4.10.1.1.03.07	N/A

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.

Cost Savings Potential (Mortgage Reduction): Inefficiencies associated with discovering the uranium chips in 618-4 has already resulted in $750K of additional costs. Rough estimated costs for treating the existing uranium waste depends on characterization results but may be as high as $3M. Improved detection, handling and treatment techniques could substantially reduce these costs.

Cultural/Stakeholder Concerns: Stakeholder concerns have not been established for this need.

Other: None.

Consequences of Not Filling Need: Discovery of pyrophoric materials will continue to delay excavation operations until methods for dealing with these materials are established.

Privatization Potential: Possible high potential in Department of Energy, Department of Defense, and private applications.

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 likely to extend well beyond the ten year time period.

End-User: Richland Environmental Restoration Project

Site Technical Point(s)-of-Contact: John April, BHI, (509) 372-9126; Ashur R. Michael, BHI, (509) 372-9074; V. R. (Vern) Dronen, BHI, (509) 372-9075; Larry M. Bagaasen, PNNL, (509) 375-6452

DOE End-User/Representative Point(s)-of-Contact: Fred R. Serier DOE, (509) 376-8517; Owen Robertson, DOE, (509) 373-6295; Richard A. Holten DOE, (509) 376-7277

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

IMPROVED METHODS FOR DEBRIS HANDLING AND SEGREGATION

Identification No.: RL-SS20
Date: September, 1998

OPS Office/Site: DOE-RL/Hanford
Operable Unit: All burial ground sites in the 100, 200, and 300 Areas
Waste Stream: Soil (Disposition Map Designations: HAZ Debris, LLW Debris, MLLW Debris, TRU Debris)
Waste Management Unit: N/A
Facility: N/A

Site Priority Ranking: High

Need Title: Improved Methods for Debris Handling and Segregation

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.

Functional Performance Requirements: Technology must reduce inefficiencies and costs associated with handling solid debris.

Schedule Requirements: Variable. Burial grounds exist in the 100, 200, and 300 Areas. The first burial ground (located in the 300 Area) excavation was partially excavated in 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. Strategies for remediation of the 200 Area burial ground sites are being revised but are scheduled to begin in 2003 and will extend several years past 2006.

Technology Insertion Point: Consideration of new technology is ongoing but a few key insertion points are available for burial grounds in different areas. The remedial design activities for 45 burial grounds in the 100 area are currently scheduled to begin in FY 2001. The remedial alternative assessment activities for initial burial grounds in the 200 area are currently scheduled to begin in FY 2001. The remedial design activities for burial grounds in the 300-FF-2 Operable Unit are currently scheduled to begin in FY 2006.

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:

- Drummed pyrophoric wastes that require overpacking in non-hazardous mineral oil while awaiting final treatment disposition
- Drummed acid and chemical waste that required sampling to determine the required level of personal protective equipment
- 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
- Tar/asbestos coatings on pipes that must be scraped off and handled as asbestos waste.

These operations reduce excavation efficiencies and increase costs. Improved methods for dealing with these and other debris handing issues that will arise in future operations are required.

PBS No.	***WBS No.***	***TIP No.***
RL-ER01	1.4.10.1.1.01.01	Candidate
& RL-ER02	1.4.10.1.1.02.05	
& RL-ER03	1.4.10.1.1.03.07	

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.

Cost Savings Potential (Mortgage Reduction): Potential savings depend on excavation inefficiencies introduced by baseline debris handling strategy

Cultural/Stakeholder Concerns: No stakeholder concerns are likely.

Other: None.

Consequences of Not Filling Need: Continued use of baseline debris handling strategy.

Privatization Potential: Possible high potential in Department of Energy, Department of Defense, and private applications.

Current Baseline Technology: Conventional excavation equipment for removal with grizzlies for separation.

Cost: Budget forecast for 300 Area burial ground activities is: FY 1999, $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. 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(s)-of-Contact: John April, BHI, (509) 372-9126; Ashur R. Michael, BHI, (509) 372-9074; V. R. (Vern) Dronen, BHI, (509) 372-9075; Larry M. Bagaasen, PNNL, (509) 375-6452

DOE End-User/Representative Point(s)-of-Contact: Fred R. Serier DOE, (509) 376-8517; Owen Robertson, DOE, (509) 373-6295; Richard A. Holten DOE, (509) 376-7277

Fiscal Year 1999 Subsurface Contaminant Science Needs

ID No.	Need Title
Detection/Distribution of Contaminants	
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	Rates 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-SS29-S	Effect of Subsurface Heterogeneities on Chemical Reaction and Transport
RL-SS30-S	Remedial Technology for Cs Beneath Waste Tanks
Remediation	
RL-SS31-S	Mathematical Formulations of Chemical Reaction/Material Transport
RL-SS32-S	Reactivity of Organics in the Hanford Subsurface
RL-SS33-S	Interaction of Remedial Processes with Hanford Subsurface
RL-SS34-S	Selectivity for Contaminants in the Hanford Subsurface
Monitoring of Contaminants	
RL-SS35-S	Use of Chemical Surrogates for Contaminants
RL-SS36-S	Chemical Indicators of Remedial Technology Processes
RL-SS37-S	Chemical Sensor Principles

Site Background Information Relevant for All Science Needs: The Hanford Site covers 1450 square kilometers along the Columbia River in the southeastern Washington State. The primary mission of the Hanford Site for nearly 50 years was to produce plutonium for national defense. Since 1943, nine plutonium production reactors, seven chemical separations plants, and various ancillary facilities were constructed and operated at the Hanford Site, with peak defense production activities occurring in the 1950s and early 1960s during the Cold War. Plutonium production, fuel processing, and fuel fabrication had a significant effect on the environment. The Hanford Site contains over 1600 contaminated waste sites; 670 occur within one half mile of the Columbia River. Defense production created over 625,000 cubic meters of solid liquid wastes containing both radioactive and chemical contamination. Early waste disposal practices have resulted in groundwater contamination levels exceeding federal drinking water standards (DWS). The Department of Energy established the environmental restoration mission in 1987 with the goal of returning the site to other beneficial uses.

There is significant soil contamination at 100, 200, and 300 areas of the Hanford Site. The approximate total volumes of soil requiring remediation (liquid waste disposal sites and burial grounds) are:

3.9 million cubic yards in the 100 Areas,
10 million cubic yards in the 200 Areas, and
0.8 million cubic yards in the 300 Area.

The 100 Area, located along the Columbia River at the inactive production reactors, has over 70 contaminated soil 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. Cobalt and Strontium-90 are the main radioactive contaminants of concern in 100 area soils. The 300 Area, located along the Columbia River on the southeastern side of the Site, 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 the result of liquid discharge to cribs, ponds and ditches. Remediation strategies and target/indicator contaminants are currently being developed for the 200 Area, located on a plateau several miles from the Columbia River. However, plutonium, uranium, cesium, cobalt, and strontium are likely to be the key indicator contaminants for many of the contaminated sites.

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. A portion of the 200 area sites may also 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. In situ characterization technologies may also help support decisions to leave some burial grounds and portions of soils sites in place.

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. Soils within the vadose zone at the 200-ZP-2 operable unit are contaminated with elevated concentrations of carbon tetrachloride. An Expedited Response Action (ERA) is being conducted using vapor extraction to remove carbon tetrachloride from the soil beneath the operable unit. A final remedial strategy has not yet been developed to mitigate the soil contamination.

Groundwater plumes are located in the 100, 200, and 300 areas. Tritium has been found in groundwater in all three locations. Other plumes are specific to the function of the area. For example, 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 groundwater contaminant is hexavalent chromium, which occurs in two main plumes. The north plume is about 2,000 feet by 4,000 feet and a south plume of about 2,000 feet by 2,000 feet. Both plumes have an average thickness of about 15 feet with concentrations ranging from 60 to 600 ppb. Depth to the water table is approximately 85 feet. Hexavalent chromium has been identified as a contaminant of concern for juvenile salmon 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 100-HR-3 and 100-KR-4 operable units specified installation of a pump-and-treat systems to intercept chromate plumes that impact the Columbia River. The objective of the Interim Remedial Measure (IRM) is protection of juvenile salmon in the river substrate from exposure to hexavalent chromium.

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. 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 interim remedial measure (IRM) 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. One containment approach being evaluated for this application is an in situ permeable strontium adsorption barrier. Implementation of this approach has been stalled due to regulators concerns over the effectiveness of long-term containment strategies. A main concern is that high concentrations of Sr-90 will accumulate in the barrier and result in a catastrophic release into the Columbia River if the barrier is washed out during a major flooding event.

Groundwater in the 200 Areas has been contaminated by carbon tetrachloride, trichloroethylene, and degradation products of these compounds have also been detected in groundwater. Concentrations of carbon tetrachloride, chloroform, and trichloroethylene in groundwater at the 200-ZP-1 operable unit exceed the regulatory limit. Remediation must meet a functional requirement of less than 5 ppb of carbon tetrachloride. Current remedial actions include pumping contaminated water from the aquifer and treating it with an air-stripping action followed by vapor-phase GAC polishing.

The current approach of using ex-situ ion exchange treatment of contaminated water and air is considered to be relatively expensive. 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.

Additional challenges to restoration of the Hanford Site involve timely and accurate monitoring and assessment of remedial technology performance. At present, concentrations of chromium, strontium-90, and carbon tetrachloride are measured by discrete sampling from wells or river substrate with analysis in analytical laboratories. Time for receipt of analytical results vary, but require approximately 24 hours for turn around time for strontium-90, and can extend to several weeks for hexavalent chromium and carbon tetrachloride. Laboratory analytical work is highly accurate, but time delays and high cost are considered to be significant drawbacks. In situ monitoring would lower the analytical chemistry cost of remediation projects and fate and transport studies. The possibility also exists to incorporate in situ monitoring with existing pump-and-treat remediation systems. This objective would support design changes to allow fully automated operation of the pump-and-treat systems. 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.

Nature of the Problem and Long-Term Potential Remedial Solutions: A summary of the contaminants of highest interest is given below:

Groundwater Contaminants
- Carbon tetrachloride, trichloroethylene
- Hexavalent Chromium
- Radionuclides: Tritium, ^{90}Sr, ^{99}Tc, ^{129}I

Vadose Zone Contaminants
- Carbon tetrachloride
- Chromium, Lead, Mercury, Cobalt
- Radionuclides; Tritium, Uranium, Plutonium, ^{90}Sr, ^{99}Tc, ^{129}I, ^{137}Cs
- The potential for cesium to become a groundwater contaminant is recognized.

Several long-term remedial technologies are being considered for these waste plumes at Hanford; additional scientific information is needed to make them effective for environmental restoration. These technologies are considered generally representative of technologies that could be effective at Hanford; the list is not considered to be limiting. Technologies requiring additional scientific basis include:

Reactive and passive in-situ remediation technologies: The basic science is needed to refine those approaches currently being evaluated under EM support, such as in-situ redox manipulation and use of passive containment barriers made of material such as zero-valent iron or zeolites. These technologies address remediation of deep aquifer systems.

Reactive chemical transport models: Models and codes that couple chemical information with transport are needed to conduct the assessment of contaminant reactivity and migration needed to select among remedial alternatives. The models are also needed for performance assessments of remedial technologies, where results of models are compared to post-remediation monitoring data to assess how well a remedial technology met functional performance requirements.

Semi- or real-time chemical and radiological groundwater monitoring techniques: These capabilities are needed to cut the costs of analyses where post-remediation monitoring of ground water aquifers may be required for years into the future, and to support performance assessment using reactive chemical transport models.

Hanford Site Science Need -- FY1999
Subsurface Contaminants Subgroup

Identification No.: RL-SS23-S

Science Need Title: Detection/Distribution of Contaminants--Chemical Speciation and Complexation in Site-specific Groundwaters

Site Priority Ranking: Soil and Groundwater Science Need--High

I. Functional Need:

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.

II. 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.

III. Science Need Description:

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.

IV. <u>Benefit</u>:

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-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

RL-SS21 Contaminant Mobility Beneath Tank Farms

V. Contacts:

For more information, contact:

Fred Serier, DOE (509) 376-8517
Loni Peurrung, PNNL (509) 373-0201

Hanford Site Science Need -- FY1999
Subsurface Contaminants Subgroup

Identification No.: RL-SS24-S

Science Need Title: Detection/Distribution of Contaminants--Chemical Binding on Site-Specific Mineral Surfaces

Site Priority Ranking: Soil and Groundwater Science Need--High

I. Functional Need:

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.

II. 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.

III. Science Need Description:

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 CO_2, 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.

IV. Benefit:

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-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

RL-SS21 Contaminant Mobility Beneath Tank Farms

V. Contacts:

For more information, contact:

Fred Serier, DOE (509) 376-8517
Loni Peurrung, PNNL (509) 373-0201

Hanford Site Science Need -- FY1999
Subsurface Contaminants Subgroup

Identification No.: RL-SS25-S

Science Need Title: Detection/Distribution of Contaminants--Chemical Form and Mobility of Dense, Non-Aqueous Phase Liquids in Hanford Subsurface

Site Priority Ranking: Soil and Groundwater Science Need--High

I. Functional Need:

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.

II. 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-ZP-2. 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.

III. Science Need Description:

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.

IV. Benefit:

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-SS01 Cost-effective, In-situ Remediation of Carbon Tetrachloride in the Vadose Zone and Groundwater

RL-SS02 Improved, Real-time, In-Line Detection of Carbon Tetrachloride in Process Water

RL-SS03 Improved, Real-time, In-Line Detection of Carbon Tetrachloride in Groundwater

RL-SS21 Contaminant Mobility Beneath Tank Farms

V. Contacts:

For more information, contact:

Fred Serier, DOE (509) 376-8517
Loni Peurrung, PNNL (509) 373-0201

Hanford Site Science Need -- FY1999
Subsurface Contaminants Subgroup

Identification No.: RL-SS26-S

Science Need Title: Transport of Contaminants--Reaction Rates for Key Contaminant Species and Complexes in Site-Specific Groundwaters

Site Priority Ranking: Soil and Groundwater Science Need--High

I. Functional Need:

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.

II. 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 adsoprtion 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.

III. Science Need Description:

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.

IV. <u>Benefit</u>:

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-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

RL-SS21 Contaminant Mobility Beneath Tank Farms

V. Contacts:

For more information, contact:

Fred Serier, DOE (509) 376-8517
Loni Peurrung, PNNL (509) 373-0201

Hanford Site Science Need -- FY1999
Subsurface Contaminants Subgroup

Identification No.: RL-SS27-S

Science Need Title: Transport of Contaminants--Rates of Coupled Abiotic and Biogeochemical Reactions Involving Contaminants in Hanford Subsurface

Site Priority Ranking: Soil and Groundwater Science Need--High

I. Functional Need:

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.

II. 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.

III. Science Need Description:

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 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).

IV. Benefit:

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-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

RL-SS21 Contaminant Mobility Beneath Tank Farms

V. Contacts:

For more information, contact:

Fred Serier, DOE	(509) 376-8517
Loni Peurrung, PNNL	(509) 373-0201

Hanford Site Science Need -- FY1999
Subsurface Contaminants Subgroup

Identification No.: RL-SS28-S

Science Need Title: Transport of Contaminants--Rates of Colloid Formation and Colloidal Transport of Contaminants in Site-Specific Groundwaters

Site Priority Ranking: Soil and Groundwater Science Need--High

I. Functional Need:

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.

II. 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.

III. Science Need Description:

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).

IV. Benefit:

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-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

RL-SS21 Contaminant Mobility Beneath Tank Farms

V. Contacts:

For more information, contact:

Fred Serier, DOE (509) 376-8517
Loni Peurrung, PNNL (509) 373-0201

Hanford Site Science Need -- FY1999
Subsurface Contaminants Subgroup

Identification No.: RL-SS29-S

Science Need Title: Transport of Contaminants--Effect of Subsurface Heterogeneities on Chemical Reaction and Transport

Site Priority Ranking: Soil and Groundwater Science Need--High

I. Functional Need:

Determine how the physical and chemical properties of the specific Hanford formations affect the transport of chemical solutes and colloids.

II. 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.

III. Science Need Description:

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.

IV. Benefit:

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-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

RL-SS21 Contaminant Mobility Beneath Tank Farms

V. Contacts:

For more information, contact:

Fred Serier, DOE (509) 376-8517
Loni Peurrung, PNNL (509) 373-0201

Hanford Site Science Need -- FY1999
Subsurface Contaminants Subgroup

Identification No.: RL-SS30-S

Science Need Title: Transport of Contaminants--Remedial Technology for Cs Beneath Waste Tanks

Site Priority Ranking: Soil and Groundwater Science Need--High

I. Functional Need:

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.

II. 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.

III. Science Need Description:

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.

IV. Benefit:

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-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

RL-SS21 Contaminant Mobility Beneath Tank Farms

V. Contacts:

For more information, contact:

Fred Serier, DOE (509) 376-8517
Loni Peurrung, PNNL (509) 373-0201

Hanford Site Science Need -- FY1999
Subsurface Contaminants Subgroup

Identification No.: RL-SS31-S

Science Need Title: Remediation--Mathematical Formulations of Chemical Reaction/Material Transport

Site Priority Ranking: Remedial Action--High

I. Functional Need:

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.

II. 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.

III. Science Need Description:

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-SS29-2: 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.

IV. Benefit:

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-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

RL-SS21 Contaminant Mobility Beneath Tank Farms

V. Contacts:

For more information, contact:

Fred Serier, DOE (509) 376-8517
Loni Peurrung, PNNL (509) 373-0201

Hanford Site Science Need -- FY1999
Subsurface Contaminants Subgroup

Identification No.: RL-SS32-S

Science Need Title: Remediation--Reactivity of Organics in the Hanford Subsurface

Site Priority Ranking: Remedial Action--High

I. Functional Need:

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.

II. 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.

III. Science Need Description:

The biodegradation of halogenated organic compounds (TCE, PCE, DCE, TCA, DCA--CCl_4, 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.

IV. Benefit:

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-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

RL-SS21 Contaminant Mobility Beneath Tank Farms

V. Contacts:

For more information, contact:

Fred Serier, DOE	(509) 376-8517
Loni Peurrung, PNNL	(509) 373-0201

Hanford Site Science Need -- FY1999
Subsurface Contaminants Subgroup

Identification No.: RL-SS33-S

Science Need Title: Remediation--Interaction of Remedial Processes with Hanford Subsurface

Site Priority Ranking: Remedial Action--High

I. Functional Need:

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.

II. 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.

III. Science Need Description:

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.

IV. Benefit:

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

RL-SS21 Contaminant Mobility Beneath Tank Farms

V. Contacts:

For more information, contact:

Fred Serier, DOE (509) 376-8517
Loni Peurrung, PNNL (509) 373-0201

Hanford Site Science Need -- FY1999
Subsurface Contaminants Subgroup

Identification No.: RL-SS34-S

Science Need Title: Remediation--Selectivity for Contaminants in the Hanford Subsurface

Site Priority Ranking: Remedial Action--High

I. Functional Need:

For Hanford site conditions, determine those chemical reactions that can select among contaminants and be used to separate contaminants from contaminated groundwaters and soils.

II. 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.

III. Science Need Description:

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.

IV. Benefit:

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

RL-SS21 Contaminant Mobility Beneath Tank Farms

V. Contacts:

For more information, contact:

Fred Serier, DOE	(509) 376-8517
Loni Peurrung, PNNL	(509) 373-0201

Hanford Site Science Need -- FY1999
Subsurface Contaminants Subgroup

Identification No.: RL-SS35-S

Science Need Title: Monitoring of Contaminants--Use of Chemical Surrogates for Contaminants

Site Priority Ranking: Remedial Action--High

I. Functional Need:

To assess potential migration of difficult-to-measure contaminants in the Hanford subsurface, select relevant chemical analogues (similar group, charge, ionic size) to contaminant of interest that can be measured by existing measurement technologies.

II. 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, chemical analogues have been identified based on chemical form, charge, and ionic size. 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.

III. Science Need Description:

Science needs include the identification of adequate surrogates for the contaminants of interest. 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.

IV. Benefit:

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-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

RL-SS21 Contaminant Mobility Beneath Tank Farms

V. Contacts:

For more information, contact:

Fred Serier, DOE (509) 376-8517
Loni Peurrung, PNNL (509) 373-0201

Hanford Site Science Need -- FY1999
Subsurface Contaminants Subgroup

Identification No.: RL-SS36-S

Science Need Title: Monitoring of Contaminants--Chemical Indicators of Remedial Technology Processes

Site Priority Ranking: Remedial Action--High

I. Functional Need:

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.

II. 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.

III. Science Need Description:

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.

IV. Benefit:

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

RL-SS21 Contaminant Mobility Beneath Tank Farms

V. <u>Contacts</u>:
For more information, contact:

Fred Serier, DOE	(509) 376-8517
Loni Peurrung, PNNL	(509) 373-0201

Hanford Site Science Need -- FY1999
Subsurface Contaminants Subgroup

Identification No.: RL-SS37-S

Science Need Title: Monitoring of Contaminants--Chemical Sensor Principles

Site Priority Ranking: Remedial Action--High

I. Functional Need:

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

II. 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.

III. Science Need Description:

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.

IV. Benefit:

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-SS02 Improved, Real-time, In-line Detection of Carbon Tetrachloride in Process Water

RL-SS03 Improved, Real-time, In-situ Detection of Carbon Tetrachloride in Groundwater

RL-SS05 Improved, Real-time, In-line Detection of Hexavalent Chromium in Process Water

RL-SS06 Improved, Real-time, In-situ Detection of Hexavalent Chromium in Groundwater

RL-SS08 Improved, Real-time, In-line Detection of Strontium-90 in Process Water

RL-SS09 Improved, Real-time, In-situ Detection of Strontium-90 in Groundwater

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

RL-SS21 Contaminant Mobility Beneath Tank Farms

V. Contacts:

For more information, contact:

Fred Serier, DOE (509) 376-8517
Loni Peurrung, PNNL (509) 373-0201

Commentary on FY 1999 Subsurface Contaminants Science and Technology Needs Process

The FY 1999 Science and Technology needs for the Subsurface Contaminants section were reviewed by Bechtel Hanford, Inc (BHI) and Pacific Northwest National Laboratory (PNNL). Twenty needs from last year were carried over and updated. One need was deleted due to low priority. Two needs from last year are being carried in the Waste Tank section; and two new needs were generated. The fifteen Science Needs were carried over to FY 1999. All changes are noted in the FY 1998 - FY 1999 Crosswalk table below.

Old (FY98)	New (FY99)	NEED TITLE	Changes in FY 1999 Revision
		Groundwater Project	
RL-SS01	RL-SS01	Cost-Effective, In Situ Remediation of Carbon Tetrachloride in the Vadose Zone and Groundwater	Updated
RL-SS02	RL-SS02	Improved, Real-Time, In-Line Detection of Carbon Tetrachloride in Process Water	Updated
RL-SS03	RL-SS03	Improved, Real-Time, In Situ Detection of Carbon Tetrachloride in Groundwater	Updated
RL-SS04	RL-SS04	Cost-Effective, In Situ Remediation of Hexavalent Chromium in Groundwater	Updated
	RL-SS23	Improved, Ex Situ Remediation of Chromium in Groundwater	New
RL-SS05	RL-SS05	Improved, Real-Time, In-Line Detection of Hexavalent Chromium in Process Water	Updated
RL-SS06	RL-SS06	Improved, Real-Time, In Situ Detection of Hexavalent Chromium in Groundwater	Updated
RL-SS07	RL-SS07	Cost-Effective, In Situ Remediation of Strontium-90 in Groundwater	Updated
RL-SS08	RL-SS08	Improved, Real-Time, In-Line Detection of Strontium-90 in Process Water	Updated
RL-SS09	RL-SS09	Improved, Real-Time, In Situ Detection of Strontium-90 in Groundwater	Updated

Old (FY98)	New (FY99)	NEED TITLE	Changes in FY 1999 Revision
Remedial Action and Waste Disposal Project			
RL-SS10	RL-SS10	Improved Technologies for Detection/Delineation of Burial Ground Contents and Subsurface Geological Boundaries	Updated
RL-SS11	RL-SS11	Cost-Effective, In Situ Remediation of Hexavalent Chromium in the Vadose Zone	Updated, improved focus.
RL-SS12	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	Updated
	RL-SS24	Improved Ex Situ Treatment of Soils Contaminated with Lead and Other TCLP Metals	New
RL-SS13	RL-SS13	Improved, Real-Time Field Screening During Excavation for Heavy Metals with Emphasis on the Following: Lead, Chromium, Mercury, and Barium	Updated, improved focus.
RL-SS14	RL-SS14	Improved, Real-Time Field Screening During Excavation for Radionuclides with Emphasis on the Following: Uranium, Plutonium, and Strontium-90	Updated, improved focus.
RL-SS15	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, and Lead	Updated
RL-SS16	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	Updated
RL-SS17	RL-SS17	Long-Life Waste Isolation Surface Barrier	Updated
RL-SS18	RL-SS18	Improved Handling and Segregation of TRU Waste (Debris)	Updated

Old (FY98)	New (FY99)	NEED TITLE	Changes in FY 1999 Revision
RL-SS19	RL-SS19	Detection, Handling and Treatment of Pyrophoric Materials in Burial Grounds	Updated and expanded to included treatment.
RL-SS20	RL-SS20	Improved Methods for Debris Handling and Segregation	Updated

The following needs were endorsed by the Waste Tanks Subgroup and have relevance to the Subsurface Contaminants Subgroup. These needs are included in the Waste Tanks section.

Old (FY98)	New (FY99)	NEED TITLE	Changes in FY 1999 Revision
		Groundwater Project	
RL-SS21	RL-WT053-S	Contaminant Mobility Beneath Tank Farm	Included as a Waste Tanks science need
RL-SS22	RL-WT029	Data and Tools for Performance Assessments	Included in Waste Tanks section
RL-WT017	RL-WT017	Long-Term Testing of Surface Barrier	Updated: substantively unchanged.
RL-WT018	RL-WT018	Testing of Sand-Gravel Capillary Barrier	Updated: substantively unchanged.
	RL-WT061	Reactive Barriers to Contaminant Migration	New

FY 1999 WASTE TANKS TECHNOLOGY NEEDS

ID#	NEEDS TITLE
RL-WT01	Technetium-99 Analysis in Hanford Tank Waste and Contaminated Tank Farm Areas
RL-WT04	DST Corrosion Monitoring
RL-WT05	Remote Inspection of High-Level Waste Single Shell Tanks
RL-WT06	Identification and Management of Problem Constituents for HLW Vitrification
RL-WT09	Representative Sampling and Associated Analysis to Support Operations and Disposal
RL-WT013	Establish Retrieval Performance Evaluation Criteria
RL-WT015	Standard Method for Determining Waste Form Release Rate
RL-WT016	Glass Monolith Surface Area
RL-WT017	Long-Term Testing of Surface Barrier
RL-WT018	Testing of Sand-Gravel Capillary Barrier
RL-WT021	Cleaning, Decontaminating and Upgrading Hanford Pits
RL-WT022	Tank Knuckle NDE
RL-WT023	Prediction of Solid Phase Formation in Hanford Tank Waste Solutions
RL-WT024	Enhanced Sludge Washing Process Data
RL-WT026	Tank Leak Detection Systems for Underground Single-Shell Waste Storage Tanks (SSTs)
RL-WT027	Tank Leak Mitigation Systems
RL-WT029	Data and Tools for Performance Assessments
RL-WT060	PHMC Retrieval and Closure - Hanford/SRS Waste Mixing Mobilization
RL-WT061	Reactive Barriers to Contaminant Migration
RL-WT062	PHMC DST Retrieval - Hanford DST Transfer Pump Improvements

ID#	NEEDS TITLE
RL-WT063	PHMC Retrieval and Closure - Hanford SST Saltcake Dissolution Retrieval
RL-WT064	PHMC Retrieval and Closure - Hanford Past Practice Sluicing Improvements
RL-WT065	Direct Inorganic and Organic Analyses of High-Level Waste

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

TECHNETIUM-99 ANALYSIS IN HANFORD TANK WASTE AND CONTAMINATED TANK FARM AREAS

Identification No.: RL-WT01
Date: September, 1998

Program: Tanks - Characterization
OPS Office/Site: Richland Operations Office/Hanford
Operating Unit: N/A
Waste Stream: Low Level Waste, High Level Waste, Vadose Zone
Waste Management Unit: N/A
Facility: 222-S Laboratory

Site Priority Ranking: Medium

Need Title: Technetium-99 Analysis in Hanford Tank Waste and Contaminated Tank Farm Areas

Need Description: An accurate, robust production laboratory method for the measurement of technetium-99 (^{99}Tc) concentration in Hanford waste tank matrices and in soils from the vadose zone surrounding the tanks is needed. The method must provide a high level of confidence in the ^{99}Tc concentrations because data is important in risk-based assessments. In order to obtain this level of confidence, verification of method performance needs to be done by the use of independent methods and/or by inter-laboratory comparisons on actual waste samples between DOE Sites.

Functional Performance Requirements: 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 the vadose zone and in processed or treated waste. Performance requirements will vary for the different applications of the data and matrices.

For example, the EQL for ^{99}Tc in the LLW ICD-19 is 5xE-04 uCi/mL. The LLW 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 Data Quality Objective (DQO) for performance assessment is 2.0xE-2 uCi/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/batch for preparation and 1 hour per batch for analysis) and permit reasonably large batch sizes (4 to 10 samples + QC). The use of hazardous chemicals and generation of waste should be minimized.

Schedule Requirements: A validated and acceptable method will be needed to support LLW and HLW feed characterization and acceptance by the Privatization vendor. The schedule for this activity is changing with the awarding of the contract to BNFL. However, if data from present characterization is to be utilized to support the certification of the waste transferred then the need is immediate. Work was completed in 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 recent instances where the radiochemical results are higher than the ICP/MS. This indicates the existing method may not be reliable in all matrices and the limits of reliability are not established. There presently is no explanation for these differences. There have also been indications that analyses for ^{99}Tc are higher than predicted by modeling at both SRL and Hanford. Vadose zone sampling is expected to begin in FY 1999. Waste characterization is ongoing with future emphasis on Privatization and waste disposal.

Presently ^{99}Tc can be determined by radiochemical and Inductively Coupled Plasma/Mass Spectrometer (ICP/MS) techniques. When both techniques provide equivalent results they can be confidently reported. Presently the amount of this 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 is planned in September 1998 with the users of this data. More definitive requirements and schedule for ^{99}Tc analyses may result from this meeting.

Problem Description: An accurate production laboratory method for establishing the technetium-99 concentration in low level waste and vadose zone soils is needed. Technetium-99 concentration is a critical component of feed to the waste vitrification vendors. The absolute accuracy of these analytical results produced at Hanford has been questioned and found to be in disagreement with results produced at another 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 tank wastes can produce inconsistent performance of radiochemical sample preparation methods in use. In addition, the method must be applicable to soils which may contain waste material that leak from the tank. Technetium in the +7 oxidation state is known to be mobile in the soil column and therefore the concentration in tank wastes 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 poly atomic interferences that have not been clearly defined for this relatively new technology.

PBS No.	***WBS No.***	***TIP No.***
RL-TW01	1.1.1	N/A

Justification For Need:

Technical: Private vendors will receive low-level waste after being 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.

Regulatory: The technetium-99 concentration in feed streams classified as low-level waste is critical since the resulting vitrified product may contain inventory beyond the permitted quantities for on-site disposal.

Environmental Safety and Health: 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 technetium-99 into the soils surrounding the tanks. The mobility and long half-life of the isotope makes the concentration value significant for environmental consequences.

***Science*:** Measurement methodology must be demonstrated acceptable by peer review. This is performed by sample exchange between national laboratories and process control laboratories. The reduction-oxidation potential will be different from tank-to-tank as a result of organic and inorganic components present. Extractions performed to reduce the effects of radiochemical interferences are only effective when the isotope is in the +7 oxidation state. Therefore the radiochemical measurement methodology must be robust to overcome the matrix effects and oxidize all oxidation states of technetium to the pertechnetate form. Comparison of the radiochemical and ICP/MS techniques for ^{99}Tc provides the confidence needed for application of both techniques to sensitive projects.

Cost Savings Potential (Mortgage Reduction): Potential cost savings are represented by a measurement method that assures the vendor and DOE that a true concentration of the technetium-99 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.

Cultural/Stakeholder Concerns: 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.

Technical Point of Contact: W. I. Winters, Numatec Hanford Company, (509) 373-1951

End User Point of Contact: J. E. Hyatt, Waste Management Federal Services of Hanford, (509) 376-7923

Contractor Facility/Project Manager: Russell J. Murkowski - LMHC (509) 373-3885

DOE Representative Point(s) of Contact: James A. Poppiti, (509) 376-4550; fax (509) 376-2002; e-mail: james_a_poppiti@rl.gov

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

DST CORROSION MONITORING

Identification No.: RL-WT04
Date: September, 1998

Program: Tank Waste Remediation System - Operations
OPS Office/Site: Richland Operations Office/Hanford Site
Operable Unit (if applicable): N/A
Waste Stream: Double Shell Tanks
Waste Management Unit (if applicable):
Facility: Tank Farms

Site Priority Ranking: High

Need Title: DST Corrosion Monitoring

Need Description: Corrosion monitoring of 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. As many as 6 low hydroxide (out of corrosion specification) tanks continue to be operated. This indicates that this system is inadequate to support corrosion control. Tank samples are infrequent and their analysis difficult and expensive. Process knowledge is complicated by waste streams that are exempt from the corrosion control specifications. In-tank, real-time measurement of the corrosive characteristics of the tank wastes is needed to improve control of corrosion processes. This need supports TWRS Program Logic "Conduct Tank Farms Safe Operations" and "Conduct Reduced Mortgage Tank Farm Safe Operations." Corrosion monitoring is discussed in the Safe Storage Technical Basis Review, Activity Number 190.N45.

Functional Performance Requirements:
- Identify the onset of stress corrosion cracking.
- Identify the onset of pitting.
- Order of magnitude quantification of mass loss during pitting and cracking.
- Quantification of uniform corrosion rates.

Schedule Requirements: Work is to be performed in Fiscal Years 1998 through 2000

Problem Description: Corrosion control of high level waste Double Shell Tanks (DST) 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 six DSTs at Hanford have operated outside of corrosion chemistry limits in the past two years. Detection and remediation of these low hydroxide tanks has been slow and costly.

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 three 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:

1. Safer operation and reduced risk of tank liner failure. 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. Significant potential for cost reduction: More than $100K in unplanned work scope at Hanford in fiscal year 1996 and 1997 on sampling and analysis to determine the extent of out of specification conditions.

3. Increased tank life due to more rapid identification and resolution of off-normal conditions.

4. Avoidance of unnecessary chemical additions due to unknown corrosion conditions: More than 10,000 gallons of waste volume added to the tanks at Hanford through fiscal year 1997 through unplanned sodium hydroxide additions. Direct monitoring of the actual tank corrosion conditions may have shown these additions to be unnecessary.

5. Possible cost savings over time as a result of the relaxation of corrosion inhibitor addition requirements as corrosion behavior becomes better understood. Each metric ton of sodium addition avoided (as sodium hydroxide corrosion inhibitor) will save approximately $1,000,000 in low level waste vitrification costs.

PBS No.	***WBS No.***	***TIP No.***
RL-TW03	1.1.3	N/A

Justification for Need:

Technical: 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.

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.

Regulatory: *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 will provide an acceptable performance measurement of current corrosion protection measures and early warning of potentially corrosive conditions.

DOE Order 5820.2A, *Radioactive Waste Management*, requires monitoring of cathodic protection systems, methods for periodically assessing waste storage system integrity, and adjustment of waste chemistry to control corrosion.

DOE-STD-1073-93, *Configuration Management*, 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, *Tank Waste Remediation System Functions and Requirements* contains corrosion control requirements for the Store Waste (F4.2.1.1) and Transfer Waste (F4.2.4.4) functions.

Environmental Safety and Health: WHC-SD-WM-OSR-005, *Single-Shell Tank Interim Operational Safety Requirements*, WHC-SD-WM-OSR-004, *Aging Waste Facility Interim Operational Safety Requirements*, and WHC-SD-WM-OSR-016, *Double-Shell Tank Interim Operational Safety Requirements*. These support documents contain interim operational safety requirement - administrative controls for corrosion control, cathodic protection, and integrity assessments. Implementation of these administrative controls necessitates corrosion control activities.

WHC-SD-WM-PLN-068, *TWRS Life Management Program Plan*, identifies stress corrosion cracking, pitting corrosion, and uniform corrosion as the primary aging mechanisms for DSTs. On-line monitoring of DSTs for these mechanisms will provide necessary data for damage prediction models being developed for the DST Life Management Program.

BNL/DOE-HQ Tank Structural Integrity Panel, *Guidelines for Development of Structural Integrity Programs for DOE High-Level Waste Storage Tanks - DRAFT*, discusses the important role of corrosion monitoring in the context of a comprehensive structural integrity program.

Cost Savings Potential (Mortgage Reduction):

Mortgage Reduction - Estimated Total Life Cycle Cost (TLCC) for wastes added to the DST system is $100 per gallon. Avoidance of the 30,000 gallons of chemicals added in fiscal years 1994-1996 would produce $3,000,000 TLCC savings.

Cost Avoidance - Avoid premature replacement of DSTs. Replacement cost estimated by the Multi-Function Waste Tank Facility Project was $67,000,000 per tank.

Cost Avoidance - Remove $50,000 sampling cost for each corrosion sample avoided. This would also free the sampling crew and equipment to take more urgent samples (safety screening, privatization, etc.)

Cultural/Stakeholder Concerns: N/A

Other: N/A

Consequences of Not Filling Need:
Regulatory Impacts
The Hanford Operations contractor has previously entered into negotiations with the Washington State Department of Ecology (WDOE) for determination of acceptable compliance with WAC 173-303-640. Completion of this activity was a part of the negotiations. Failure to complete this activity might be construed by WDOE as failure to comply with WAC legal requirements and failure to negotiate compliance in good faith.

Programmatic Impacts
Corrosion control of double shell tanks is currently provided by process knowledge and tank sampling. The continued operation of 4 low hydroxide (out of corrosion specification) tanks

indicates that this system is inadequate to support corrosion control. Tank samples are infrequent and their analysis difficult and expensive. Process knowledge is complicated by waste streams that are exempt from the corrosion control specifications. In-line, real-time measurement of the corrosive characteristics of the tank wastes will augment the current system to provide an acceptable level of corrosion control information to satisfy the programmatic drivers above.

Outsourcing Potential: Modified commercial technology could be marketed back to the private sector.

Current Baseline Technology: There is no baseline technology for direct monitoring of corrosion in high level waste tanks.

End-User: Retrieval/Tank Farm Operations

Site Technical Points of Contact: James L. Nelson - LMHC (509) 373-6296

Contractor Facility/Project Manager: Howard L. Budweg - FDH (509) 376-8476, Ryan A. Dodd - LMHC (509) 373-5629

DOE End-User/Representative Points of Contact: Mark L.Ramsay - DOE-RL (509) 376-7924

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

REMOTE INSPECTION OF HIGH-LEVEL WASTE SINGLE SHELL TANKS

Identification No.: RL-WT05
Date: September, 1998

Program: Tanks - Operations
OPS Office/Site: Richland Operations Office/Hanford
Operable Unit (if applicable): N/A
Waste Stream: Single Shell Tanks
Waste Management Unit (if applicable):
Facility: Tank Farms

Site Priority Ranking: Medium

Need Title: Remote Inspection of High-Level Waste Single Shell Tanks

Need Description: The Tri Party Agreement (TPA) schedule requires retrieval of wastes in the Single Shell Tanks (SSTs) to begin by 2004 for future vitrification and permanent storage in a waste repository. In order to meet this schedule, a retrieval method needs to be selected to retrieve the waste for processing. A Non-Destructive Examination (NDE) of the tank needs to be performed prior to the selection of a retrieval method to assure successful retrieval of the waste from the tank.

Functional Performance Requirements: 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.

Acceptance criteria for NDE has the following allowable flaw sizes:

Through- wall crack length-	12"
Maximum allowable crack depth-	3/16"
Thinnest allowable wall section- (where t is the original thickness) and	0.8t
Maximum allowable pit depth-	0.5t

The selected remote inspection method needs to be demonstrated in a SST with very little waste. Leakage rates from detected through-wall cracks have to be estimated to assess sluicing feasibility of the SSTs.

Schedule Requirements: Functional systems will first be useful if deployed prior to retrieval of wastes from the SSTs which is scheduled to begin by 2004. However, the benefits can be captured even with later deployments.

Problem Description: Initially, SSTs that have little or no waste need to be selected for NDE of the tank wall 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 and size of the cracks that led to the leakage of wastes for the leaking SSTs need to be determined. Waste leakage rates should be estimated based on the defect information, and the acceptability of sluicing for retrieval operations needs to be evaluated for each selected SST.

In order to be able to meet the TPA SST waste retrieval schedule, initially only one tank from a group of tanks containing similar wastes should be studied. The retrieval decision made for this one tank should be extended to remaining tanks in the group.

Every effort should be made to perform the examination with a remote device such as the Light duty Utility Arm (LDUA) or similar robotic equipment to more efficiently minimize costs. The potential benefits of NDE evaluation (and possible destructive evaluation of some of the SSTs) include:

- Determination of feasibility of sluicing as a waste retrieval method for the SSTs.

- Prioritization of tanks for waste retrieval and processing.

PBS No.	***WBS No.***	***TIP No.***
RL-TW03	1.1.3	N/A

Justification For Need:

***Technical*:** Sluicing is the baseline approach for SST retrieval. As such, it is necessary to know early on whether or not it is feasible to use this method.

Regulatory:

- DOE-STD-1073-93, *Configuration Management*, 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, *Tank Waste Remediation System Functions and Requirements* contains corrosion control requirements for the Store Waste (F4.2.1.1) and Transfer Waste (F4.2.4.4) functions.

Environmental Safety & Health:

- WHC-SD-WM-OSR-005, *Single-Shell Tank Interim Operational Safety Requirements*, WHC-SD-WM-OSR-004, *Aging Waste Facility Interim Operational Safety Requirements*. These support documents contain interim operational safety requirement - administrative controls for corrosion control, cathodic protection, and integrity assessments. Implementation of these administrative controls necessitates corrosion control activities.

- WHC-SD-WM-PLN-068, *TWRS Life Management Program Plan*, identifies stress corrosion cracking, pitting corrosion, and uniform corrosion as the primary aging mechanisms for DSTs.

- BNL/DOE-HQ Tank Structural Integrity Panel, *Guidelines for Development of Structural Integrity Programs for DOE High-Level Waste Storage Tanks - DRAFT*, discusses the important role of corrosion monitoring in the context of a comprehensive structural integrity program.

Cost Savings Potential (Mortgage Reduction): Determination of the integrity of SSTs prior to retrieval will avoid the use of more costly retrieval techniques. Sluicing a sound tank may save $10M or more over robotic or teleoperated approaches.

Cultural/Stakeholder Concerns: N/A

Other: N/A

Consequences Of Not Filling Need:

Regulatory Impacts: The U. S. DOE has previously entered into a TPA commitment with the Washington State Department of Ecology (WDOE) and the U. S. Environmental Protection Agency to begin retrieval of SST wastes by the year 2004. Completion of this activity was a part of the negotiations. . Failure to complete this activity might be construed by WDOE as failure to comply with TPA commitments, WAC legal requirements, and failure to negotiate in good faith.

Programmatic Impacts: Sluicing is considered to be one of the primary methods to retrieve waste from the SSTs. It is possible that sluicing may not be a viable method for retrieval of some SSTs due to the extensive corrosion experienced by some of the tanks. Therefore, it is important to initiate tank inspection to rule out sluicing at an early stage in order to have adequate time to pursue other retrieval methods prior to the 2004 deadline to initiate retrieval of SST wastes.

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.

Current Baseline Technology: There is no baseline technology for in-situ inspection of SSTs to assess corrosion damage. Techniques have been developed to inspect tanks at INEEL using the LDUA and ACFM technology, but these may not be applicable to Hanford SSTs because the device cannot take readings below the level of the waste.

Programmatic Risks: There is an unknown, but undoubtedly high probability that some SSTs will leak when sluiced. If leakage volumes are unacceptably large, there will be high costs and lengthy delays to switch to another waste retrieval technology.

Connection to TWRS Logic: This need supports TWRS Program Logic "Develop SST Retrieval Methods and Requirements."

End-User: Retrieval/Tank Farm Operations

Site Technical Point(s)-of-Contact: James L. Nelson, (509) 373-6296; Ramamohan P. Anantatmula, (509) 373-0785, Lockheed Martin Hanford Corporation

Contractor Facility/Project Manager: William J. Stokes - MACTC (509) 373-0354

DOE End-User/Representative Point(s)-of-Contact: Mark L. Ramsay, (509) 376-7924

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

IDENTIFICATION AND MANAGEMENT OF PROBLEM CONSTITUENTS FOR HLW VITRIFICATION

Identification No.: RL-WT06
Date: September, 1998

Program: Tanks - Process Waste
OPS Office/Site: Richland Operations Office/Hanford
Operable Unit (if applicable): N/A
Waste Stream: High-level waste
Waste Management Unit (if applicable): N/A
Facility: Tank Farms

Site Priority Ranking: Medium

Need Title: Identification and Management of Problem Constituents for HLW Vitrification

Need Description: Currently, HLW glasses are formulated to assure that little or no insoluble phases exist in the HLW melter. Insoluble phases are caused by such problem constituents as chrome minerals, spinels, and noble metals. An alternative method for handling problem constituents in HLW glasses is needed. The volume of HLW glass that will be produced from the sludges at Hanford is dependent on the ability to solubilize or dilute problem constituents that make up a very small fraction of the overall waste. Minimizing the impact of the problem constituents is important for formulating a strategy and staging the wastes to be treated during the Phase II outsourcing effort. Diluting the problem constituents usually involves blending of waste types and/or increasing the volume of glass waste forms. Alternatively, separations of problem constituents is an option. All of these alternatives are expensive.

Information is needed on the technical viability of producing HLW glasses with insoluble phases. Information such as settling rates and rheological properties is needed for insoluble phases to determine if the phases will settle in a HLW melter and, if so, whether the settled sludge can be discharged through a bottom drain or by other means. Information is also needed to determine the impact of the insoluble phases on the durability of the waste form. Ultimately, new HLW glass formulations can be produced that reduce the overall glass volume for various waste types and reduce the blending requirements at Hanford. Based on the results of this study, the cost and risk of producing waste forms with insoluble phases will have to be compared with other options such as blending or diluting to determine the best path forward. This information is needed to formulate a strategy for the Phase II outsourcing effort at Hanford. This includes waste blending requirements for the DOE, waste volume minimization requirements for the Contractors, and overall contracting strategy.

Functional Performance Requirements:

- Based on current HLW feed processability reports, identify physical (particle size, particle morphology, and settling rate) and chemical (composition and crystalline structure) characteristics for insoluble phases in HLW glass formulations with high waste loadings
- If applicable, determine the physical characteristics of settled layers of insoluble particles (sludges)
- Evaluate the methods for removing the settled sludge layers either continuously or periodically.
- Evaluate the processability of the new glass formulations

PBS No.	***WBS No.***	***TIP No.***
RL-TW05	1.1.5	N/A

Schedule Requirements: This effort needs to be completed in time to support trade studies supporting the Phase 2 RFP Planning. This information for the trade studies may be needed by 2008.

Justification For Need:

Technical: Data from testing will be used to support the RFP generation for Phase 2 of the TWRS Outsourcing Effort.

Regulatory: Regulators agree that DOE should move ahead according to Tri-Party Agreement. RCRA generally requires waste minimization.

Cost Savings Potential (Mortgage Reduction): This is an area of potential high return-on- investment.

Cultural/Stakeholder Concerns: A representative of Hanford's Site Technology Coordination Group has registered a suggestion to minimize High Activity or High Level Waste be balanced with minimization of on-site disposal of LAW.

Other: None

Consequences Of Not Filling Need: Implementation of baselines demonstrated in Phase 1 and accepting the strategy of relying on the Private sector to make long term technology investments for Phase 2 with private monies.

Outsourcing Potential: High

Current Baseline Technology: Current baseline will be defined when Private Contractors submit Phase Ia deliverables. DOE evaluation and downselection for Phase Ib is scheduled for May 1998. Standard pre-privatization flowsheets generated by the M&O Contractor are assumed as baseline until Phase Ia deliverables are evaluated and selected by the DOE.

End-User: TWRS Process Waste Support Function

Technical Points of Contact: Rudy Carreon, (509) 373-7771

Contractor Facility/Project Manager: N/A

DOE End-User/Representative Point(s)-of-Contact: Peter T. Furlong, (509) 372-1738; fax (509) 373-0628; e-mail: peter_t_furlong@rl.gov or Catherine S. Louie (509)376-6834

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

REPRESENTATIVE SAMPLING AND ASSOCIATED ANALYSIS TO SUPPORT OPERATIONS AND DISPOSAL

Identification No.: RL-WT09
Date: September, 1998

Program: Tank Waste Remediation System, Waste Feed Delivery
OPS Office/Site: Richland Operations Office/Hanford Site
Operable Unit (if applicable): N/A
Waste Stream: Double Shell Tanks
Waste Management Unit (if applicable): N/A
Facility: Tank Farms

Site Priority Ranking: High

Need Title: Representative Sampling and Associated Analysis to Support Operations and Disposal

Need Description: To develop and demonstrate a concept for taking representative samples and associated rapid analysis of feeds which are to be staged for cross-site transfer or are to be staged as feed for the Privatization Contractors. Feed for Privatization Phase I immobilization demonstrations must be sampled prior to transfer to the Privatization Contractor. The samples must be representative of the tank contents.

To accomplish this, the intermediate waste feed staging tank contents must be sampled while being mixed for transfer to the Private Contractor's feed staging tank. A variable depth sampling system is needed that can be operated in conjunction with the active mixing system to take representative samples and certify the tank contents. The certified tank contents will be needed either for acceptance of the feed by the Privatization Contractor or as a means to determine the additional compensation that the Privatization Contractor will receive.

(Reference: "Alternatives Generation and Analysis for the Phase I Intermediate Waste Feed Staging System Design Requirements," WHC-SD-TWR-AGA-001, Rev. 0).

Functional Performance Requirements: The sampling and analytical capabilities should be able to provide representative samples and measure the parameters needed to support successful cross-site transfers and needed as specified in the Privatization Contract for envelopes A, B, and C and envelope D. The Privatization Phase 1 supernate solutions to be sampled are targeted to be dilute slurry/supernate solutions with a maximum of 2% solids by weight. The samples will be drawn from the tank with a lift distance of up to 50 feet. The system to be provided will need to be deployed using existing spare tank penetrations or be installed into an existing process pit located in the tank farm. 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 ALARA principles.

Schedule Requirements: The cross-site transfer line from Tank 102-SY will be operational in FY 1998; this sampling and analysis capability would be beneficially employed anytime thereafter. To support the privatization, this method needs to be developed by FY 1999 and the methods procured and installed in FY 2000 and FY 2001 so that it could be demonstrated as soon as possible, and implemented on the Feed Staging Tank as soon as possible. If the baseline schedule for Privatization holds (hot start-up in June, 2002) the installation of the sampling system would not occur until several tanks have already been processed. If the Privatization schedule for LAW slips by four years (an assumption of a recent alternative scenario supporting contract negotiations) there will be an opportunity to be ready for the first feed tank.

Problem Description: A representative, and preferably also rapid, sampling and analysis system has to be developed and demonstrated so that feeds to the cross-site transfer line and to both the LLW and HLW Privatization Contractors can be staged successfully with a minimum impact on tank space. Current grab samplers consisting of "bottle-on-a-string" are used for slurry/supernate sampling. This system of sampling has been found to be cross contaminated with material from higher elevations above the desired sample depth as it is withdrawn from the tank. Although this cross contamination is proportional, it could skew the sample results. Also, this method cannot be performed during active mixing system operation, therefore allowing time for in-tank stratification to be re-established before the sampling can be performed. The sampling is a manual operation performed thorough an existing riser using a portable "glove bag" for containment control that has potential for personal contamination and exposure. With Hanford'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 sample and analyze much more rapidly in order to ensure that DOE provides feeds in accordance with its privatization contracts and with a minimum use of tank space. Representative sampling involving potentially non-homogeneous waste feed is definitely needed. 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.

Possible concept: On-line sampling and analysis could satisfy this need. AEA has developed the capability of obtaining representative samples of slurries of waste with a fluidics sampling pump, and this concept is being adapted for Savannah River Site waste tank use. If this device were combined with on-line analytical methods, this need could be satisfied.

PBS No.	*WBS No.*	*TIP No.*
RL-TW05	1.1.5	N/A
RL-TW01	1.1.1	

Justification for Need:

Technical: This effort is required to ensure that feed is delivered to the cross-site transfer line and to Privatization Contractors in a timely manner with the use of minimum double shell tank space. This activity will seek improved sampling systems that support ALARA goals and can be operated at variable depths while the DST mixing system is operating.

Regulatory: Will maintain the certification of waste being transferred for immobilization.

Environmental Safety and Health: Using on-line instrumentation will reduce the exposure of personnel during taking of the samples in the field and analysis of the samples in the laboratory. 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. The transportation of samples to the 222-S Analytical Lab would be avoided.

Cost Savings Potential (Mortgage Reduction): Set-up 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 was developed. The cost of taking and analyzing samples currently is on the order of $400K - $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. The at-tank farm sampling will also reduce the need for additional sample transportation casks, vehicles, and staff, and reduce the need for additional analytical laboratory facilities and staff.

Cultural/Stakeholder Concerns: N/A

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 in late FY 1996. This technology could be integrated with existing analytical techniques in a demonstration relevant to the feed staging applications identified.

Consequences of Not Filling Need: Greater risk of plugging the cross site transfer lines; increased delay in making transfers; possible slippage of retrieval schedules. Privatization Contractors' feed may not be delivered by DOE on the schedule agreed to in the contract and

DOE will be forced to pay the Privatization Contractors for idle facilities. PHMC 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 doesn't initially meet specifications (i.e., requires rework prior to transfer to the Private Contractors feed staging tank).

Outsourcing Potential: The representative sampler could be supplied and possibly also installed by AEA Technology, or possibly BNFL, or possibly Numatec or SGN Systems, or the Russians since this technology or variations thereof have been used by these foreign organizations in their waste management and waste processing activities. The sample distribution manifold system is available through British Columbia Research Inc., a Canadian technology development firm. The measurement of rheological properties associated with the representative samples would need to be made with analyzer equipment commercially available and adapted to the sample distribution manifold system. The analysis requirements would be different for the feed staging for the cross-site transfer where the emphasis would be on ensuring pumpability through the cross-site transfer pipe and waste compatibility of what is being transferred versus what is in the receiver tank. On the other hand, for the requirements for the intermediate feed staging tanks for privatization, the emphasis is to ensure the tank contents comply with the desired feed envelope: A, B, or C for supernatants, and envelope D for sludges.

Current Baseline Technology: Current plans for feed staging tank sampling and analysis involve trying to mix the waste and take "bottle on the string" or other grab samples followed by analysis in the 222-S Laboratory. It takes weeks or even months to analyze a tank of waste.

Programmatic Risks: 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 Privatization Contractors 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 their will be disputes over the analysis of the waste (Critical Risk 31). In addition to these critical risks there are a number of lower level risks which this alternative reduces. A more detailed discussion of both the critical risks and the lower level risks are contained in a deployment strategy which was scheduled to be published in July. The total list of risks considered are 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.

Connection to TWRS Logic: This alternative technology could tie into the logic to any of a series of logic block (one for each source/staging tank combination) for obtaining a sample of the feed to the Privatization Contractor. The first of these is TBR 150.B34 - Obtain 105-AN Feed Qualification sample from 241-AP-102 for the baseline logic. A complete list of these is provided in the deployment strategy for the existing baseline. The deployment strategy will be updated as the baseline is changed.

***Related Technology Needs/Opportunities Statement*:** "Real Time Waste Property Measurement System for Waste Transfer"

End-User: Tank Farm Operations/Retrieval

Site Technical Points of Contact: K.A. Gasper - NHC (509) 373-1948, R.M. Boger - NHC (509) 376-3355, F.R. Reich - COGEMA Engineering (509) 376-4063 for sampler, and Roger Gilchrist - PNNL (509) 372-6088 for sampler manifold.

Contractor Facility/Project Manager: Russ L. Treat, (509) 373-3824

DOE End-User/Representative Points of Contact: Privatization: Neil R. Brown (509) 372-2323, Robert A. Gilbert (509) 376-2310 , Rudy Carreon (509) 373-7771; Retrieval: Bruce L. Nicoll (509) 376-6006; Characterization: James A. Poppiti (509) 376-4550

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

ESTABLISH RETRIEVAL PERFORMANCE EVALUATION CRITERIA

Identification No.: RL-WT013
Date: September, 1998

Program: Tanks - Retrieval
OPS Office/Site: Richland Operations Office/Hanford
Operable Unit (if applicable): N/A
Waste Stream: Single Shell Tanks
Waste Management Unit (if applicable): N/A
Facility: Tank Farms

Site Priority Ranking: High

Need Title: Establish Retrieval Performance Evaluation Criteria

Need Description: The Tri-Party Agreement (TPA) establishes an interim retrieval performance goal to leave no more than 360 cubic feet of waste in 75 foot diameter SSTs, and no more than 30 cubic feet in 20 foot diameter SSTs. This interim goal is intended to be finalized or modified over time based on demonstrations of retrieval technology, and on evaluation of cost, technical practicability, exposure of workers and public to radiation, and compliance with Nuclear Regulatory Commission requirements that will establish authority to regulate disposal of the radioactive component of residual waste.

A principal function of waste retrieval is to remove sufficient waste from tanks to permit tank closure. The TWRS EIS evaluated environmental impacts associated with retrieval of waste from SSTs using technologies that are expected to leave residual volumes of waste approximating the interim TPA retrieval performance goal. If residual waste must be retrieved from SSTs as part of closure operations, environmental impacts of such waste retrieval, including impacts on tank waste processing, have not been evaluated.

An additional aspect of establishing retrieval performance objectives concerns the amount of leakage of tank waste that would be allowable during retrieval operations. The amount of leakage that would be allowable depends on what will be done to remediate soil as a consequence of such leakage. Thus determination of allowable tank leakage during retrieval is related to and dependent on criteria for closing tank farms.

Evaluation of alternatives for tank farm closure, which would include evaluation of environmental impacts associated with retrieval of waste to the degree required for "clean closure" was not included within the scope of the TWRS EIS. The TWRS EIS stated that "sufficient information is not available to make final decisions on closure." The TWRS EIS states that the Hanford Tanks Initiative would "gather information and reduce uncertainties associated with tank closure" and that "information that would be gathered through the Hanford Tanks Initiative would be used to establish processes and criteria for future closure options."

In a report summarizing its review of the TWRS EIS, the Committee on Remediation of Buried and Tank Wastes, National Research Council, criticized DOE's and Ecology's decision to defer analysis of closure alternatives, because of the interrelationship of retrieval and closure. The Committee endorsed DOE's decision to address issues on retrieval and closure through the Hanford Tanks Initiative.

Several discrete technology needs must be satisfied to support decisions for tank closure alternatives. These needs include improvements to equipment and methods for tank waste heel removal, , methods to capture samples of waste that are not directly below the riser, and methods to map contaminants in the vadose zone. These needs are expanded in the following paragraphs.

Need Title: **Vadose Zone Contaminants Distribution**

Needs Description: Alternative technologies to conventional core drilling for characterization of the vadose zone that are fast, economical and minimize intrusion to the vadose zone are needed. These technologies should: 1) qualitatively and semi-quantitatively screen the soil column for Contaminants of Potential Concern (COPCs) and in so doing identify zones of contamination in the tank backfill material and vadose zone in tank farms; and 2) obtain soil samples at selected depths for confirmatory laboratory analysis. The technology must be capable to detect metal pipes and obstructions, and selectively seal any borings introduced into the soil column to eliminate any potential pathway for contaminant leakage to the aquifer. Technology to verify the quantity and extent of contaminants leaked to the vadose zone in tank farms will reduce the uncertainty associated with estimates of the radionuclide and hazardous chemical inventory in the tank farm soils. This information is key input to the performance assessment model(s) and the assessment of alternatives for retrieval and tank farms closure.

Need Title: **SST Retrieval Equipment/System Development**

Need Description: Performance and cost data comparing alternate and enhanced retrieval methods to the performance baseline of past-practice sluicing is needed. Data will be applied to the selection of retrieval systems for 1)Tank C-106 Heel Removal, 2) M&I retrieval of SSTs during Privatization Phase I, 3) concept design technical input to the Privatization Phase II specification (TPA Milestone M-45-04A) and 4) Assessment of retrieval technology performance for SST closure alternatives analysis. Supports maintaining core competency by providing expertise in the application of retrieval tools, regardless of the implementor.

Need Title: **Sampling Methods For Residual Heels - Off Riser Axis**

Need Description: Methods are needed to sample the residual waste from multiple off-riser locations in HLW tanks for residual waste analysis and composite leach testing. The results will provide key information required in support of the assessment of alternatives for retrieval and tank farm closure. Conventional methods (i.e., core and auger sampling) are constrained to single-point sampling locations immediately below available risers, which are limited in number. Sampling may not be attempted or successful at locations where there is little to no waste, where the waste layer is thin and dry, and where manual tapes and other items have been dropped from the riser to the floor of the tank. To reduce the uncertainty associated with the radionuclide and hazardous chemical inventory of the residual waste, sufficient numbers of locations in the tank must be sampled to provide sufficient characterization information to support tank waste retrieval and tank farm closure decisions.

Functional Performance Requirements:

Schedule Requirements: Completion of definition of retrieval performance objectives is needed by FY 2000 so that the results can be incorporated into the Outsourcing Phase II specification due to be completed in FY2003 and the first Single Shell Tank Closure Plan, due to be completed by November, 2004 (TPA M-45-06-T01).

Problem Description: Other than the retrieval performance goal provided in the Tri-Party Agreement, which is recognized by the Washington Department of Ecology and DOE in a memorandum of understanding as only an "interim" goal, no basis currently exists for defining retrieval performance objectives that address how much waste must be removed from SSTs and how much leakage during retrieval of SSTs will be allowable.

PBS No.	***WBS No.***	***TIP No.***
RL-TW04	1.1.4	Candidate

Justifications:

Technical Justification: This effort is required to establish retrieval system performance requirements relating to how much waste must be removed from SSTs, and how much waste may leak from SSTs during retrieval operations.

Regulatory Justification: 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 retrieval performance objectives and criteria for closure of Hanford SSTs.

ES&H Justification: Health and safety risks to workers and members of the public associated with alternatives for closing tank farms will be evaluated as part of the effort to address this technology need.

Cultural/Stakeholder Factors: The Washington Department of Ecology and DOE have signed a memorandum of understanding that commits to establishing retrieval performance objectives through soliciting input from Indian Nations and stakeholders, through interaction with the Hanford Advisory Board, Community Leaders Network, and the Site Technology Coordinating Group.

Cost Savings: A significant cost avoidance is expected if DOE can reduce uncertainty in the degree of waste removal required for waste retrieval operations and in limiting leakage during retrieval. Reduction of uncertainty in waste retrieval performance requirements will lead to lower contingency factors included in Outsourcing Phase II proposals. In addition, early establishment of retrieval performance objectives will reduce the risk that retrieval systems will need to be deployed a second time in a given SST, after a final retrieval performance goal is established, for SSTs that are retrieved by the PHMC contractor during Phase I Outsourcing.

Other: N/A

Consequences of Not Filling Need: Establishing retrieval system performance objectives based solely on what is technologically achievable, without regard to practicality, cost, and health and safety risk, could lead to inappropriate allocation of site cleanup funds. Deferring establishment of retrieval performance objectives will increase contingency in Phase 2 Outsourcing proposals for retrieval of SST wastes, and will increase the likelihood of requiring multiple deployments of SST retrieval systems by the PHMC contractors during Phase 1 Outsourcing.

Outsourcing Potential: Retrieval system performance specifications will be provided to the Phase 2 Outsourcing Contractor.

Baseline Technology: No baseline technology or approach has been established for closing Hanford tank farms, or for establishing the degree of waste removal from tanks that will be sufficient to close tank farms. Baseline technologies have not yet been demonstrated/established to retrieve difficult to remove residual hard heel; to retrieve multiple samples off-riser; and to screen for contaminants and selectively sample soils in the upper vadose zone in the tank farms.

End-User: TWRS Retrieval/Tank Farm Operations

DOE POCs: Bruce L. Nicoll, (509) 376-6006 Fax: (509) 373-0628, David S. Shafer (509) 376-9255 Fax: (509) 373-1313, Robert W. Lober (509) 373-7949 Fax: (509) 376-8532

Contractor Facility/Project Manager: R. W. (Bill) Root, Informatics (509) 373-1328

Site Technical POC: R. W. (Bill) Root, Informatics (509) 373-1328 Fax: (509) 373-6101

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

STANDARD METHOD FOR DETERMINING WASTE FORM RELEASE RATE

Identification No.: RL-WT015
Date: September, 1998

Program: Tanks - Storage & Disposal
OPS Office/Site: Richland
Operable Unit: Not Applicable
Waste Stream: Immobilized Low-Activity Tank Waste
Waste Management Unit: Not Applicable
Facility: Tank Farms

Site Priority Ranking: Medium

Need Title: Standard Method for Determining Waste Form Release Rate

Need Description: 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, amount and type of mineral and non-mineral species).

Waste forms are typically developed to minimize the rate of release as measured by a variety of test methods. Current ILAW product specifications require 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 Hanford. 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 2 ILAW product specifications.

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 Low-Level Tank Waste Interim Performance Assessment" (WHC-EP-0884), 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.

Functional Performance Requirements:

1) Develop and standardize a waste form release rate method applicable to dry environments. The effort should compare results from this method to others.

2) 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 2 waste form release rate specification.

3) Coordinate efforts with Hanford Low-Level Tank Waste Performance Assessment to ensure that environmental conditions are typical of Hanford.

Schedule Requirements:

1) For use in the Hanford Low-Level Tank Waste Performance Assessments such data and testing are needed by February 2001. Preliminary versions of the performance assessments will need data by January 1999.

2) A standard method for determining waste form release rate and supporting data is needed to prepare the ILAW product specifications for Phase 2 of the TWRS outsourcing beginning in approximately 2003.

Problem Description: 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 a ILAW product specification. The test should be accepted by a standards test organization such as the ASTM.

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 (_ = 0.1 to 1.0), and pH (ph = 6.0 to 12.0) conditions for use in performance assessment activities.

PBS No.	***WBS No.***	***TIP No.***
RL-TW09	1.1.9	N/A

Justification for Need:

Technical: Numerous test methods including the MCC test, PCT, and ANS 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.

Regulatory: DOE Order 5820.2a 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.

Environmental Health and Safety: 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 tank waste.

Cost Savings Potential: 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.

Cultural Stakeholder Concerns: 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.

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.

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.

Current Baseline Technology: Standardized tests are in fully immersed or saturated media (PCT, MCC) or in vapor (at high temperatures). Performance of tests at proper temperature, moisture, and pH is not currently possible but relies on extrapolation.

Connection to TWRS Logic:
The need for near term "getter research" to support the performance assessment and subsequent design of the ILAW disposal facility is outlined in TBR 460.145. The scheduled completion date for collecting the geochemical information to support the performance assessment is December

31, 1999. The late start for collection of this information is January 4, 2000. Activity 510.030 in the TWRS program logic is for preparing a closure EIS. The Record of Decision for the TWRS EIS identified closure technology development as prerequisite to conducting a closure EIS.

End-User: TWRS Storage and Disposal Project

Site Technical Point(s)-of-Contact: Fred Mann, Fluor Daniel Northwest; (509)376-5728; fax: (509)376-1293; email: frederick_m_mann@rl.gov or v92515@fep0.rl.gov
J. H. Westsik, Jr., Pacific Northwest National Laboratory; (509) 376-5985; fax: (509) 376-0166

Contractor Facility/Project Manager: Russell J. Murkowski - LMHC (509) 373-3885

DOE Representative Point of Contact: Phil LaMont, RL/TWRS; (509)376-6117; fax:(509)372-1350; philip_e_lamont@rl.gov

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

GLASS MONOLITH SURFACE AREA

Identification No.: RL-WT016
Date: September, 1998

Program: Tanks - Storage & Disposal
OPS Office/Site: Richland
Operable Unit: Not Applicable
Waste Stream: Immobilized Low-Activity Tank Waste
Waste Management Unit: Not Applicable
Facility: Tank Farms

Site Priority Ranking: Medium

Need Title: Glass Monolith Surface Area

Need Description: A method is needed to estimate the surface area of vitrified low activity waste. 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, 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.

Functional Performance Requirements:

For typical low-level waste glass monoliths using a variety of sizes and cooling methods:
1) Determine surface area and crack patterns.
2) Determine area reachable by moisture.
3) Accelerate aging and repeat measurements.
4) Determine unsaturated hydraulic properties of fractured and aged specimens.

Schedule Requirements: For use in the Hanford Low-Level Tank Waste Performance Assessments such data and testing are needed by September 2000. Preliminary versions of the performance assessments will need data by September 1998.

Problem Description: Status of technology for measurement and aging not known.

PBS No.	***WBS No.***	***TIP No.***
RL-TW09	1.1.9	N/A

Justification for Need:

Technical: 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.

Regulatory: Contaminant release rates are an important input the performance assessment which is required under DOE Order 5820.2A (soon to be codified under 10 CFR 834).

Environmental Health and Safety: 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 tank waste.

Cost Savings Potential: 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 hundred's of millions of dollars.

Cultural Stakeholder Concerns: 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.

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.

Outsourcing Potential: Methods could support the vitrification technology industry by providing a means to quantify long-term performance of vitrified products.

Current Baseline Technology: Rule of thumb (based on very limited and probably inapplicable experience).

Connection to TWRS Logic:
The need for near term "getter research" to support the performance assessment and subsequent design of the ILAW disposal facility is outlined in TBR 460.145. The scheduled completion date for collecting the geochemical information to support the performance assessment is December

31, 1999. The late start for collection of this information is January 4, 2000. Activity 510.030 in the TWRS program logic is for preparing a closure EIS. The Record of Decision for the TWRS EIS identified closure technology development as prerequisite to conducting a closure EIS.

End-User: TWRS Storage and Disposal Project

Site Technical Point-of-Contact: Fred Mann, Fluor Daniel Northwest; (509)376-5728; fax: (509)376-1293; email: frederick_m_mann@rl.gov or v92515@fep0.rl.gov

Contractor Facility/Project Manager: Russell J. Murkowski - LMHC (509) 373-3885

DOE Representative Point of Contact: Phil LaMont, RL/TWRS; (509)376-6117; fax:(509)372-1350; philip_e_lamont@rl.gov

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

LONG-TERM TESTING OF SURFACE BARRIER

Identification No.: RL-WT017
Date: September, 1998

Program: Tanks - Storage & Disposal
OPS Office/Site: Richland
Operable Unit: Not Applicable
Waste Stream: Immobilized Low-Activity Tank Waste
Waste Management Unit: Not Applicable
Facility: Tank Farms

Site Priority Ranking: Medium

Need Title: Long-Term Testing of Surface Barrier

Need Description: Surface barriers are being used over many Hanford environmental restoration and waste management sites and more barriers are expected 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. Project-specific funding at Hanford ends in September 1997. Since the design life of the barrier is 1,000 years, need data on degradation to better understand the validity of the design life estimate.

A similar Technology Needs statement has also been included in the Subcon needs list.

Functional Performance Requirements: Monitor performance of an existing barrier under both natural conditions and artificially applied increases in precipitation to reflect variability of natural conditions and possible human intrusion). Develop degradation experiments and perform them.

Schedule Requirements: For use in the Hanford Low-Level Tank Waste Performance Assessments such data and testing are needed by September 2000. Preliminary versions of the performance assessments will need data by September 1998. Closure will start occurring in 2005.

Problem Description: Short-term testing has been performed. Need continuing testing.

PBS No.	***WBS No.***	***TIP No.***
RL-TW09	1.1.9	N/A

Justification for Need:

Technical: The estimated natural recharge at the proposed tank waste disposal facility location is 3 mm/year. The specifications of the Hanford surface barrier are 0.5 mm/year for 1,000 years.

Regulatory: DOE Order 5820.2A (soon to be codified as 10 CFR 834) requires a performance assessment. 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 headquarters 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.

Environmental Health and Safety: See regulatory just above.

Cost Savings Potential: Surface barriers are being used among the DOE complex and particularly at Hanford. Improvements in design would establish confidence in long-term performance and would greatly affect both waste management and environmental restoration budgets.

Cultural Stakeholder Concerns: 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 which many see as vital in maintaining the unique shrub-steppe biological community in this area.

Consequences of Not Filling Need: The performance assessment 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.

Outsourcing Potential: 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.

Current Baseline Technology: A cover is undergoing 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 after FY 1997.

Connection to TWRS Logic:
The need for near term "getter research" to support the performance assessment and subsequent design of the ILAW disposal facility is outlined in TBR 460.145. The scheduled completion date

for collecting the geochemical information to support the performance assessment is December 31, 1999. The late start for collection of this information is January 4, 2000. Activity 510.030 in the TWRS program logic is for preparing a closure EIS. The Record of Decision for the TWRS EIS identified closure technology development as prerequisite to conducting a closure EIS.

End-User: TWRS Storage and Disposal Project

Site Technical Point-of-Contact: Fred Mann, Fluor Daniel Northwest; (509) 376-5728; fax: (509)376-1293; email: frederick_m_mann@rl.gov or v92515@fep0.rl.gov

Contractor Facility/Project Manager: Russell J. Murkowski - LMHC (509) 373-3885

DOE Representative Point of Contact: Phil LaMont, RL/TWRS; (509)376-6117; fax:(509)372-1350; philip_e_lamont@rl.gov

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

TESTING OF SAND-GRAVEL CAPILLARY BARRIER

Identification No.: RL-WT018
Date: September, 1998

Program: Tanks - Storage & Disposal
OPS Office/Site: Richland
Operable Unit: Not Applicable
Waste Stream: Immobilized Low-Activity Tank Waste
Waste Management Unit: Not Applicable
Facility: Tank Farms

Site Priority Ranking: Low

Need Title: Testing of Sand-Gravel Capillary Barrier

Need Description: Water is the driving force behind releasing contaminants from waste forms and then carrying those contaminants to groundwater. Surface moisture barriers (such as the Hanford barrier) have a design life of 1,000 years. Yet because of the dry conditions at Hanford, moisture infiltration should be minimized for thousands of years.

Unlike a surface barrier (which uses many of the same hydrologic principles), the capillary barrier diverts water away from the object underneath rather than storing the water until evaporation or plant transpiration removes the water. Thus the capillary barrier is expected to have a significantly longer life and be more effective than a surface barrier for moisture diversion.

Although the principles of sand-gravel capillary barriers are well established, such barriers (especially of ones the size needed for DOE applications) have not been extensively tested. Performance data are needed to confirm design parameters and long-term performance estimates.

Functional Performance Requirements: Design, construct, and operate a sand-gravel capillary barrier of significant extent. A variety of water input rates (ranging from those expected from the use of a surface barrier to those expected from crop irrigation) should be applied with moisture seepage through and around the barrier being collected. Effort should be expended to identify failure mechanisms.

***Schedule Requirements*:** Results from testing should be available to support preconceptual design of the waste disposal facilities for LAW.

Problem Description: A sand-gravel capillary barrier consists of a layer of fine material having high conductivity (such as sand) over a layer of coarse material having low conductivity (such as gravel). These layers are sloped in order to encourage water runoff. Experiments are needed to determine the range of application as well as technical parameters such as the slope of the layers and the optimal types of materials in the layers.

PBS No.	***WBS No.***	***TIP No.***
RL-TW09	1.1.9	N/A

Justification for Need:

Technical: The "Hanford Low-Level Tank Waste Interim Performance Assessment" (WHC-EP-0884) as well as earlier studies have identified the sand-gravel capillary barrier as a key component in the design of the disposal facility.

Regulatory: DOE Order 5820.2A (soon to be codified as 10 CFR 834) requires a performance assessment for DOE radioactive waste disposal facilities. The infiltration of moisture into the facility is a key parameter in determining the performance.

Environmental Health and Safety: See regulatory just above

Cost Savings Potential: The sand-gravel capillary barrier (if it can be shown to work in the field) is much less expensive than other facility design options or requiring a significantly better performing waste form. If restrictions on waste form, then procurement costs for the waste form could be reduced by hundreds of millions of dollars.

Cultural Stakeholder Concerns: Disposal of low-activity tank waste has the largest environmental impact of any intentional Hanford action.

Other:

Consequences of Not Filling Need: Other facility design option must be identified or (more likely) the specifications for Phase 2 of Hanford TWRS Privatization must be significantly tightened. The latter could add hundreds of millions of dollars to the procurement costs.

Outsourcing Potential: May have application to the design and construction of barriers over solid waste and especially hazardous waste landfills in the arid and semi-arid Western United States.

Current Baseline Technology: Theory is well understood. Limited field experience on related surface barriers.

Connection to TWRS Logic:
The need for near term "getter research" to support the performance assessment and subsequent design of the ILAW disposal facility is outlined in TBR 460.145. The scheduled completion date for collecting the geochemical information to support the performance assessment is December 31, 1999. The late start for collection of this information is January 4, 2000. Activity 510.030 in the TWRS program logic is for preparing a closure EIS. The Record of Decision for the TWRS EIS identified closure technology development as prerequisite to conducting a closure EIS.

End-User: TWRS Storage and Disposal Project

Site Technical Point-of-Contact: Fred Mann, Fluor Daniel Northwest; (509)376-5728; fax: (509)376-1293; email: frederick_m_mann@rl.gov or v92515@fep0.rl.gov

Contractor Facility/Project Manager: Russell J. Murkowski - LMHC (509) 373-3885

DOE Representative Point of Contact: Phil LaMont, RL/TWRS; (509)376-6117; fax:(509)372-1350; philip_e_lamont@rl.gov

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

CLEANING, DECONTAMINATING AND UPGRADING HANFORD PITS

Identification No.: RL-WT021
Date: September, 1998

Program: Tank Waste Remediation System
OPS Office/Site: Richland Operations Office/Hanford Site
Operable Unit (if applicable): N/A
Waste Stream:
Waste Management Unit (if applicable): N/A
Facility: Hanford Pits

Site Priority Ranking: Medium

Need Title: Cleaning, Decontaminating and Upgrading Hanford Pits

Need Description: Waste retrieved from Hanford tanks must pass through a number of pits associated with single shell tanks before it is received by the privatization contractor for disposal. Many of these pits will have to be modified before the waste can be transferred. Current methods for modifying, operating, cleaning and decontaminating these pits are labor intensive and costly and result in a high dose to workers. Currently, work associated with pits is the single largest contribution to TWRS operations dose levels. For example, the dose in the 241-C-106 pits was 40 R/hr. After investing $2 million and 5 months, the dose had been reduced to only 20 R/hr. During the pit operations, 25 personrems were accumulated.

Functional Performance Requirements: Improved methods of pit decon 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 decon 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:

1. Reduce the dose levels at the edge of the pit to as low as reasonably achievable by a combination of trash removal and decon , in one week.

2. Assist in the removal of heavy objects from the pit by positioning the crane hook onto lifting bails.

3. Provide jumper and connector measurements, accurate to +/- 1/64 inch, so replacement/alternate jumpers can be fabricated without operator entry into the pit to obtain measurements.

4. Provide devices to change out and/or install jumpers in less than one shift.

5. Perform as many pit decon and refurbishment operations as possible with the greenhouse roof in place.

6. Provide CCTV viewing of in-pit operations.

Schedule Requirements: The HTI project will begin decontaminating and upgrading pits on tank 241-C-106 in June, 1999. New methods of pit decon 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.

Problem Description: Technologies for remote mapping or remote handling must be adapted to the configuration and specific tasks that are required. Existing commercial equipment cannot be deployed without modification. Chemical methods to decontaminate surfaces must be demonstrated to be effective and methods must be developed to assure cleaning solutions can be contained during decontamination, and suitably disposed after the solution is loaded with contaminants.

PBS No.	***WBS No.***	***TIP No.***
RL-TW03	1.1.3	Candidate

Justification for Need:

Technical: 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.

Regulatory: N/A

Environmental Safety and Health: Present methods require significant worker dose, particularly when manned entry is required for complicated tasks.

Cost Savings Potential (Mortgage Reduction): Over 600 pits exist at Hanford, 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.

Cultural/Stakeholder Concerns: None identified for mapping or remote systems. 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.

Other: N/A

***Consequences Of Not Filling Need*:** For HTI, about 2 million dollars has been budgeted for additional pit cleaning, decon and upgrade on pits that were moderately decontaminated (at a cost of about 2 million dollars) by a predecessor project (W-320). If 67 Hanford tanks must be retrieved with a pit decontamination for each tank at a cost of 4 million dollars each, total costs could exceed a quarter of a billion dollars.

Outsourcing Potential: All phases of this need have potential for commercial applications.

Current Baseline Technology: Manual, long-reach tools, conventional decontamination and shielding techniques.

End-User: Tank Farm Operations, TWRS Projects

Site Technical Point(s)-of-Contact: Tom May, NHC (509) 372-2493

Contractor Facility/Project Manager: R. W. (Bill) Root - Informatics (509) 373-1328

DOE End-User/Representative Point(s)-of-Contact: Mike Royack, (509) 376-4420

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

TANK KNUCKLE NDE

Identification No.: RL-WT022
Date: September, 1998

Program: Tanks - Operations
OPS Office/Site: Richland
Operable Unit (if applicable): N/A
Waste Stream: Double Shell Tanks
Waste Management Unit (if applicable):
Facility: Tank Farms

Site Priority Ranking: High

Need Title: Tank Knuckle NDE

Need Description: The Tri Party Agreement (TPA) schedule requires the completion of the Double Shell Tank (DST) system Integrity Assessment Program by the end of fiscal year 1999. It is required that no fewer than 6 DSTs will undergo a non-destructive evaluation (NDE) of a portion of the tank wall, bottom knuckle, and bottom. 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. This region is accessible for examination only 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 the length and through-wall extent of defects is not possible using current technology.

Functional Performance Requirements: Functional requirements for ultrasonic inspection capable of characterizing defects in the knuckle region include:

- Propagating ultrasound a distance of four feet around a plate with a one-foot radius.
- Detect cracks that exceed 0.18 inches and determine the through wall extent to an accuracy of 0.1 inch.
- Detect corrosion that exceeds 25% wall thickness and determine the through wall extent to an accuracy of 0.05inches.

Schedule Requirements: DSTs will continue to be needed for waste storage through approximately 2024. The earlier a NDE system can be deployed, the greater the potential benefit.

Problem Description: Comprehensive NDE of DST primary and secondary tank walls is required by TPA 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. The ability to examine the inner shell of double-shell waste tanks and perform examination of the main cylinder section of a tank was demonstrated on 241-AW-103 in fiscal year 1996.

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 accessible only by propagating ultrasonic energy around a plate with a one-foot radius bend. 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.

TSAFT imaging technology is a proven 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.

PBS No.	***WBS No.***	***TIP No.***
RL-TW03	1.1.3	N/A

Justification For Need:

Technical: 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.

Regulatory: Completion of the physical examinations of the DSTs is required by TPA commitment and as a prerequisite for obtaining Resource Conservation and Recovery Act (RCRA) Part B permit status for continued operation of the DST system.

- Washington Administrative Code 173-303-640(2)(c)(iii) requires a physical examination (NDE) or leak test as a part of an integrity assessment program.

Environmental Safety & Health: Assessing the integrity of double shell tanks helps ensure that no catastrophic leaks will occur in the double shell tanks. Early detection of any degradation of double shell tanks provides an opportunity to plan and develop corrective actions.

Cost Savings Potential (Mortgage Reduction): Developing tank knuckle NDE technology will reduce the time required for examining double shell tanks by reducing the area that must be scanned for defect detection and characterization. This technology is needed to provide the quantitative information on the length and depth of the flaws of any flaws detected during the inspection of the knuckle region of the tanks. Without this technology, very conservative assumptions will have to be made about the flaw size.

Cultural/Stakeholder Concerns: The oversight committee on tank integrity has identified inspection of the knuckle region of double shell tanks as critical.

Other: N/A

Consequences Of Not Filling Need:

Regulatory Impacts: The U. S. DOE has previously entered into negotiations with the Washington State Department of Ecology (WDOE) and the U. S. Environmental Protection Agency for determination of acceptable compliance with WAC-173-303-640. Completion of DST NDE was a part of these negotiations.

Programmatic Impacts: If knuckle NDE technology is not developed, a majority of the high-stress region of the knuckle that rests on the concrete foundation can not 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. That uncertainty contributes to programmatic risk of serious delays in the TWRS program should a leak occur.

Outsourcing Potential: N/A

Current Baseline Technology: Baseline NDE technology is capable of evaluating only wall thinning on uniform plate in the DST annuli. There is no capability for examining the bottom knuckle or tank bottom. Moreover, the ability to identify pitting and cracking is limited.

Programmatic Risks: The TWRS program needs knuckle NDE technology to avoid two serious risks:

- Delay of the program as a consequence of a DST leak unexpectedly taking one or more tanks out of service.
- Physical regulatory non-compliance and the resulting negative attention.

***Connection to TWRS Logic*:** This need supports TWRS Program Logic "Maintain Authorization Basis" and "Conduct Tank Farm Safe Operation."

End-User: Retrieval/Tank Farm Operations

Site Technical Point(s)-of-Contact: Dan C. Pfluger, (509) 376-6164, Lockheed Martin Hanford Corporation, Tom T. Taylor, (509) 375-4331, Pacific Northwest National Laboratory, Jim L. Nelson, (509) 373-6296, Lockheed Martin Hanford Corporation.

Contractor Facility/Project Manager: Howard L. Budweg - FDH (509) 376-8476

DOE End-User/Representative Point(s)-of-Contact: Mark L. Ramsay, (509) 376-7924

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

PREDICTION OF SOLID PHASE FORMATION IN HANFORD TANK WASTE SOLUTIONS

Identification No.: RL-WT023
Date: September, 1998

Program: Tanks - Process Waste
OPS Office/Site: Richland Operations Office/Hanford
Operable Unit: (if applicable): N/A
Waste Stream: Double and Single Shell Tanks
Waste Management Unit: if applicable): N/A
Facility: Tank Farms

Site Priority Ranking: Medium

Need Title: Prediction of Solid Phase Formation in Hanford Tank Waste Solutions

Need Description: Information is needed on the physical and chemical properties, which represent the complex solid and liquid matrices of the Hanford tank wastes. This information is needed to predict solids precipitation, gel formation, and the crystal structure of solids, which form in retrieval, wash, and leach solutions. Much information is available from past solubility chemistry work at Hanford and from other DOE sites. Available information needs to be compiled for easier use, missing data need to be identified, and work performed to supply the missing data. The information will be used to support the development of the Hanford Tank Waste Remediation System Retrieval, Waste Feed Delivery, and Disposal Program. The Disposal Program supports the Hanford Privatization (vitrification) effort by supplying feed to a private vitrification contractor.

Functional Performance Requirements: Development of mathematical models, test equipment, and final reports (which establish the basis for ultimate design development) will be produced. A compilation of data which describes the process conditions which result in line plugging or otherwise unfavorable waste transfer properties will be developed. The compilation should accurately and efficiently predict solubilities for the major problem species expected in the complex solid and liquid matrices expected in the Hanford tank wastes. Examples of problem species are aluminates, phosphates, fluorophosphates, silicates, and chromates. The information should be suitable for inclusion in the Aspen software program and the Environmental Simulation Program (ESP), both of which are in use at Hanford. The work should include literature review to identify what solubility data are missing and identify what experimental work is needed to provide the missing data. The identified experiments should be performed and the resulting data included in the compilation.

Schedule Requirements: This effort was initiated in FY 1998. It provides needed information for specifying the interface between the Retrieval Contractor and the Private Vitrification Contractor and is fundamental for preparation of the design work necessary to support the TWRS Disposal mission. Information on the chemical systems associated with the Phase 1 feeds needs to be available by March 1999 so that the HLW and LAW plans can be updated and findings incorporated. Acquisition of remaining data should be completed by the end of FY 2000. Data obtained to meet this technology should be provided every year as input to the TWRS Operation and Utilization Plan, (HNF-SD-WM-SP-012; Level 1 Logic Box 150.B22, "Maintain TWRSO&UP) as it becomes available.

Problem Description: Solids and gels are known to form in the Hanford tank wastes when the solution ionic strength is decreased. 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 wash, leach, and dissolution processes are based on an understanding of the dissolution thermodynamics and kinetics rather than just empirical data. Water usage and makeup chemical addition can also be reduced which together with the improvement in efficiency can reduce the amount of HLW glass produced.

PBS:	***WBS:***	***TIP No.***
RL-TW04	1.1.1.3.3	N/A

Justification for Need:

Technical: This effort will provide a basis for developing well based and technically sound process designs.

Regulatory: N/A

Environmental Safety & Health: Safety impacts to the ultimate operations of the final system will benefit from the information by supporting Technical Safety Requirement (TSR) development.

Cost Savings Potential (Mortgage Reduction): A significant cost avoidance is expected by optimizing the final design of the system.

Cultural Stakeholder Concerns: N/A

Other: N/A

Consequences of Not Filling Need: The lack of technical understanding of wastes may cause conservative assumptions to be implemented without just merit.

Outsourcing Potential: N/A

Current Baseline Technology: A thermodynamic model known as the Environmental Simulation Program (ESP) has been only partially validated with actual waste solubility data.

End-User: TWRS (Program/Waste Disposal Division)

Site Technical Points-of-Contact: Ivan Papp, (509) 372-0940; John Garfield, (509) 376-2745

Contractor Facility/Project Manager: N/A

DOE Representative Point of Contact: Peter Furlong, (509) 372-1738; fax (509) 373-028;
email: peter_t_furlong@rl.gov or
Rudy Carreon (509) 373-7771; email: rudolfo_rudy_carreon@rl.gov

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

ENHANCED SLUDGE WASHING PROCESS DATA

Identification No.: RL-WT024
Date: September, 1998

Program: Tanks - Process Waste
OPS Office/Site: Richland Operations Office/Hanford
Operable Unit: (if applicable): N/A
Waste Stream: Single Shell Tanks
Waste Management Unit: if applicable): N/A
Facility: Tank Waste Pretreatment

Site Priority Ranking: Medium

Need Title: Enhanced Sludge Washing Process Data

Need Description: This is a continuation of the Enhanced Sludge Wash (ESW) program that has been in progress for several years. A strategy was originally developed (Kupfer 1994, Kupfer 1995) that showed how data from 47 single shell tanks could be used to represent 93 %of the SST sludge volume. During Fiscal Years 1994, 1995, 1996, and 1997 enhanced sludge washing tests were performed on 30 samples of single shell tank (SST) sludges to establish chemical and radionuclide removal efficiencies. When ESW showed poor chromium removal from particular sludge samples, additional tests were performed to determine how to improve the chromium removal by longer leach times or by oxidative leaching. The results from these tests were extrapolated to represent 75 % of the SST sludge volume at Hanford.

An independent review of the data available in January 1997 concluded that as much as 80 % of the tank waste sludge could be processed using enhanced sludge washing, with the balance of the sludge material being treated with additional processes to meet DOE's goals on reducing glass production. There may be 20 percent of the tank sludge that requires special handling such as selectively applied extended leach duration, or oxidative chromium leaching. From this review and the completion of FY 1997 testing, DOE-RL determined in September 1997 that there "is sufficient technical basis to complete the Tri-Party Agreement Interim Milestone M-50-03 based upon the current understanding of the tank waste compositions, tank waste inventory, tank waste pretreatment chemistry, retrieval process modeling and high-level waste (HLW) vitrification process chemistry." (Sanders 1997)

Notwithstanding the M-50-03 determination, parts of the 1995 Kupfer sampling and testing strategy remain to be completed. The REDOX-type sludge wastes contain most of the hard-to-remove chromium, and require additional testing to confirm chromium removal efficiencies during enhanced sludge washing and to reduce uncertainties in extrapolating data from single tanks to groups of tanks. Completion of this strategy supports retrieval sequence development and broadens the technical foundation that is needed for bidding Phase 2.

Functional Performance Requirements: Enhanced sludge wash process data representing 90+% of the SST sludge volume and 70+% of the DST sludge volume. An understanding of the Cr removal chemistry that allows reduction of the impact of Cr on HLW glass by 50%.

Schedule Requirements: This work is immediately driven by the need to support the SST retrieval sequence analysis. The retrieval sequence analysis will provide the foundation for preparation of the Phase 2 RFP and contract award, and meets Tri-Party Agreement Interim Milestones M-45-02D through M-45-02I (annual updates of the SST Retrieval Sequence document). Test data will serve as an input to TWRS Level 1 Logic box 150.B24, "Maintain TWRSO&UP", as it becomes available and will be used in annual updates to the TWRS Operation and Utilization Plan.

The actual start of the Phase 2 bidding process is probably delayed by several years because of the delay and extension of Phase 1.

ESP verification work should be conducted as soon as possible, i.e., as soon as funds are available. The experimental results are already available for cross-checking.

Problem Description: The scope of additional testing is similar to the program that was planned for FY 1998. This includes testing the effect of temperature, duration and caustic concentration on the leach/wash behavior of high priority sludges, and observing the stability of leachates and wash solutions. Tank waste sludge samples showing poor chromium removal need to be subjected to additional testing to determine how to increase chromium removal.

Of the Kupfer strategy tanks that remain to be tested, tank BX-110 is available because it was not tested during FY 1998, tank S-110 was sampled recently and its availability for ESW testing is unknown, and tank TX-118 sampling is scheduled for September 1998. Other samples that are available because they were not tested during FY 1998 are: tanks B-101, SX-108, C-103, U-103, and C-102 (in rough order of priority).

The final aspect of ESW work is the cross-checking of ESP results with experimental results. Four ESW experiments were modeled during the current year and six more are scheduled for FY 1999.

PBS No.	***WBS No.***	***TIP No.***
RL-TW05	1.1.5	N/A

Justification for Need:

Technical: This effort will provide a basis for a fair cost estimate and the writing of a meaningful RFP for Privatization Phase 2.

Regulatory: N/A

Environmental Safety & Health: N/A

Cost Savings Potential (Mortgage Reduction): A significant cost avoidance is expected if DOE is armed with information that allows a more precise RFP to be written and a realistic knowledge of the Privatization Phase 2 costs with which to evaluate Vendors' proposals.

Cultural Stakeholder Concerns: N/A

Other: N/A

Consequences of Not Filling Need: The lack of technical understanding of Privatization Phase 2 will cause the Phase 2 Vendors' facilities to be more expensive due to an inexact RFP and a lack of understanding upon which to do a bid evaluation.

Outsourcing Potential: N/A

Current Baseline Technology: Satisfying this technical need is required to meet the current baseline.

End-User: TWRS Process Waste Support Function

Site Technical Point-of-Contact: Steve Schaus, (509) 372-1149; Randy Kirkbride, (509) 372-2115

Contractor Facility/Project Manager: Russ L. Treat, (509) 373-3824

DOE Representative Point of Contact: Peter T. Furlong, (509) 372-1738; fax (509) 373-0628; e-mail: peter_t_furlong@rl.gov, and
Rudy Carreon (509) 373-7771, e-mail: rudolfo_rudy_carreon@rl.gov

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

TANK LEAK DETECTION SYSTEMS FOR UNDERGROUND SINGLE-SHELL WASTE STORAGE TANKS (SSTS)

Identification No.: RL-WT026
Date: September, 1998

Program: Tanks - Retrieval
OPS Office/Site: Richland Operations Office/Hanford
Operable Unit (if applicable): N/A
Waste Stream: Single Shell Tanks
Waste Management Unit (if applicable): N/A
Facility: Tank Farms

Site Priority Ranking: High

Need Title: Tank Leak Detection Systems for Underground Single-Shell Waste Storage Tanks (SSTs)

Need Description: The use of past-practice sluicing for SST waste removal involves the addition of liquid to tanks and therefore increases the potential for waste leakage to the environment. Leak detection applies to all SST retrieval, including retrieval during Phase I and preparation of the Phase II specification. Leak detection methods are needed that can signal and quantify a leak from a tank when only a small amount of waste has escaped.

Functional Performance Requirements: The final leak detection approach and requirements will be negotiated with DOE-RL and Ecology. Candidate detection 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. Detection systems should address the following types of issues:

- Sensitivity to detect a minimum leak volume of not more than 2000 gallons of liquid
- Determine the quantity of leaked material to +/- 50%
- Limit the false detection of a leak to no more than 20%
- 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 frame of a sluicing campaign)
- Cost-benefit and risk-reduction when compared to the baseline approach and no-action scenario

- The detection tool/system must include a capability for installation verification and periodic performance verification while installed and/or in service
- 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, capable of "surviving" deployment

Schedule Requirements: This need supports TPA milestones for submitting annual progress reports on the development of waste tank leak detection, monitoring, and mitigation (LDMM) activities. TPA milestones M45-08A and B require presentation of the leakage mitigation approach that will be used during sluicing of SSTs, and demonstration and evaluation of those tools that prove to be viable. Leak detection systems will be of value throughout the waste retrieval period, which may extend from FY 1999 to 2024.

Problem Description: 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 mitigation measures can be implemented. The tank farm areas are quite 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.

PBS No.	***WBS No.***	***TIP No.***
RL-TW03	1.1.3	N/A

Justification For Need:

Technical: Provisions for leakage detection are prerequisite to initiating actions to remove waste from leaking tanks. TPA Milestone M-45-08A requires measures for leak detection to be included in the design of the initial SST retrieval task. This effort is required to ensure that the specification for initial SST waste retrieval, and the Phase II Privatization Contract, are adequate for bidders to make informed decisions and to show a minimum cost.

Regulatory: 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. Leakage mitigation is a major Hanford Stakeholder value and is expressed as a concern by Ecology through the TPA milestones of the M45-08 series. In particular, milestone M45-08-T02 requests a statement of "*...acceptable leak monitoring/detection and mitigation measures necessary to permit sluicing operations.*"

Environmental Safety & Health: 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. The establishment and technology to control leakage within allowable leakage volumes (ALVs) is an important mitigation action since that approach sets operational limits within which soil remediation and closure can still proceed even in the event that leakage may occur. A viable approach to leakage mitigation during sluicing will contribute to the capability to ensure that leakage is managed below ALVs, and to maintain overall safe operations during waste retrieval.

Cost Savings Potential (Mortgage Reduction): 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 can avoid this type of higher contingency factor in the Phase II Privatization bids.

Cultural/Stakeholder Concerns: Leakage detection and mitigation during waste retrieval are major issues of concern with Ecology and Hanford Stakeholders. This concern is reflected in TPA milestones, review of the TWRS EIS, and in other public documentation.

Other: N/A

Consequences Of Not Filling Need: A position based upon current baseline detection and mitigation tools and capabilities will be negotiated with Ecology. Since current capabilities for detection are based on material balances, the inherent sensing sensitivity is a function of the sensitivity and accuracy of tank level measuring systems. 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. Phase II Privatization Contractors would have to put a larger contingency in their bids for retrieval of SSTs to negotiate this matter with Ecology, Hanford Stakeholders, and the public by themselves.

Outsourcing Potential: Demonstration of candidate mitigation tools and methods will show where industry has the capabilities to perform now and where additional technology would be helpful.

Current Baseline Technology: The current baseline detection approach is based on measuring the tank inventory and flowrates of material introduced to a tank for sluicing and discharged from the tank as retrieved waste to conduct a material balance. A discrepancy among these figures may indicate a leak. The leak sensitivity is estimated to be about 8000 gallons.

End-User: Retrieval/Tank Farm Operations

Site Technical Point(s)-of-Contact: D. F. Iwatate (DESH), (509) 376-8856; P. W. Gibbons (NHC), (509) 372-0095

Contractor Facility/Project Manager: Russ L. Treat - MACTC (509) 373-3824

DOE End-User/Representative Point(s)-of-Contact: Bruce L. Nicoll, (509) 376-6006; fax (509) 372-1350; e-mail: bruce_l_nicoll@rl.gov

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

TANK LEAK MITIGATION SYSTEMS

Identification No.: RL-WT027
Date: September, 1998

Program: Tanks - Retrieval
OPS Office/Site: Richland Operations Office/Hanford
Operable Unit (if applicable): N/A
Waste Stream: Single Shell Tanks
Waste Management Unit (if applicable): N/A
Facility: Tank Farms

Site Priority Ranking: High

Need Title: Tank Leak Mitigation Systems

Need Description: The use of past-practice sluicing for SST waste removal involves the addition of liquid to tanks and therefore increases the potential for waste leakage to the environment. Leakage mitigation applies to all SST retrieval, including retrieval during Phase I and preparation of the Phase II specification. Leakage mitigation efforts and tools, that can be shown to provide cost-benefit and significant risk reduction over baseline methods, should be incorporated into retrieval system design and operating procedures. 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 leakage mitigation tools for possible application during SST retrieval operations is required on a continuing basis.

Functional Performance Requirements: The final leakage mitigation approach and requirements will be negotiated with DOE-RL 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. Mitigation systems should address the following types of issues:

- Maximizing in-tank and/or ex-tank opportunities to reduce or stop leakage prior to, during, or following sluicing
- 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 sluicing campaign)

- Cost-benefit and risk-reduction when compared to the baseline approach and no-action scenario
- 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.

Schedule Requirements: This need supports TPA milestones for submitting annual progress reports on the development of waste tank leak detection, monitoring, and mitigation (LDMM) activities. TPA milestones M45-08A and B require presentation of the leakage mitigation approach that will be used during sluicing of SSTs, and demonstration and evaluation of those tools that prove to be viable. Leak mitigation systems can provide value throughout the duration of waste retrieval, which may extend to 2024.

Problem Description: 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 mitigating technologies determine that deployment, implementation, and operation is feasible, then further evaluation should be pursued. Such evaluations may include demonstrations and testing. Example concepts that could be evaluated include retrieval methods which 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, sheet barriers, close-coupled grout injection barriers, and dry-air containment barriers.

PBS No.	***WBS No.***	***TIP No.***
RL-TW03	1.1.3	Candidate

Justification for Need:

Technical: Provisions for leakage mitigation are prerequisite to initiating actions to remove waste from leaking tanks. TPA Milestone M-45-08A requires measures for leak mitigation to be included in the design of the initial SST retrieval task. This effort is required to ensure that the specification for initial SST waste retrieval, and the Phase II Privatization Contract, are adequate for bidders to make informed decisions and to show a minimum cost.

Regulatory: 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. Leakage mitigation is a major Hanford Stakeholder value and is expressed as a concern by Ecology through the TPA milestones of the M45-08 series. In particular, milestone M45-08-T02 requests a statement of "*...acceptable leak monitoring/detection and mitigation measures necessary to permit sluicing operations.*"

Environmental Safety & Health: 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. The establishment and use of allowable leakage volumes (ALVs) is an important mitigation action since that approach sets operational limits within which soil remediation and closure can still proceed even in the event that leakage may occur. A viable approach to leakage mitigation during sluicing will contribute to the capability to ensure that leakage is managed below ALVs, and to maintain overall safe operations during waste retrieval.

Cost Savings Potential (Mortgage Reduction): 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 can avoid this type of higher contingency factor in the Phase II privatization bids.

Cultural Stakeholder Concerns: Leakage detection and mitigation during waste retrieval are major issues of concern with Ecology and Hanford Stakeholders. This concern is reflected in TPA milestones, review of the TWRS EIS, and in other public documentation.

Other: N/A

Consequences of Not Filling Need: A position based upon current baseline mitigation tools and capabilities will be negotiated with Ecology. 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. Phase II privatization Contractors would have to put a larger contingency in their bids for retrieval of SSTs to negotiate this matter with Ecology, Hanford Stakeholders, and the public by themselves.

Outsourcing Potential: Demonstration of candidate mitigation tools and methods will show where industry has the capabilities to perform now and where additional technology would be helpful.

Current Baseline Technology: Current baseline mitigation approach includes the following measures:

- Use of "smart sluicing" by Retrieval Operations to minimize aggravation of tank weak points
- Sluicing with appropriate diligence to determine, at the earliest possible time, if leakage is occurring
- Removal of water from tanks via interim stabilization when leakage rate and volume warrant
- 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.

End-User: Retrieval/Tank Farm Operations

Site Technical Points-of-Contact: D. F. Iwatate (DESH), (509) 376-8856; P. W. Gibbons (NHC), (509) 372-0095

Contractor Facility/Project Manager: Russ L. Treat - MACTC (509) 373-3824

DOE Representative Point of Contact: Bruce L. Nicoll, (509) 376-6006; fax (509) 372-1350; e-mail: bruce_l_nicoll@rl.gov

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

DATA AND TOOLS FOR PERFORMANCE ASSESSMENTS

Identification No.: RL-WT029
Date: September, 1998

Program: Tanks - Storage & Disposal
OPS Office/Site: Richland
***Operable Unit*: (if applicable):** N/A
Waste Stream: Immobilized Low-Activity Tank Waste
Waste Management Unit: if applicable): N/A
Facility: Tank Farms

Site Priority Ranking: Medium

***Need Title*:** Data and Tools for Performance Assessments

Need Description: Performance assessments must be developed for all disposal actions, and the models that are used for these assessments require a defensible basis for the movement of water. Most databases describe recharge and distribution of water for non-arid conditions. The arid conditions at Hanford are not accurately represented by the existing data. This need is comprised of two elements:

1) 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 time of compliance of the facility.

2) Assessments of waste disposal require the knowledge of hydraulic properties in the unsaturated sediments (the vadose zone). Typically, these properties are inferred or estimated from small cores or particle size distributions obtained from a drilled borehole. Field measurements of hydraulic properties will eliminate the uncertainty when extrapolating small-scale laboratory measurements.

This Technology Needs statement has been included in the Subcon needs list.

Functional Performance Requirements:

For recharge issues:

1) Identify range of factors that affect recharge

2) Develop new and innovative methods to determine recharge rates in and around subsurface disposal facilities
3) Estimate recharge rates for a subset of the range of factors and correlate estimates from multiple methods.
4) Use estimates to quantify spatial and temporal distribution of recharge rates for the spatial and temporal extent of the disposal facility.

Factors of interest that can contribute to variable recharge rates include soil type, vegetation, facility and surface cover design, human activity, climate, and time.

For hydraulic properties:

Design, construct, and operate a device to measure hydraulic properties in the vadose zone. Measurement of variables such as water content and matric potential, which are used to calculate conductivity, must be accurate and quick. The device must be portable and reusable.

Schedule Requirements: For use in the Hanford Low-Level Tank Waste Performance Assessments, such data and testing are needed by September 2000. Preliminary versions of the performance assessments will need data by September 1998.

Problem Description: Computer codes, hydraulic measurements, and tracer movement can be used to estimate recharge rates. These techniques are not often used in conjunction, and hardly ever to characterize the spatial distribution of recharge rates.

PBS No.	***WBS No.***	***TIP No.***
RL-TW09	1.1.9	N/A

Justification for Need:

Technical: Provide technical basis for characterizing the distribution of hydraulic properties and recharge rates in and around the Hanford Low-Level Tank Waste Disposal System. Such information will also be required for other waste management actions involving subsurface disposal.

Regulatory: Performance assessments are required by DOE Order 5820.2A, soon to be revised and issued as DOE Order 435.1. Composite analyses, which also require knowledge of recharge, are required under separate guidance and are related to the soon to be issued 10 CFR 834, Radiation Protection of the Public and the Environment.

Environmental Health and Safety: Recharge water is the main means for dissolution/release of contaminants from waste and the transport of those contaminants to groundwater.

Cost Savings Potential: 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.

Cultural Stakeholder Concerns: Disposal of low-activity tank waste has the largest environmental impact of any intentional Hanford action.

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.

Outsourcing Potential: N/A

Current Baseline Technology: Point estimates of recharge and laboratory measurements of hydraulic properties on small cores.

Connection to TWRS Logic:
The need for near term "getter research" to support the performance assessment and subsequent design of the ILAW disposal facility is outlined in TBR 460.145. The scheduled completion date for collecting the geochemical information to support the performance assessment is December 31, 1999. The late start for collection of this information is January 4, 2000. Activity 510.030 in the TWRS program logic is for preparing a closure EIS. The Record of Decision for the TWRS EIS identified closure technology development as prerequisite to conducting a closure EIS.

End-User: TWRS Storage and Disposal Project

Site Technical Point-of-Contact: Fred Mann, Fluor Daniel Northwest, phone: (509)376-5728; fax: (509)376-1293; email: frederick_m_mann@rl.gov or v92515@fep0.rl.gov

Contractor Facility/Project Manager: Russell J. Murkowski - LMHC (509) 373-3885

DOE Representative Point of Contact: Phil LaMont, RL/TWRS, phone (509)376-6117; fax:(509)372-1350; email: philip_e_lamont@rl.gov

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

PHMC RETRIEVAL AND CLOSURE - HANFORD/SRS WASTE MIXING MOBILIZATION

Identification No: RL-WT060
Date: September, 1998

Program: Waste Feed Delivery
OPS Office/Site: Richland Operations Office/Hanford
Operable Unit (if applicable): N/A
Waste Stream: Double Shell Tanks
Waste Management Unit (if applicable):
Facility: Tank Farms

Site Priority Ranking: Medium

Need Title: PHMC Retrieval and Closure - Hanford/SRS Waste Mixing Mobilization

Need Description: This activity combines mixer pump retrieval enhancement needs from Hanford and Savannah River Site (SRS).

1) Hanford needs 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) Hanford also requires, as part of mixer pump retrieval, a means of transferring waste from a tank that is being actively mixed at the waste depth that is best for a given transfer requirement without having to change pumps for surface decant and bottom/sludge transfer operations with attendant low water level conditions.

3) 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. Safety impacts to Authorization Bases also needs to be evaluated. The Tanks Focus Area (TFA) is evaluating the use of Flygt mixers for SRS this year as part of this goal.

4) Savannah River Site is preparing to begin sludge retrieval using its baseline long-shaft mixers. They need to optimize their operational strategy so that as much sludge as possible can be sent to DWPF as feed. This will require testing of multiple pump

retrieval interactions. Hanford may use results of the SRS work for long-shaft mixer operational improvements as one candidate solution for the extended sludge retrieval.

Functional Performance Requirements: Mixer pumps must mobilize the wastes and homogenize them to meet privatization contractor waste feed envelopes. Those envelopes are currently being redefined as a result of the privatization contractor's proposed approach.

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.

Parameter	Baseline Mixer Pump (Project W-211)	Advanced Design Mixer Pump
Cost for each pump	$500K	$625K
U_oD (nozzle velocity X nozzle diameter) ft^2/sec	29.4	29.4
Riser diameter (inches)	42	42
Installed Weight (lbs)	25,000	20,000
Pump operating life, intermittent (hrs)	5,000	5,000
Pump starts/stops	100	100
Pump installed life in tank (years)	5	10
Approximate total quantity of pumps required for the TWRS program life	216	86

Schedule Requirements: The 101-AZ process test of mixer pump performance is scheduled to be run in mid-FY99. This test will establish baseline performance benchmarks for mixer pumps at Hanford.

The first waste feed delivery to the privatization contractor which relies on mixer pumps to mobilize waste is scheduled for completion of turnover to operations in December of 2002. Two pumps have been installed in 101-AZ by project W-151 to run the process test. Project W-151 has procured a spare pump. Project W-211 has procured 2 pumps for installation in DSTs. The most recent "what if" planning case includes design for 5 DST systems using these mixer pumps in FY 1999.

If the process test proves that mixer pump performance is less than adequate, very little time will be available to design and deploy an alternative technology. 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 begin in FY 2000 and continue each year for several years.

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.

Problem Description: Mixing pump technology is expensive, and its function has not yet been proven in Hanford tanks. Mixing is the current technical baseline for retrieval from Double Shell Tanks. Because it is both expensive and unproven, it is desirable to continue looking for alternatives or enhancements which are more effective and/or less costly.

Possible Concept: One possible alternative or performance enhancer is the use of the Flygt (brand name) mixer. These commercially available mixer are under testing and development by SRS and show promise both as a cost effective alternative to mixer pumps, and as a supplement to mixer pumps which can improve mobilization. The Flyght mixers are submersible motor, direct drive, propeller type mixers which are commonly deployed in water treatment and settling basin applications.

PBS No.	***WBS No.***	***TIP No.***
RL-TW04	1.1.4	Candidate

Justification For Need:

Technical: This task will first determine the requirements of the technology based on the needs. Once the requirements have been established, then the search for the technology candidates can begin. Therefore there is not a specific technology to describe at this time.

To be successful this first step must clearly identify and quantify all requirements for the system. Further, to give an adequate baseline for comparison, the current baseline technology (mixer pumps) will be evaluated for their performance in each of those requirement areas. The focus of this work must be on technologies which can be adapted for field deployment. Therefore the Authorization Bases of these systems must be investigated and all requirements which would be placed on a field deployed alternative or enhancement technology must be identified and quantified.

Regulatory: 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 TWRS program commitments.

Environmental Safety & Health: 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.

Cost Savings Potential (Mortgage Reduction): 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. Therefore any alternative technology must be cost competitive with this 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 TWRS program about 216 of the baseline pumps will be needed. If the baseline pump is replaced by the Advanced Design Mixer Pump, that quantity drops to 86 pumps.

Therefore the current baseline will spend $108M for the baseline pump or $53.8M for the Advanced Design Mixer Pump. To be cost effective alternatives must reduce this overall cost.

Cultural/Stakeholder Concerns: N/A

Other: N/A

Consequences of Not Meeting Need: The current baseline has high costs with uncertain performance capability. This alternative and/or enhancement development process will reduce the risk of unacceptable performance, and may also result in significant cost savings and/or performance improvements.

Outsourcing Potential: The objective of this effort is to make maximum use via adaption of existing commercial technologies. It is not intended to develop new technologies which can be commercialized. However anytime that government works cooperatively with industry there is the potential that, in adapting commercial technologies for government applications, that technologies advancements will be made which will benefit commercial applications.

Current Baseline Technology: The current baseline technology is the use of mixer pumps which were designed and developed specifically for mobilization of settled wastes.

Programmatic Risks: One of the principal goals of this effort is to manage the unproven performance risks of the mixer pumps. Pumps have been extensively tested with simulants both in scale and full size. However these pumps have not been run in a Hanford waste tank. Two mixer pumps were installed in Hanford Tank 101-AZ on June 15 and 16, 1996, and have been waiting on the process test to run.

There is some risk that the Hanford wastes will behave significantly differently that the simulants, and so the mixer pump performance may be different than predicted. As a result of the TWRS Privatization contractual evolution, the performance requirements for the mixer pumps may also be evolving. If the mixer pump performance in tank AZ-101 does not meet the evolving performance requirements, there will be a need for more effective alternative technologies, or for technologies which enhance the performance of the mixer pump.

The ability to provide the right feed on time to the Privatization contractor is critical to the success of the contract. All that feed material will pass through the Double Shell Tank system and mixer pumps are the baseline technology for mobilizing and homogenizing the solids to be

fed to the Privatization Contractor. Therefore it is critical that this function be cost effectively and reliably performed to the necessary requirements.

Connection to TWRS Logic: There are a number of logic blocks which are based on the deployment of mixer pump technology. Currently, project W-211 has the responsibility to deploy that technology in 10 Double Shell Tanks. The follow on project to W-211 is W-522 which will deploy mixing technology in the DSTs which are required to provide Phase 1 feed to the Privatization Contractor.

The "what if" planning case has W-211 designing deployment of mixer pump technology in 4 tanks in FY 1999, with construction beginning on AP-102 and AP-104 in FY 2000.

The first deployment of mixer pumps in DSTs was through project W-151. This deployment is to be the Process Test where pump performance on actual waste will be tested for the first time at Hanford. The baseline programmatic assumption is that the test will prove the pumps successful, and that the pump will remain in place for the first transfer to the Privatization Contractor, RTP Activity Number 16A78, scheduled for September 2001. The "what if" planning case defers that transfer to 2004.

End-User: Tank Farm Operations/Retrieval

Site Technical Point(s)-of-Contact: George L. Crawford, Numatec Hanford Corp. (509) 373-0428, fax: 509/376-8652

Contractor Facility/Project Manager: Russ L. Treat - MACTC (509) 373-3824

DOE/End-User/Representative Point(s)-of-Contact: Bruce L. Nicoll, DOE-RL (509)376-6006, fax: 509/372-1350, email: bruce_l_nicoll@rl.gov

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

REACTIVE BARRIERS TO CONTAMINANT MIGRATION

Identification No: RL-WT061
Date: September, 1998

Program:
OPS Office/Site: Richland
Operable Unit (if applicable): N/A
Waste Stream: Tanks
Waste Management Unit (if applicable):
Facility: Tank Farms

Site Priority Ranking: Medium

Need Title: Reactive Barriers to Contaminant Migration

Need Description: 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 carbon-14, technetium-99, iodine-129, selenium-79 and uranium. The relative importance of these constituents may vary depending on assumptions used during the specific analysis.

Sixty-seven of the 149 Single-Shell tanks at Hanford 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, 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.

Functional Performance Requirements: 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.

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 will be 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 2001. The results from the performance assessment will be used during the design of the waste package or disposal facility.

Problem Description: 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 PNNL and SNL) 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.

PBS No.	***WBS No.***	***TIP No.***
RL-TW04	1.1.3.1.2	N/A

Justification For Need:

Technical: Deployment of sequestering agents 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.

Environmental Safety & Health: Deployment of sequestering agents will reduce the long-term risk to both human health and the environment by attenuating the migration of mobile contaminants.

Cost Savings: 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.

Cultural/Stakeholder Concerns: 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 reduce the amount of contaminated soil.

Other: Concerns regarding the migration of contaminants from existing subsurface contamination and future leaks from sluicing could impact TWRS 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.

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.

Baseline Technology: 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 TWRS Immobilized Low Activity Waste (ILAW) program logic.

Programmatic Risk:
Development of this technology will reduce the programmatic risk associated with long-term health risk by improving the "Reasonable Expectation that the Waste will not Harm the Public."

Connection to TWRS Logic:
The need for near term "getter research" to support the performance assessment and subsequent design of the ILAW disposal facility is outlined in TBR 460.145. The scheduled completion date for collecting the geochemical information to support the performance assessment is December 31, 1999. The late start for collection of this information is January 4, 2000. Activity 510.030 in the TWRS program logic is for preparing a closure EIS. The Record of Decision for the TWRS EIS identified closure technology development as prerequisite to conducting a closure EIS.

End User: TWRS Storage and Disposal Project

Site Technical Point(s)-of-Contact: Ed Fredenburg (LMHC) [Tank Farm Closure], (509) 372-0435, Fred Mann, (FDNW) [Waste Disposal], (509) 376-5728

DOE End-User/Representative Point(s)-of-Contact: Phil LaMont [Waste Disposal], (509) 376-6117, Craig West [Tank Farm Closure] (509) 373-7542

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

PHMC DST RETRIEVAL - HANFORD DST TRANSFER PUMP IMPROVEMENTS

Identification No: RL-WT062
Date: September, 1998

Program: Waste Feed Delivery
OPS Office/Site: Richland
Operable Unit (if applicable): N/A
Waste Stream: Double Shell Tanks
Waste Management Unit (if applicable):
Facility: Tank Farms

Site Priority Ranking: Medium

Need Title: PHMC DST Retrieval - Hanford DST Transfer Pump Improvements

Need Description: Capability to transfer supernate, sludge, slurries out of a DST while the mixer pumps are operating at full speed is needed to support Waste Feed Delivery to privatization contractor. It is desired to accomplish this with the minimum about of equipment located in the DST. An improved pump concept or configuration must be demonstrated that can withstand the jet forces from the mixer pumps and, when required, pump only the supernate.

Functional Performance Requirements: Conclusions from a demonstration must confirm these capabilities:

- the transfer pump can withstand all static and dynamic loads in the DST
- the pump can transfer waste slurries at tank operating conditions and meet the flow and head requirements (approximately 150 gpm at 100-200 feet)
- the pump suction can be positioned to decant supernate only when desired.

Schedule Requirements: The results of this activity must be completed to provide design criteria and guidance to project W-211 to support feed delivery of LAW and HLW to privatization contractor. W-211 is scheduled to initiate detailed design on 6 DSTs between FY 1999 and FY 2004. Based on the design requirements, the method selected may be able to be adapted to already completed designs. The demonstration should be completed no later than FY 2001 to generate the greatest benefit.

Problem Description: Current baseline does not allow for simulanteous operations of the transfer pump while the mixer pumps are operating. The delay time between shutting down the mixers and starting the transfer may be too great to transfer sufficient HLW solids to the privatization contractor without delays.

Possible Concept: Develop a transfer pump that has a variable height suction and is sufficiently strong enough to withstand the forces for 2 mixer pumps operating at full speed. An alternate concept could be developed that allowed two separate pumps each performing a portion of the functions and being installed in a single riser.

PBS No.	***WBS No.***	***TIP No.***
RL-TW04	1.1.4	N/A

Justification For Need:

Technical: Based on laboratory results it is uncertain that mobilized solids will remain in suspension long enough to allow the transfer pumps to transfer the solids to the privatization contractor.

Regulatory: There are no identified regulatory issues associated with this activity over those already identified as part of the project.

Environmental Safety & Health: There are no identified environmental, safety or health issues associated with this activity over those already identified as part of the project.

Cost Savings Potential (Mortgage Reduction):
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 out-of-spec waste transfers that require additional time, analysis, tank transfers and potentially contractual penalties from the privatization contract. Each out-of-spec event could have cost impacts up to $100K or more.

Cultural/Stakeholder Concerns: N/A

Other: N/A

Consequences of Not Meeting Need: If this activity is not supported operating time, schedule delay and inefficient use of equipment will be experienced. Cost penalties associated with feed transfer delays to privatization contractor could be significant.

Outsourcing Potential: N/A

Current Baseline Technology: 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.

Costs: Current baseline transfer pump cost is $385,000 including the drive motor and variable frequency drive (VFD).

End User: TWRS (Retrieval/Tank Farm Operations)

DOE Representative POC: Bruce L. Nicoll, DOE-RL, Phone: 509/376-6006, Fax: 509/372-1350, Email: bruce_l_nicoll@rl.gov

Site Technical POC: George L. Crawford, Numatec Hanford Corp., Phone: 509/373-0428, Fax: 509/376-8652

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

PHMC RETRIEVAL AND CLOSURE - HANFORD SST SALTCAKE DISSOLUTION RETRIEVAL

Identification No: RL-WT063
Date: September, 1998

Program: Waste Feed Delivery
OPS Office/Site: Richland
Operable Unit (if applicable): N/A
Waste Stream: Single Shell Tanks
Waste Management Unit (if applicable):
Facility: Tank Farms

Site Priority Ranking: Medium

Need Title: PHMC Retrieval and Closure - Hanford SST Saltcake Dissolution Retrieval

Need Description: Performance data and retrieval efficiency data is required for a simplified sprinkler-applied water dissolution of saltcake system for use in Hanford's Single shell tanks. 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 stimulant of waste shall provide the necessary data to select this method for baseline implementation.

Functional Performance Requirements: These will be established based on the range of performance capabilities determined during this activity and to meet the established retrieval performance objectives.

Schedule Requirements: Based on the SST Retrieval Program Mission analysis Report HNF-2944, the retrieval of SSTs will be initiated in the year 2003 with a total of 36 tanks being retrieved by the year FY 2012 and all of the SSTs being retrieved by 2018. Therefore this effort could be effective as early as 2003 or as late as 2012 for the PHMC or be utilized by a private contractor after 2012 until all the SSTs are closed.

Problem Description: A significantly less costly system is desired for SST saltcake waste retrieval. The current SST baseline cost is $35 Million per tank using the past practice sluicing method. Not included in this estimate is the infrastructure necessary to make the waste transfers. For the sprinklers system use of existing transfer lines and infrastructure can be used.

Possible Concept: By placement of a single or multiple sprinklers through a riser into a SST, water can be added to the tank to allow the saltcake to dissolve. As the dissolution proceeds, a transfer pump can transfer the dissolved salt 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.

PBS No.	***WBS No.***	***TIP No.***
RL-TW04	1.1.4	N/A

Justification For Need:

Technical: This task will establish technical performance capability of a sprinkler system for retrieval of saltcake form 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.

Regulatory: 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 TWRS program commitments.

Environmental Safety & Health: 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 risk to workers and the environment should be reduced by implementing this technology. Safety and health risk will be compared to the existing system.

Cost Savings Potential (Mortgage Reduction): The current system of past practice sluicing cost estimate is $35 million per tank. If a system could be developed and demonstrated that could reduce this cost to ½ or less based on 23 million gallon of saltcake in 66 SST's, the savings potential would be significant.

Cultural/Stakeholder Concerns: N/A

Other: N/A

Consequences of Not Meeting 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.

Outsourcing Potential: N/A

Current Baseline Technology: 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.

Baseline Costs: $35 million for 66 SST's for a total of $2.3 billion not including necessary infrastructure additions and modifications.

End User: TWRS (Retrieval/Tank Farm Operations)

DOE Representative POC: Bruce L. Nicoll, DOE-RL, Phone: 509/376-6006, Fax: 509/372-1350, Email: bruce_l_nicoll@rl.gov

Site Technical POC: George L. Crawford, Numatec Hanford Corp., Phone: 509/373-0428, Fax: 509/376-8652.

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

PHMC RETRIEVAL AND CLOSURE - HANFORD PAST PRACTICE SLUICING IMPROVEMENTS

Identification No: RL-WT064
Date: September, 1998

Program: Waste Feed Delivery
OPS Office/Site: Richland
Operable Unit (if applicable): N/A
Waste Stream: Single Shell Tanks
Waste Management Unit (if applicable):
Facility: Tank Farms

Site Priority Ranking: Low

Need Title: PHMC Retrieval and Closure - Hanford Past Practice Sluicing Improvements

Need Description: Improvements in sluicing technology have been made since past practice sluicing was performed at Hanford for tank waste retrieval. A better understanding of these improvements and how they compare to past practice sluicing is needed to optimize waste retrieval operations. A direct comparison between the past practice sluice nozzles and current industrial nozzles capabilities needs to be performed to provide the most effective design requirements to support HLW feed delivery. A comparison between past practice pumping systems and current improved pumping systems capabilities should also be completed. The comparisons must provide a clear quantitative analysis of the ability of each nozzle and pump type and configuration and its ability to move different waste types.

Functional Performance Requirements: The current baseline performance requirements are based on past practice sluicing using Hanford developed nozzles and pumps. If any improvements are identified as part of this activity, they shall be considered for change to the baseline so that the best available technology will be utilized. Final functional performance requirements will be provided to projects as design criteria to support HLW feed delivery in support of contractual requirements.

Slurry transfer capabilities are required to allow the transfers to be accomplished with minimum liquid levels in the tanks. Ability to restart a transfer after a shutdown without additional liquid addition is also required. The ability of the transfer system to transfer various waste forms, i.e particulate, large pieces, fines , is desirable. Specific functional requirements associated with the pumping system shall be that it must be self priming at any elevation within the DST. It must also be capable of transferring larger chunks of waste that is not broken up by the sluicer but is only moved around in the tank.

Schedule Requirements: Improvements identified shall be available for inclusion into the project design criteria to support C-102 and C-104 Retrieval design scheduled to start FY 2000. C-104 and C-102 waste is currently identified as needed to support HLW feed delivery to private contractor.

Problem Description: Since past practice sluicing is based on 1960's pump and nozzle technology, industrial capabilities has advanced over the last 30 years and this advancement in technology should be incorporated into any SST sluicing retrieval system. Reduction in water usage, ability to move waste, effectiveness of sluicing, restart of interrupted transfers, minimum liquid levels remaining in tanks and improved pumping capabilities must be considered.

Possible Concept: Perform an industrial survey of various industries that have developed sluicing systems and nozzles. Select a series of pumps and nozzle types and suppliers and perform an array of test conditions to determine the ability of the pumps and nozzle to move various waste types. Perform the same array of test to a pump and nozzle used in past practice sluicing and compare the results to the industrial nozzles.

PBS No.	***WBS No.***	***TIP No.***
RL-TW04	1.1.4	N/A

Justification For Need:

Technical: This task will first establish the limits of currently available industrial technology and compare it to past practice sluicing technology. All system requirements must be clearly identified and quantified so that adequate technical design requirements can be provided to Projects needed to support contractor requirements for waste feed delivery.

The focus of this work must be on features and technologies that can be adapted for field deployment. All requirements placed on field deployment and enhanced features must be identified and quantified.

Regulatory: Analysis of the results of this effort will serve as a bases for reaching agreements with regulatory agencies on establishing retrieval performance objectives and the need for additional waste removal prior to closure of the SSTs.

Environmental Safety & Health: Environmental and Safety reviews of any technologies considered must be compared to current authorization bases for acceptability and necessary changes identified. Improvements in reduction in personnel exposure, reduction in risk to the environment and safety of workers will receive additional considerations.

Cost Savings Potential (Mortgage Reduction): Cost saving potential can not be quantified. Yet clearly some cost savings will be realized due to the use of commercially available systems and components. Improved retrieval efficiency can be translated into reduced operating and maintenance cost.

Cultural/Stakeholder Concerns: N/A

Other: N/A

Consequences of Not Meeting Need: The current baseline has high cost with uncertain performance efficiency. This activity will allow for a better definition of the ability of a current industrial system to meet the required retrieval rates needed to support Feed delivery. Increasing the retrieval efficiency for SSTs will reduce the risk of not meeting contractual requirements.

Outsourcing Potential: N/A

Current Baseline Technology: The baseline technology used is past practice sluicing performed at Hanford over 27 years during the 1950s, 1960s, and 1970s. This technology was last used at Hanford in 1978 to empty out AX-104.

Costs: The current baseline cost is $35 million per tank to install a past practice sluicing system in a total of 35 SSTs during Phase 1 retrieval. This is a total of $1.22 billion for PHMC Phase 1 retrieval.

End User: TWRS (Retrieval/Tank Farm Operations)

DOE Representative POC: Bruce L. Nicoll, DOE-RL, Phone: 509/376-6006, Fax: 509/372-1350, Email: bruce_l_nicoll@rl.gov

Site Technical POC: George L. Crawford, Numatec Hanford Corp., Phone: 509/373-0428, Fax: 509/376-8652.

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

DIRECT INORGANIC AND ORGANIC ANALYSES OF HIGH-LEVEL WASTE

Identification No: RL-WT065
Date: September, 1998
OPS Office/Site: Richland Operations Office/Hanford
Operable Unit (if applicable): N/A
Waste Stream: Double Shell Tanks and Single Shell Tanks
Waste Management Unit (if applicable): N/A
Facility: Tank Farms

Site Priority Ranking: High

Need Title: Direct Inorganic and Organic Analyses of High-Level Waste

Need Description: Characterization is needed to ensure regulatory compliant treatment, storage, and disposal of the waste, including requirements for meeting land disposal restrictions, delisting, and permitting of the treatment facility. Characterization in support of regulatory compliance will be applied during a number of steps in the treatment cycle, including waste storage, feed delivery certification, treatment, waste products qualification and disposal. Methods for analysis of regulated constituents of concern have not been validated for high level radioactive waste matrices. A direct chemical analysis of tank waste regulated inorganic and organic constituents would reduce turn-around time, waste production, and worker exposure.

RCRA characterization is driven primarily through the Hanford Federal Facility Agreement and Consent Order (also known as the Tri-Party Agreement). Characterization requirements include planning, sampling and analysis events, and reporting (Tri-Party Agreement Milestone M-44-00 et seq.). This milestone requires DOE to issue characterization deliverables consistent with identified program needs. Additional requirements were added to Milestones M-45, M-51, and M-60 requiring the Retrieval and Disposal Projects to define their information needs. Additional characterization requirements will be defined through the Double-Shell Tank System, privatized treatment facilities, and waste acceptance facilities RCRA permits (to be part of the Hanford Site permit, WA 7890008967).

An additional driver for this work is the completion of the Risk Assessment which must be completed by the TWRS Privatization Contractor.

Functional Performance Requirements: Regulatory constituents of concern are identified on a site specific basis. For the Hanford site, approximately 125 organic analytes and 35 inorganic analytes have been identified for analyses in the Regulatory Data Quality Objectives (Wiemers 1998, draft). The Washington Department of Ecology has agreed to the use of target estimated qualification limits (EQLs) and precision requirements as defined in SW-846 as performance requirements for the analytical methods. The applicable regulations allow for the use of alternative methods under Washington Administrative Code (WAC) 173-303-110 and various guidance documents. The Environmental Protection Agency (EPA) and Nuclear Regulatory Commission have also recently issued joint guidance for testing activities related to mixed low-level waste (FR 62079, November 20, 1997). Selected method(s) must be demonstrated with actual waste per EPA method validation protocol.

Schedule Requirements: Additional characterization data is required immediately to support the TWRS Privatization process design and permitting activities which are already initiated. The staging of waste for delivery to the treatment facility will be initiated in FY 2003. Deployment of functional systems for characterization as soon as possible will minimize the cost impacts due to the treatment facility risk assessment, by second quarter of FY 2000 and is required by first quarter of FY 2001 to support optimizing permit-driven feed certification.

Problem Description: The Tri-Party Agreement has provided DOE a schedule for coming into compliance with RCRA. Existing methods defined in SW-846 that may be applicable to high level waste may not be appropriate due to large volume requirements, holding time restrictions, and/or complex matrices. Validated modifications to the SW-846 methods or validated alternative methods are required for DOE to petition for method modifications or alternative methods in order to be in compliance with RCRA requirements. Permitting of the treatment facility, treatment of the waste, and final disposal are dependent upon completion of these analyses. Treatment of the DST waste is necessary to accommodate retrieval of the SST waste and closure of the SST farms (M-45-00 et seq.).

A path to achieving data needs has been proposed in the TWRS Regulatory Data Quality Objectives. The first step will be methods validation using actual waste. Tank waste feed candidates for TWRS Privatization Phase 1 will be selected for analyses of regulatory constituents of concern. Once methods have been validated, a tank grouping approach will be considered for selection of subsequent Phase 1 and Phase 2 tank waste analysis. Methods developed and the characterization data obtained will be used to support future activities including certification of the feed, process control during operations as specified in the treatment facility permit, and qualification of the waste products, including delisting (pursuing an exemption or exclusion under 40 CFR 260 and Chapter 173-303 WAC) and meeting land disposal restriction requirements (40 CFR 268 and WAC 173-303-140).

Every effort should be made to deploy an analytical technology which optimizes turn-around time, minimizes sample and waste volume and worker exposure and meets target performance requirements.

PBS No.	*WBS No.*	*TIP No.*
RL-TW05	1.1.5.1	N/A

Justification For Need:

Technical: TWRS Privatization Contract Number DE-RP06-96RL13308 specifies feed and product requirements.

Regulatory: 40 CFR262 and WAC 173-303-170 specifies waste generator characterization requirements.

- 40 CFR 268 and WAC 173-303-140 specify land disposal restrictions
- 40 CFR 261 and WAC 173-303-070 specify requirements for identification and listing of hazardous waste.
- Additional RCRA requirements are applicable pursuant to 40 CFR and Chapter 173-303 WAC.

Environmental Safety & Health:

- 10 CFR 835 defines ALARA

Cost Savings Potential (Mortgage Reduction): Deployment of a direct inorganic and organic analysis for regulatory constituents of concern will provide a cost savings throughout the entire life cycle of the high level waste storage, treatment and disposal processes.

Cultural/Stakeholder Concerns: Washington Department of Ecology, EPA Region 10, EPA Region 8 (Nevada), Nevada - EPA. Other state agencies for Oregon, Idaho, and Nevada and native American nations such as the Confederated Tribes of the Umatilla Indian Reservation (e.g., agency(s) where IHLW will be transported). Local emergency response organizations located in areas where IHLW will be transported.

Other: N/A

Consequences Of Not Filling Need: *Regulatory Impacts:* The U. S. DOE has previously entered into a TPA commitment with the Washington State Department of Ecology (WDOE) and the U. S. Environmental Protection Agency to characterize waste per RCRA compliance, retrieve SST beginning 1998 and treat wastes beginning 2003. These activities require characterization of the regulated constituents of concern. Failure to complete the characterization activities in a timely manner will result in delay of the referenced TPA commitments.

Programmatic Impacts: Characterization of waste is required for RCRA compliance. Treatment of the waste will be dependent on these characterization activities. Retrieval of SST waste is dependent on treatment of DST waste. Validated methods are required for characterization. Early identification of efficient characterization methods will support permitting activities and better enable waste feed certification, treatment facility operations and waste product qualifications.

Outsourcing Potential: Direct analysis could be applicable to other DOE and private industry cleanup sites.

Current Baseline Technology: There is no accepted baseline technology for direct analysis of regulated inorganic and organic constituents of concern to meet DOE needs for tank waste cleanup.

Programmatic Risks: Retrieval of SST waste and treatment and final disposal of SST and DST waste are dependent on acceptable characterization of waste consistent with RCRA requirements.

Connection to TWRS Logic: This activity supports DOE's obligations for Phase I of Privatization as defined in the Contract DE-RP06-96RL13308.

End-User: DOE TWRS, TWRS Privatization Contractor, OCRWM, WDOE, EPA, other DOE sites with mixed wastes.

Site Technical Point(s)-of-Contact: Nancy Welliver, DOE-RL, Tel: (509) 373-9880, Fax: (509) 373-0628, nancy_c_welliver@rl.gov

Contractor Facility/Project Manager:

Karyn Wiemers
Pacific Northwest National Laboratory
Tel: (509) 376-4565
Fax: (509) 373-0733
karyn.wiemers@pnl.gov

Langdon Holton
Pacific Northwest National Laboratory
Tel: (509) 373-9202
Fax: (509) 373-0733
langdon.holton@pnl.gov

DOE End-User/Representative Point(s)-of-Contact: Bill Taylor, DOE-RL, Tel: (509) 372-3864, Fax: (509) 373-0628, william_j_taylor@rl.gov

FY 1999 WASTE TANKS SCIENCE NEEDS

RL-WT Number	Need Title
RL-WT031-S	Rapid Waste Characterization
RL-WT032-S	Monitoring of Key Waste Physical Properties During Retrieval and Transport
RL-WT033-S	Chemistry of Problem Constituents for HLW Vitrification
RL-WT034-S	Long-Term Performance of LAW Forms
RL-WT035-S	Moisture Flow and Contaminant Transport in Arid Conditions
RL-WT036-S	Alternate Waste Form Development
RL-WT037-S	Sludge Treatment
RL-WT038-S	Process Models for Sludge Treatment
RL-WT039-S	Advanced Methods for Achieving LLW Volume Minimization
RL-WT040-S	Mechanisms of Line Plugging
RL-WT041-S	Radionuclide Partitioning
RL-WT042-S	Flammable Gas Generation, Retention, and Release in HLW Tanks
RL-WT043-S	Effect of Human and Natural Influences on Long-Term Water Distribution
RL-WT044-S	Distribution of Recharge Rates
RL-WT045-S	Vadose Zone Flow Simulation Tool Under Arid Conditions
RL-WT046-S	Getter Materials
RL-WT047-S	Tritium Separations
RL-WT048-S	Innovative Methods for Radionuclide Separation
RL-WT049-S	Effect of Processing on Waste Rheological and Sedimentation Properties
RL-WT050-S	Effect of Organic Constituents on Waste Processing
RL-WT051-S	Foam Generation and Stability
RL-WT052-S	Characterization of Organic Species in Waste Feed to LAW and HLW Treatment Facilities
RL-WT053-S	Contaminant Mobility Beneath Tank Farms
RL-WT054-S	Solids Yield and Deagglomeration

RL-WT Number	Need Title
RL-WT055-S	Tank Integrity Verification
RL-WT056-S	Half-Lives of Se-79 and Sn-126
RL-WT057-S	Materials for Long-Term Waste Isolation

Hanford Site Science Need
Tanks Subgroup

Identification No.: RL-WT031-S

Need Title: Rapid Waste Characterization

FY99 Site Priority Ranking:

I. Functional Need:

Characterization of the waste is needed to: 1) support methods used to determine what, if any, actions are required to assure safe interim storage of each waste type; 2) determine suitable waste mixing to assist in development of transport methods and requirements; 3) develop efficient and cost effective separations processes; and 4) determine the basis for payment of waste treatment services by private contractors.

Qualification of major organic constituents in Hanford tank wastes is needed to estimate flammability and fuel content. Rapid yes/no evaluation of volatile hazardous components (e.g. radionuclides and carcinogens) are needed to assure adequate storage and retrieval protocols. Presently, little is known about the organic forms and their distribution in the tanks. Identification and distribution of organic materials are needed to determine if the wastes can be classification as "safe", "conditionally safe", or "unsafe". Similarly, data is not presently available concerning the content, distribution and form of fissile material.

Information concerning the chemical forms and concentrations of the matrix components and their radioactive constituents is necessary before adequate waste consolidation (mixing) protocols and/or separations processes can be engineered. Knowledge of the wastes chemical and physical properties are required to construct appropriately designed retrieval, pretreatment and waste stabilization facilities.

Under TWRS Privatization, private contractors operating waste treatment facilities will be paid for services based on the amount of sodium processed and the waste oxide loading in the immobilized low-activity waste (minus sodium and silicon oxides). In particular, a determination of soluble sodium (vs. insoluble sodium in entrained solids) delivered with the feed will be required. Accurate, rapid (one-week turnaround) characterization of the feed stream will be needed to support the feed certification plan and provide a timely method for resolving disputes.

II. Problem Description:

There is currently a lack of cost-effective and timely methods to sample and characterize the chemical and physical properties of tank wastes. Lack of data has resulted in employment of conservative, time-consuming, and potentially over-engineered methods in order to satisfy worst case scenarios. Qualitative on-site and preferably in-situ analysis is needed to address concerns related to safety, waste forms (physical and chemical properties), and their distributions in the tank. One of the major problems with characterizing wastes is assuring that the methods used to retrieve wastes provide representative samples with respect to volume and distribution. These deficiencies drive the need for rapid, at least qualitative, in situ analysis.

Present analysis methods are time-consuming or insufficient to provide the data needed to address the needs listed above. In addition, the data that is obtained often carries unreasonable precision and accuracy requirements. Highly precise and accurate measurements may be necessary for final waste processing requirements; however, the information needed to assist in designing viable retrieval and pretreatment methods do not require highly accurate determinations of elements but rather qualification of their form and distribution in the waste tank.

III. Science Need Description:

Presently, samples are removed from the tanks, extruded in a hot cell facility, with subsamples subsequently analyzed. Analytical techniques now require time-consuming preparation. Derivatization, caustic dissolution, leaching, and phase separations are required to fully characterize the organic and inorganic constituents. Methods which employ more direct analysis approaches should be used and ideally developed for on-line or in-situ determinations.

Need Timing: 1-3 years

IV. Benefit:

Benefit code: check all that apply:

✓ Cost Savings ✓ Risk Reduction ✓ Enabling Knowledge

V. Contacts:

For more information, contact:

Catherine Louie, DOE-RL TWRS (509) 376-6834 catherine_s_louie@rl.gov
Loni Peurrung, PNNL (509) 373-0201 lm_peurrung@pnl.gov

Hanford Site Science Need
Tanks Subgroup

Identification No.: RL-WT032-S

Need Title: Monitoring of Key Waste Physical Properties During Retrieval and Transport

FY99 Site Priority Ranking:

I. Functional Need:

Ensure safe operations during retrieval and transport of waste, including the prevention of pipe plugging.

II. Problem Description:

During Phase I of privatization, TWRS will retrieve waste by water addition (sluicing). While precipitated salts are expected to go back into solution, this has not been verified with actual wastes. If solids remain undissolved, they can cause operational difficulties during transfer. Moreover, they can result in the transferred stream being greater than 5% solids, which is the contractual maximum specified in the Privatization contracts. The chemistry of these concentrated supernates is quite complex, and the dilution itself may cause additional precipitation. For example, dilution may aid dissolution of sodium nitrate but may also cause gibbsite (aluminum hydroxide) to precipitate. Formation of foams during retrieval or transport could also result in processing complications. Monitoring of key waste physical properties such as particle size, shape, and density distribution; particle charge; bubble size, shape, and spatial distribution; interstitial liquid and mixture densities; rheological properties such as viscosity, yield stress, compressibility, and shear modulus will provide broad safety margin for waste retrieval and transport.

III. Science Need Description:

There are a number of scientific challenges in this area. The key issue common to most of the physical properties is the colloidal nature of the solids in the waste slurries. Off-line monitoring and characterization risks the possibility of changing many of the physical properties from their in-situ conditions. The properties especially susceptible to these changes are particle and bubble characteristics and rheological behavior of the waste. However, in-situ and on-line (or in-line) monitoring of these parameters face a number of difficulties such as fouling, attenuation, radiation damage, drift, and safety risks. In addition, it is often difficult to implement the principles required for measurement of these parameters. As an example, implementation of a vibrating rod viscometer, while simple in application, does not provide information about steady shear viscosity.

Direct measurements of the above parameters are more preferred over indirect and heuristic methods in which a substantial amount of validation and calibration is required for each waste slurry to be retrieved. As an example, response of bubbles to an acoustic wave is commonly viewed as being an attractive method for size characterization of bubbles suspended in a simple liquid. However, in a complex solid-liquid-gas network, many rheological issues complicate this method of measurement and render it less direct. Further work on these issues and alternative approaches to measuring these waste properties is required.

Need Timing: 4-10 years

IV. Benefit:

Monitoring of many of the parameters described above provide additional tools for more precise analysis of the waste conditions, which would enable the operators and decision makers to perform retrieval and transport operations while minimizing the cost and risks of failure and damage.

Benefit code: check all that apply:

√ Cost Savings √ Risk Reduction √ Enabling Knowledge

V. Contacts:

For more information, contact:

Catherine Louie, DOE-RL TWRS (509) 376-6834 catherine_s_louie@rl.gov
Loni Peurrung, PNNL (509) 373-0201 lm_peurrung@pnl.gov

Hanford Site Science Need
Tanks Subgroup

Identification No.: RL-WT033-S

Need Title: Chemistry of Problem Constituents for HLW Vitrification

FY99 Site Priority Ranking:

I. Functional Need:

Minimize the volume of immobilized waste produced through maximum loading of waste into the waste form.

II. Problem Description:

Currently, HLW glasses are formulated to assure that little or no insoluble phases exist in the HLW melter. Insoluble phases are caused by such problem constituents as chrome minerals, spinels, and noble metals. An alternative method for handling problem constituents in HLW glasses is needed. The volume of HLW glass that will be produced from the sludges at Hanford is dependent on the ability to solubilize or dilute problem constituents that make up a very small fraction of the overall waste. Minimizing the impact of the problem constituents is important for formulating a strategy and staging the wastes to be treated during the Phase II privatization effort. Diluting the problem constituents usually involves blending of waste types and/or increasing the volume of glass waste forms. Both of these alternatives are expensive.

III. Science Need Description:

There is a need for a better understanding of the solution thermodynamics in multicomponent borosilicate liquids. In many cases, the solubility of one oxide is limited by the presence of another in the melt. For example, large amounts of either Zr or Al (important waste components) are soluble in sodium silicate liquids, but when Al is added to a sodium zirconium silicate liquid, ZrO_2 precipitates. The chemistry behind this phenomenon needs to be understood if optimum waste compositions are to be achieved. Other problematic components are those which have an acidic nature, such as Cr or P. Their solubility is considerably reduced by the presence of other acidic oxides such as B_2O_3. The structural roles and chemistry which leads to these effects is poorly understood and data are lacking. Data is needed to support the development of predictive models for liquidus temperature and durability as a function of waste composition and process characteristics. New theoretical and experimental methods for describing and studying this type of behavior need to be developed if waste formulation is to be done by means other than trial and error.

Need Timing: 4-10 years

IV. Benefit:

Better predictive capability would reduce the need for mixing, reduce waste volumes and reduce costly errors in the event that ill understood mixing actually increased waste volumes. It also provides enabling knowledge, because existing theories of silicate solution thermodynamics do not work well for multicomponent system, and current experimental methods are costly and time consuming.

Benefit code: check all that apply:

✓ Cost Savings ✓ Risk Reduction ✓ Enabling Knowledge

This science need supports the following Hanford tanks technology need(s):
RL-WT06 Identification and Management of Problem Constituents for HLW Vitrification

V. Contacts:

For more information, contact:

Catherine Louie, DOE-RL TWRS (509) 376-6834 catherine_s_louie@rl.gov
Loni Peurrung, PNNL (509) 373-0201 lm_peurrung@pnl.gov

Hanford Site Science Need
Tanks Subgroup

Identification No.: RL-WT034-S

Need Title: Long-Term Performance of LAW Forms

FY99 Site Priority Ranking:

I. Functional Need:

To validate LAW waste form performance in environmental media.

II. Problem Description:

The release rate of radionuclides from a waste form to the environment is a complex function of the interactions between the waste form, water, and other waste package components in the disposal system. For the disposal of immobilized low-activity tank waste (ILAW), the waste form and package are expected to be in a dry environment. In such an environment, the release rate is sensitive to variations in the physical (temperature, water content) and chemical (pH, solution composition) environment, which are affected by corrosion of the waste form itself and the formation of secondary phases. The contaminant release rate is also proportional to the surface area accessible to moving moisture. Thermal stress fractures in glasses increase the total surface area, but it is not known whether such cracks are accessible to water in a dry environment. Models are needed that describe the radionuclide release rate as a function of these physical and chemical variables to provide a source-term for risk assessment. A credible long-term performance model must, therefore, include:

- An explicit functional relationship between the dissolution kinetics of the waste form and the chemistry of the water in contact with the form, including any secondary mechanisms, such as ion-exchange, that may either directly release radionuclides or indirectly impact the dissolution kinetics

- Secondary phase paragenesis, especially for solids that impact the waste form corrosion rate or limit solubility of radionuclides

- Constitutive relationships that describe the surface area accessible to moisture, which may be more than the external, geometric surface area of the waste form but less than a total area that includes all internal fracture surfaces

- Constitutive relationships that correlate variations in unsaturated flow properties of the waste form/package as secondary phases form from waste form corrosion.

Better test methods are also needed to guide model development and to develop product specifications. Current ILAW product specifications require short duration PCT and ANS 16.1 testing of the waste forms, which do not provide data relevant to long-term performance for the expected disposal system environment at Hanford. A 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 2 ILAW product specifications.

III. Science Need Description:

Develop and validate a long-term waste-form performance model for ILAW that describes the radionuclide release rate from the waste form as a function of the physical and chemical environment of the disposal system. Collect fundamental data on waste form dissolution kinetics, secondary phase thermodynamic properties and precipitation kinetics, unsaturated flow properties of the waste form/package and the effects of secondary phase formation on these properties. Develop test methods that are more representative of expected disposal system conditions at Hanford for use in evaluating long-term behavior of waste forms, validating performance models, and in setting product specifications.

Need Timing: 4-10 years

IV. Benefit:

Current risk assessments utilize arbitrary, constant radionuclide release rates for ILAW that are not technically defensible. Development of a scientifically-credible release model and testing methods for ILAW will allow for development of more accurate waste form specifications, potentially saving hundreds of millions of dollars.

Benefit code: check all that apply:

✓ Cost Savings ✓ Risk Reduction ✓ Enabling Knowledge

This science need supports the following Hanford tanks technology need(s):
RL-WT016 Glass Monolith Surface Area

V. Contacts:

For more information, contact:

Catherine Louie, DOE-RL TWRS (509) 376-6834 catherine_s_louie@rl.gov
Loni Peurrung, PNNL (509) 373-0201 lm_peurrung@pnl.gov

Hanford Site Science Need
Tanks Subgroup

Identification No.: RL-WT035-S

Need Title: Moisture Flow and Contaminant Transport in Arid Conditions

FY99 Site Priority Ranking:

I. Functional Need:

To understand the movement of contaminants through zones of low moisture (region-wide saturation less than 10%) for use in risk assessments.

II. Problem Description:

Many waste disposal sites in the western U.S. 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.

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.

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 not known how these effects vary with moisture content.

III. Science Need Description:

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. 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 wastes and waste forms. Upon degradation, wastes 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 wastes forms.

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.

Need Timing: 1-3 years

IV. Benefit:

The setting of waste form specifications for the immobilization of low-activity Hanford Tank waste and of disposal facility specifications will be determined by analyses using this type of information. Setting such specifications will result in trading cost (hundred of millions of dollars) and risk (mrem/yr in drinking water exposure - 4 mrem/yr is current EPA limit). Other projects at Hanford (e.g., tank closure, soil remediation) will also benefit.

Benefit code: check all that apply:

✓ Cost Savings ✓ Risk Reduction _ Enabling Knowledge

This science need supports the following Hanford tanks technology need(s):
RL-WT029 Data and Tools for Performance Assessments

V. Contacts:

For more information, contact:

Catherine Louie, DOE-RL TWRS (509) 376-6834 catherine_s_louie@rl.gov
Loni Peurrung, PNNL (509) 373-0201 lm_peurrung@pnl.gov
Fred Mann, FDNW (509)376-5728 frederick_m_mann@rl.gov

Hanford Site Science Need
Tanks Subgroup

Identification No.: RL-WT036-S

Need Title: Alternate Waste Form Development

FY99 Site Priority Ranking:

I. Functional Need:

Development of alternative waste forms for high- and low-level waste immobilization.

II. Problem Description:

Development and knowledge of alternative waste forms to borosilicate glass could reduce costs and increase the long-term performance of immobilized high- and low-level waste. These alternative waste forms could potentially be used by private vendors during Phase II privatization.

III. Science Need Description:

Many waste feeds present at the Hanford site are not soluble in or are incompatible with the baseline borosilicate glass host. Alternative glass or crystalline (mineral or synthetic) waste forms that can incorporate all components of a specific waste feed are desirable. A viable alternative waste form must be capable of forming a stable glass or crystalline 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 related processing equipment. In addition, relatively low processing temperatures are desirable, as are simple heat treatment cycles. The waste form must be chemically durable under environmental storage conditions (aqueous environments are of primary concern) and thermally stable under repository conditions over a geologic time scale.

Development of alternate waste forms will require an understanding of glass and ceramic structures and phase stabilities. Identification and characterization of the range of glass or ceramic phases that can be produced for a given waste feed as a function of feed composition is critical so that thermodynamics and geological evidence can be used to assess long term stability 2 and compatibility with repository conditions. Qualification of a new, alternate waste from will also rely on the determination of 1) solubility limits of waste in a host and the factors that control them, 2) long- and short-range atomic structures of potential waste form hosts, and 3) the effect of composition and structure on key waste form properties such as chemical durability and processing temperatures.

Need Timing: 4-10 years

IV. Benefit:

A limited number of alternate waste forms can significantly reduce costs by minimizing final waste volumes and simplifying pretreatment processes. Alternate waste forms with superior durability to borosilicate glass can reduce the risk of contamination to the environment. Benefit code: check all that apply:

✓ Cost Savings ✓ Risk Reduction _ Enabling Knowledge

V. Contacts:

For more information, contact:

Catherine Louie, DOE-RL TWRS (509) 376-6834 catherine_s_louie@rl.gov
Loni Peurrung, PNNL (509) 373-0201 lm_peurrung@pnl.gov

Hanford Site Science Need
Tanks Subgroup

Identification No.: RL-WT037-S

Need Title: Sludge Treatment

FY99 Site Priority Ranking:

I. Functional Need:

Safe, effective, and efficient waste processing to reduce the volume of the immobilized HLW stream.

II. Problem Description:

An understanding of the enhanced sludge wash (ESW) process is needed to prepare for Phase I and Phase II privatization and for bid evaluation of vendors' proposals. Currently, only about 70 to 80 percent of the maximum order quantity for Phase I sludge washing has been identified. Additional feeds must be identified that can satisfy Envelope D after pretreatment to ensure that the Private Contractors will be able to operate through 2011. Moreover, this knowledge is needed to support development of the Phase II specification for TWRS waste pretreatment.

DOE has determined that ESW produces a reasonable number of HLW glass canisters. Additional data on ESW performance are required to provide a sound basis for the second phase of privatization. A high emphasis needs to be placed on obtaining information on chromium chemistry in the sludges and saltcakes. Chromium removal is needed to reduce its impact on the HLW glass volume. Additional data on the effect of varying temperature and caustic concentration on leach performance would also be beneficial.

III. Science Need Description:

Fundamental understanding of aluminum and chromium chemistry is a prerequisite to the development of predictive capabilities regarding the behavior of these components in Hanford tank systems. Quantification of the solubilities and dissolution rates of Al and Cr compounds in high ionic strength, strongly basic solutions as a function of temperature, alkalinity, oxidation state of the tank environment, etc., is necessary for predicting the relative efficiency of various strategies proposed for their removal from the waste stream.

Sludge leaching with concentrated NaOH solutions at elevated temperatures is the proposed strategy for the removal of Al and Cr from the waste stream. 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 Cr in the Hanford waste tanks is inadequate. There are few available data on the equilibrium behavior of Cr 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 Cr solids in high base suggests a significant decrease in solubility with time. The Cr system is complicated by a multiplicity of valence states, thus, systematic evaluation of the solubility and kinetics of chromium compounds must also cover the oxidation of Cr(III) to Cr(VI). Since available data from tank sludge samples indicates that chromium in the solid phases is present mostly as Cr(III) whereas, in the aqueous phase, Cr appears to be present mostly as Cr(VI), fundamental investigations of the equilibria and kinetics of reactions involving the $Cr(III)_s - Cr(VI)_{aq}$ transitions are also necessary. Furthermore, such transitions are 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 Cr compounds in concentrated alkaline solutions is key to predicting the behavior and speciation of Cr in the Hanford tank systems.

Need Timing: 1-3 years

IV. Benefit:

Tank sludge pretreatment is projected to save billions of dollars in processing and disposal of Hanford HLW. A sound scientific understanding of the pretreatment processes will reduce the overall risk associated with implementing these processes.

Benefit code: check all that apply:

✓ Cost Savings _ Risk Reduction _ Enabling Knowledge

This science need supports the following Hanford tanks technology need(s):
RL-WT024 Enhanced Sludge Washing Process Data

V. Contacts:

For more information, contact:

Catherine Louie, DOE-RL TWRS (509) 376-6834 catherine_s_louie@rl.gov
Loni Peurrung, PNNL (509) 373-0201 lm_peurrung@pnl.gov

Hanford Site Science Need
Tanks Subgroup

Identification No.: RL-WT038-S

Need Title: Process Models for Sludge Treatment

FY99 Site Priority Ranking:

I. Functional Need:

Safe, effective, and efficient waste processing to minimize the volume of HLW stream.

II. Problem Description:

Information is needed on the solubility of various components in the complex solid and liquid matrices of the Hanford tank wastes. This information is needed to predict when solids will precipitate or when gels will form in retrieval, wash, and leach solutions, and to supplement empirical water wash and caustic leach data from enhanced sludge wash testing of Hanford tank sludge and saltcake samples.

III. Science Need Description:

Predicting the precipitation of solids in a complex, concentrated brine requires a suitable model and a well-designed set of data from which model parameters can be obtained. Although the identity and approximate abundances of major and minor chemical components in the Hanford tanks are fairly well defined, there are inadequate fundamental experimental data to support an adequate predictive model, and there has been inadequate use of existing data. The solubilities of solid phases in high-ionic strength brines that approximate subsets of the actual Hanford chemical systems need to be measured to: a) determine equilibrium constants, and b) extract electrolyte model parameters describing the behavior of sparingly soluble compounds.

Because of its importance to both precipitation and gel formation, Al speciation and reaction kinetics need to be examined in both simple and complex electrolyte solutions. Three key issues need to be addressed: the speciation/polymerization reactions of Al in complex electrolytes under high base conditions, the interactions of specific ions, especially Na^+, NO_2^- and possible selected organic chelators with Al species that could form under base or acid conditions, and mechanistic studies of solutions known to be oversaturated with respect to specific solid phase precipitation reactions.

Need Timing: 4-10 years

IV. Benefit:

Carefully designed experiments supporting development of a well-focused thermodynamic model allows bringing all available knowledge on the thermophysical properties of DOE waste to bear with minimum resort to expensive experimentation using actual tank waste. This includes: predicting and avoiding precipitation or gelation due to changes in temperature, dilution, or bulk chemistry during waste mixing and transport; predicting speciation important to designing and understanding the importance of chemical separations; and predicting speciation and precipitation during thermochemical, electrochemical, and other conversion processes.

Benefit code: check all that apply:

✓ Cost Savings ✓ Risk Reduction ✓ Enabling Knowledge

This science need supports the following Hanford tanks technology need(s):
RL-WT024 Enhanced Sludge Washing Process Data

V. Contacts:

For more information, contact:

Catherine Louie, DOE-RL TWRS (509) 376-6834 catherine_s_louie@rl.gov
Loni Peurrung, PNNL (509) 373-0201 lm_peurrung@pnl.gov

Hanford Site Science Need
Tanks Subgroup

Identification No.: RL-WT039-S

Need Title: Advanced Methods for Achieving LLW Volume Minimization

FY99 Site Priority Ranking:

I. Functional Need:

Minimization of LAW volume.

II. Problem Description:

Development and demonstration of alternative processing concepts could result in significant reduction in the volume of immobilized low-level waste. Waste volume minimization is both prudent from an overall cost standpoint as well as a requirement when dealing with any RCRA waste. Two technologies currently being developed and evaluated for reduction of the LLW volumes are the Clean Salt Process and electrochemical salt splitting.

III. Science Need Description:

The clean salt process involves acidification of the supernate and dissolved salt cake to a pH of 2. The salts are then crystallized from solution by concentrating and cooling the solution below the saturation point. An understanding of the thermodynamics and kinetics associated with the removal of $NaNO_3$, $NaNO_2$, and other major sodium-containing salts (i.e. crystallization process) from complex radioactive waste solutions is desired. Specific issues include a definition of the conditions under which crystals of various salts form, understanding the nucleation mechanism and how it impacts the process performance, an understanding of the crystallization processes that limit the purity of the crystals obtained in the process (i.e. contaminates are occluded in the crystals), and definition of the effect of process variables on the size and type of crystal formation.

The salt splitting process involves using a divided electrochemical cell to separate the waste salts into the associated acids and bases. With this process the generation of solids is not generally desirable due to the potential for fouling of the processing equipment. An understanding of the thermodynamic behavior of the waste subjected to expected processing conditions would allow the process to be designed and operated at conditions that would avoid the precipitation of solids.

Need Timing: 4-10 years

IV. Benefit:

The development of a scientific basis for the clean salt process and salt splitting process will reduce the cost of deployment of these technologies by reducing the number and scale of experiments required with simulant and actual wastes, and improve the efficiency of the design process. Risk will be reduced by defining the process regimes in which these processes will be successful.

Benefit code: check all that apply:

✓ Cost Savings ✓ Risk Reduction _ Enabling Knowledge

This science need supports the following Hanford tanks technology need(s):
RL-WT08 Advanced Methods for Achieving LLW Volume Minimization

V. Contacts:

For more information, contact:

Catherine Louie, DOE-RL TWRS	(509) 376-6834	catherine_s_louie@rl.gov
Loni Peurrung, PNNL	(509) 373-0201	lm_peurrung@pnl.gov

Hanford Site Science Need
Tanks Subgroup

Identification No.: RL-WT040-S

Need Title: Mechanisms of Line Plugging

FY99 Site Priority Ranking:

I. Functional Need:

Safe, effective and efficient waste storage, retrieval and transport, including the prevention of pipe plugging and transport line pressurization.

II. Problem Description:

Inter-area transport lines for particulate slurries have become plugged in the past due to particle settling, phase changes, or reactions accompanied by precipitation or gel formation that occurred during transport. Information to predict pressure drop and critical transport velocity of wastes with known properties is required to ensure that wastes can be safely transported without risk of plugging. To minimize the dilution required to modify waste properties, methods to predict the effect of dilution, washing, or leaching on the slurry properties is also required. Dilution both increases the volume of the waste and has negative implications for tank waste management both from a space perspective and for settling and separation of solids. Waste compatibility is also an issue in the case of blending of wastes from several simultaneous or sequential retrievals.

III. Science Need Description:

The science need is the ability to predict transport requires understanding of both the hydrodynamics of slurries with known properties and the chemical mechanisms that affect the properties of wastes. Hydrodynamic features that must be understood are: 1) the critical suspension velocity of a slurries containing particle sizes similar to those in radioactive wastes, 2) pressure drop as a function of flow in particulate and non-Newtonian fluids, and 3) the rate of particle attrition during transport. When gas generating wastes are transported, the effect of gas on the speed of sound in the mixture must be understood sufficiently to avoid choking.

An empirical model (but with a strong foundation in theory) is needed that could predict chemical adjustments required both to support transport operations as well as reagglomeration of materials in order to promote settling. The model should incorporate theory associated with agglomeration, sedimentation, and fluid dynamics. Dilution effects, including temperature reduction and solids dissolution/precipitation, should also be included. This model would have as its inputs the waste composition and particle size distribution. It would provide a technical basis for pipeline transport specifications that is currently lacking and may be over-restrictive. This tool should also be able to predict the effect of blending waste types of different chemistries.

The chemical mechanisms that affect flow encompass reactions which generate particles (precipitation), cause aggregation, and generate gas. To predict the chemistry effectively, the chemical principles and colloidal behavior in high salt environments must be understood. Specifically, solution containing multiple components must be investigated to identify the conditions where precipitation and gelation occurs.

Need Timing: 4-10 years

IV. Benefit:

The ability to predict the pressure drop and critical suspension velocity in slurries would allow engineers to design and operate transport lines in a manner that avoids plugging due to particle settling. The hydrodynamic information is useful only when the physical properties of the mixture are known. Some method to predict changes in physical properties during transport is also required. Understanding the chemical mechanisms and hydrodynamic mechanisms affecting particle size, viscosity and concentration would further improve engineers ability to operate the transport line.

Benefit code: check all that apply:

✓ Cost Savings ✓ Risk Reduction ✓ Enabling Knowledge

V. Contacts:

For more information, contact:

Catherine Louie, DOE-RL TWRS	(509) 376-6834	catherine_s_louie@rl.gov
Loni Peurrung, PNNL	(509) 373-0201	lm_peurrung@pnl.gov

Hanford Site Science Need
Tanks Subgroup

Identification No.: RL-WT041-S

Need Title: Radionuclide Partitioning

FY99 Site Priority Ranking:

I. Functional Need:

Safe, effective, and efficient waste processing to minimize the volume of the HLW stream.

II. Problem Description:

Current strategies for reducing the total volume of radioactive tank waste requiring disposal at Hanford and other DOE sites call for the development of methods to selectively remove non-radioactive elements such as Al, P, and Cr while retaining or precipitating the radioactive elements, including fission products and the actinide elements in the HLW stream. Unfortunately, the presence of a large number of possible solid phases, aqueous complexants, and the high ionic strength (often several molal) of these solutions makes it extremely difficult determine and predict the distribution of radionuclides between the sludges, suspended solids and aqueous supernatants. Such a lack of fundamental knowledge about the distribution of radionuclides in the HLW stream significantly impacts the numbers of glass logs requiring disposal and as a result the ultimate HLW disposal cost.

III. Science Need Description:

The sludges and suspended solids are composed of insoluble precipitates of actinides, radioactive fission products, and nonradioactive components. The supernatants are neutral to strongly alkaline solutions that can contain soluble actinides and fission products as well as high concentrations of major electrolytes including sodium hydroxide, nitrate, nitrite, phosphate, carbonate, aluminate, sulfate, and organic complexants. What is needed is a fundamentally sound means of determining or predicting the partitioning of important radionuclides (especially technetium-99) among the waste processing solutions, suspended solids, and precipitates in these complex high ionic strength solutions. Development of this predictive capability will require characterization of solid and solution phase speciation as well as experimental thermodynamic and kinetic data on important radionuclide aqueous speciation reactions, precipitation/dissolution reactions, and solid phase adsorption reactions.

Need Timing: 4-10 years

IV. Benefit:

Significantly reduced processing and disposal costs through optimization of waste processing conditions for individual tank sludges or supernatants.

Benefit code: check all that apply:

✓ Cost Savings _ Risk Reduction _ Enabling Knowledge

This science need supports the following Hanford tanks technology need(s):
RL-WT025 Enhanced Sludge Washing Process Data

V. Contacts:

For more information, contact:

Catherine Louie, DOE-RL TWRS	(509) 376-6834	catherine_s_louie@rl.gov
Loni Peurrung, PNNL	(509) 373-0201	lm_peurrung@pnl.gov

Hanford Site Science Need
Tanks Subgroup

Identification No.: RL-WT042-S

Need Title: Flammable Gas Generation, Retention, and Release in HLW Tanks

FY99 Site Priority Ranking:

I. Functional Need:

Safe, effective and efficient waste storage, retrieval and transport, including the prevention of pipe plugging, foam generation, and transport line pressurization.

II. Problem Description:

The generation, retention, and uncontrolled release of flammable gases in Hanford high-level waste tanks is a continuing safety and processing issue. A better understanding of gas transport mechanisms and waste properties is needed to ensure that the tanks are maintained in a safe condition until the waste can be processed into a safer storage system. This work would support resolution of both the Organic Safety Issue and continued tank farm operations (e.g., salt-well pumping, retrieval).

III. Science Need Description:

Analysis of the physics of the flammable gas safety issue must embody the cause-and-effect relationship of generation, retention, and release. Gas generation is the ultimate source of the hazard (though head space data indicate it is not a hazard in itself), gas retention is a measure of the potential hazard, and gas release represents the actual hazard. The scientific needs for understanding each of the three facets is described below.

Gas generation processes must be understood well enough to estimate the generation rate and relative gas composition. The generation rates of the major fuel and diluent species determine the minimum tank ventilation rate required to prevent a flammable mixture buildup in the head space. Scientific knowledge of radiolytic and thermolytic rate parameters provide the means to predict gas generation rates and composition of generated gas. These rate parameters are needed as a function of major waste type groupings and chemical components.

The retained gas volume (and composition) in the waste is a direct measure of the potential flammable gas hazard. Each plausible mechanism of gas retention exhibits its own specific process of gas release. A scientific understanding of gas retention, both mechanisms and volume, is necessary to understand gas release, including its likelihood, rate, and amount. This understanding of retention mechanisms is needed for different waste types and waste configurations.

The flammable gas hazard of a tank depends on the possible consequences of a gas release. Flammable gas cannot create consequences until it is actually released in a closed volume at a concentration that can be ignited and burn, elevating the pressure. A scientific understanding of gas release mechanisms, such as bubble movement or gas diffusion, is needed to estimate release rate, volume, and frequency and then to relate each of these to the tank waste configuration and properties to evaluate the probable consequences. This understanding of release mechanisms is needed for different waste types and waste configurations.

Need Timing: 4-10 years

IV. Benefit:

Understanding how to identify and quantify situations where flammable gases pose hazards results in risk reduction. In addition, the hazards associated with the presence of flammable gases are minimized through the appropriate application of controls, process modifications, and new process equipment. Understanding and quantifying the flammable gas hazard associated with each tank and each processing step allows for a graded application of controls and safety equipment. This graded approach results in cost savings because expensive controls and equipment are only used when needed, and not in all situations when they are clearly not needed.

Benefit code: check all that apply:

✓ Cost Savings ✓ Risk Reduction _ Enabling Knowledge

This science need supports the following Hanford tanks technology need(s):
RL-WT025 Remote Sensing of Gas Retention in HLW Slurries

V. Contacts:

For more information, contact:

Catherine Louie, DOE-RL TWRS	(509) 376-6834	catherine_s_louie@rl.gov
Loni Peurrung, PNNL	(509) 373-0201	lm_peurrung@pnl.gov

Hanford Site Science Need
Tanks Subgroup

Identification No.: RL-WT043-S

Need Title: Effect of Human and Natural Influences on Long-Term Water Distribution

FY99 Site Priority Ranking:

I. Functional Need:

Fundamental data to improve confidence in the performance assessment under realistic conditions.

II. Problem Description:

Water passing through the soil surface to the waste disposal facility provides both the agent to release the contaminants from the waste form as well as the medium to transport the contaminants to the groundwater. The amount of water applied to the surface over the next thousands of years will vary because of climate changes and because of human-initiated events .

III. Science Need Description:

Efforts are needed to 1) consider long-term land and water use at DOE sites by future generations; 2) consider natural phenomena such as near-term climate change (which is forecast to impact society in the next 100 years) or long-term climate change as we transition into the next ice age; and 3) incorporate those uses and impacts into modeling efforts to predict the transport of contaminants.

Need Timing: 4-10 years

IV. Benefit:

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 released contaminants is also proportional to the 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. The manner in which human-caused events are factored into the analysis could affect the acceptability of the disposal action, particularly to a major subset of Hanford stakeholders.

Benefit code: check all that apply:

✓ Cost Savings ✓ Risk Reduction _ Enabling Knowledge

This science need supports the following Hanford tanks technology need(s):
RL-WT029 Data and Tools for Performance Assessments

V. Contacts:

For more information, contact:

Catherine Louie, DOE-RL TWRS	(509) 376-6834	catherine_s_louie@rl.gov
Loni Peurrung, PNNL	(509) 373-0201	lm_peurrung@pnl.gov
Fred Mann, FDNW	(509) 376-5728	frederick_m_mann@rl.gov

Hanford Site Science Need
Tanks Subgroup

Identification No.: RL-WT044-S

Need Title: Distribution of Recharge Rates

FY99 Site Priority Ranking:

I. Functional Need:

Fundamental data to improve confidence in the performance assessment under realistic conditions.

II. Problem Description:

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.

III. Science Need Description:

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.

Also needed is the quantification of 1) the distribution of recharge throughout the Hanford Site as well as through the waste site, 2) the variability (uncertainty) possible in the distribution of recharge, and 3) the time delay between recharge through the land surface and that into the water table. 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.

Need Timing: 4-10 years

IV. Benefit:

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.

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.

Benefit code: check all that apply:

✓ Cost Savings ✓ Risk Reduction _ Enabling Knowledge

This science need supports the following Hanford tanks technology need(s):
RL-WT029 Data and Tools for Performance Assessments

V. Contacts:

For more information, contact:

Catherine Louie, DOE-RL TWRS	(509) 376-6834	catherine_s_louie@rl.gov
Loni Peurrung, PNNL	(509) 373-0201	lm_peurrung@pnl.gov
Fred Mann, FDNW	(509) 376-5728	frederick_m_mann@rl.gov

Hanford Site Science Need
Tanks Subgroup

Identification No.: RL-WT045-S

Need Title: Vadose Zone Flow Simulation Tool Under Arid Conditions

FY99 Site Priority Ranking:

I. Functional Need:

To understand the movement of contaminants in very complex geometries through zones of low moisture for use in risk assessments.

II. Problem Description:

To predict the movement of contaminants from the disposal of waste, a wide variety of chemical and physical phenomena must be modeled over large spatial scales and over time periods lasting thousands of years. For the release of contaminants from immobilized low-level tank waste, the physical condition and surrounding water chemistry for thousands of canisters must be modeled, where the physical and chemical environment vary with time and position in the disposal vault. For the modeling of flow into disposal facilities or around tanks in large tank farms, detailed three-dimensional geometric models must be used transient moisture fronts and steep concentration gradients must be analyzed. Finally, because of the low moisture content of Hanford soils and the significant thickness of the vadose zone, simulations over many thousands of years are required, even for the most mobile contaminants.

III. Science Need Description:

Develop a computer code using modern computer science techniques that combines time and spatially-dependent geochemical modeling with transient moisture flow and contaminant transport and which allows the determination on the results of modeling and data uncertainties. The simulator must handle geometrically complex objects and a large number of chemical species. Current extrapolated running times must be reduced by one to two orders of magnitude. The code should be structured to economically address the quantification of sensitivity of responses to uncertain physical and geochemical model parameters.

Determine the real transport properties and phenomena at a western site having complex flow and transport conditions (such as the Hanford Site). Such properties should include chemical retardation (e.g. dependency on moisture and geologic layers) and unsaturated hydraulic data. Transport phenomena should include not only transport through homogenous media but also transport through fractured and preferred vertical flow paths (such as clastic dikes).

Need Timing: 4-10 years

IV. Benefit:

Current techniques require that oversimplified models be used, making analyses too conservative. Better modeling techniques will allow more accurate waste form specifications for immobilized Hanford tank waste, potentially saving hundreds of millions of dollars, and will allow a better determination for the closure of Hanford tank farms, potentially allowing a large fraction of tanks to be remediated in a more cost-effective manner.

With a simulation tool which calculates uncertainty progation, resources can be concentrated on those data and methods having the largest impact on the calculations of environmental responses. By reducing the most important uncertainties and by providing greater assurance that the modeling is accurate and reliable, the total life-cycle cleanup will be reduced.

Benefit code: check all that apply:

✓ Cost Savings ✓ Risk Reduction _ Enabling Knowledge

This science need supports the following Hanford tanks technology need(s):
RL-WT029 Data and Tools for Performance Assessments

V. Contacts:

For more information, contact:

Catherine Louie, DOE-RL TWRS	(509) 376-6834	catherine_s_louie@rl.gov
Loni Peurrung, PNNL	(509) 373-0201	lm_peurrung@pnl.gov
Fred Mann, FDNW	(509)376-5728	frederick_m_mann@rl.gov

Hanford Site Science Need
Tanks Subgroup

Identification No.: RL-WT046-S

Need Title: Getter Materials

FY99 Site Priority Ranking:

I. Functional Need:

Fundamental data to improve confidence in the performance assessment under realistic conditions.

II. Problem Description:

In order to meet the contaminant release specifications for the disposal of Hanford low-activity tank waste, radiocontaminants are physically trapped in glass. However, only a few of these radioelements drive the performance assessment. If these key radioelements 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 Saltstone waste was an important consideration in the approval of that site's disposal of tank waste.

III. Science Need Description:

Negatively charged elements and compounds (e.g. TcO_4^-, Se^-) are poorly sorbed on most materials under basic (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.

Need Timing: 4-10 years

IV. Benefit:

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 TWRS Disposal Program. The Savannah River Site uses FeS to trap technetium, and many disposal sites use concrete to trap uranium.

Benefit code: check all that apply:

✓ Cost Savings ✓ Risk Reduction _ Enabling Knowledge

This science need supports the following Hanford tanks technology need(s):

V. Contacts:

For more information, contact:

Catherine Louie, DOE-RL TWRS	(509) 376-6834	catherine_s_louie@rl.gov
Loni Peurrung, PNNL	(509) 373-0201	lm_peurrung@pnl.gov
Fred Mann, FDNW	(509)376-5728	frederick_m_mann@rl.gov

Hanford Site Science Need
Tanks Subgroup

Identification No.: RL-WT047-S

Need Title: Tritium Separations

FY99 Site Priority Ranking:

I. Functional Need:

Limit the release of tritium to the environment.

II. Problem Description:

This problem involves the Hanford 100 Area and decontamination and decommissioning (D&D) of the N- and K-Basins. These basins contain (or have contained) spent nuclear fuel within rod assemblies for up to 10 years. The highly radioactive fuel has subjected the water in the storage basins to a neutron flux sufficient to increase the tritium content of the water. The N-Basin water currently contains 39 μCi/L of HTO, while KE-Basin contains 3 μCi/L. The KW-Basin contains the lowest concentration, at 0.3 μCi/L. However, each of these concrete basins contain 1 to 1.5 million gallons of contaminated water.

A demonstratable technology would also be applicable for the Effluent Treatment Facility (ETF). The ETF treats Hanford process waters (primarily condensate from the 242-A Evaporator) but does not remove tritium. A tritium removal technology could be placed at the effluent point of the ETF to bring the effluent into compliance with the EPA Drinking Water Act limit of 20,000 pCi/L. (Currently, treated effluent from the facility is disposed at a state-approved land disposal site in the 200-West area.)

Concentrations greater than 2,000,000 pCi/L have been detected in Hanford ground water in the 12 wells in the 200-East area. The highest levels in the Hanford Site (5,360,000 pCi/L) were near the cribs that received effluent from the PUREX plant. More importantly, the movement of the tritium plume extends from 200-East to the Columbia River. Similar problems with tritium, as HTO, are present at SRS, INEEL, and Lawrence Livermore National Laboratory. It must be emphasized that, currently, there is no cost-effective method of separating tritium from these dilute streams.

This problem involves Tri-Party Agreement (TPA) milestone M-26-05, which indicates an annual review will be made of the developing technologies for tritium separation in an effort to settle on a technology to mitigate tritiated water. There is a further milestone (M-34-01) which requires K-East basin to have a reduction of tritium from 3×10^6 to 3×10^5 pCi/L at a date under consideration by TPA participants.

III. Science Need Description:

Many processes have been developed to separate hydrogen isotopes in feed streams where the tritium is at a relatively high level and the feed volume is low. For instance, combined electrolysis-catalytic exchange and water distillation operate quite well with higher concentrations of tritiated water. Generally, high capital and power costs reduce their usefulness for separating low levels of tritium in high feed volumes. However, recent work has been directed toward increasing favorable tritium exchange with catalyzed systems using dual-temperature countercurrent cascades. Pervaporation and membrane distillation have been examined for the separation of deuterium oxide from light water (H_2O) with moderate success. PNNL recently reported the separation of HTO from light water using supported polyphosphazene membranes under nanofiltration (cross-flow) filtration conditions. Tritiated water reductions of approximately 40% were obtained in the permeate with supported carboxylated-polyphosphazene membranes. The tritium concentration in the feed water ranged from 10,000 pCi/L to 3mCi/L.

The regulatory drivers and stakeholder concerns support the continued search for a cost-effective tritium separation process. It is apparent that processes currently used to treat very high concentrations of tritium are too capital and energy demanding.

Need Timing: 4-10 years

IV. Benefit:

Waters containing unacceptable tritium concentrations (that is, above environmental release limits or drinking water standards) are released at DOE sites, including Hanford, Savannah River, Idaho National Engineering Laboratory, and Lawrence Livermore National Laboratory. Currently, water from some test wells at Hanford contain tritium concentrations approaching $6x10^3$ mCi/L while the K and N-Storage Basins are as high as 39 mCi/L. **There are no economically acceptable removal options for remediation for tritium, especially ground water, other than migration with time through geological formations**. The functional need is the next step to develop a process that will reduce the risk to the environment and public, reduce the costs for ultimate disposal for the tritium-containing water, and provide a way to recover the tritium in a concentrated form for disposal or use.

Benefit code: check all that apply:

_ Cost Savings ✓ Risk Reduction ✓ Enabling Knowledge

V. Contacts:

For more information, contact:

Catherine Louie, DOE-RL TWRS	(509) 376-6834	catherine_s_louie@rl.gov
Loni Peurrung, PNNL	(509) 373-0201	lm_peurrung@pnl.gov

Hanford Site Science Need
Tanks Subgroup

Identification No.: RL-WT048-S

Need Title: Innovative Methods for Radionuclide Separation

FY99 Site Priority Ranking:

I. Functional Need:

Reliable means for separating fission products and other troublesome components from the feed to LLW vitrification.

II. Problem Description:

Development and demonstration of innovative approaches are needed to avert the technical risk that existing technologies are not adequate to proceed with the 10 year plan for remediating Hanford tank wastes. Failure to meet required decontamination factors (DFs), reasonable volumes of HLW and LLW, or to maintain reasonable total plant operating efficiency because of operational problems with any of several separation steps could substantially delay or slow retrieval, pretreatment, and immobilization of tank waste.

III. Science Need Description:

The presence of Cs, Sr, and Tc cause radiation and performance assessment problems and must be removed from the feed to LLW vitrification. The current baseline calls for removal of these species by ion exchange. The "placeholder" baseline process for Cs has been the ion exchange resin CS-100, but its performance is not adequate. Only one other technology exists for Cs (crystalline silicotitanate). It cannot be eluted, and so new material must be purchased and vitrified each time it is loaded. A means for removing Sr and Tc have not been confirmed. Only ion exchange technologies are being considered, all of which are subject to the same potential problems: replacement of degenerated or loaded ion exchangers; unintentional filtration of particulates; channeling caused by swelling cycles; down time associated with cyclic operation; decontamination factors limited by problems with ion exchange kinetics or packing.

Therefore, fundamentally different types (not just versions) of technologies need to be available to preclude "common mode" failures among options, which could delay clean up of tank waste.

The ability to separate a radionuclide depends crucially on its speciation; without this knowledge, installed processes could be ineffective, particularly if chemical conditions change. The identity of dissolved Sr and Tc is not known and could be complicated. It has been assumed that dissolved Sr may be in complexed form which can be removed if the complexant is oxidized, but the actual DF that would result is difficult to predict. It has been assumed that Tc exists as pertechnetate and can be removed by anion exchange, but recent results show perhaps 20% of Tc is in some other, non-exchangeable form. Basic research on the speciation of Sr and Tc and oxidation state of free and complexed Tc needs to be performed.

Need Timing: 4-10 years

IV. Benefit:

New technologies would reduce waste stream volumes and reduce technical risk that existing technologies are not adequate to meet current performance requirements.

Benefit code: check all that apply:

✓ Cost Savings ✓ Risk Reduction ✓ Enabling Knowledge

This science need supports the following Hanford tanks technology need(s):
RL-WT008 Advanced Methods for Achieving LLW Volume Minimization

V. Contacts:

For more information, contact:

Catherine Louie, DOE-RL TWRS	(509) 376-6834	catherine_s_louie@rl.gov
Loni Peurrung, PNNL	(509) 373-0201	lm_peurrung@pnl.gov

Hanford Site Science Need
Tanks Subgroup

Identification No.: RL-WT049-S

Need Title: Effect of Processing on Waste Rheological and Sedimentation Properties

FY99 Site Priority Ranking:

I. Functional Need:

Safe, effective, and efficient waste processing to minimize the volume of HLW stream.

II. Problem Description:

Information is needed on the effect of processing on the rheological and sedimentation properties of the complex solid and liquid matrices of the Hanford tank wastes. This information is needed to predict when gels will form in retrieval, wash, and leach solutions, and to supplement empirical water wash and caustic leach data from enhanced sludge wash testing of Hanford tank sludge and saltcake samples.

III. Science Need Description:

A large portion of the insoluble solids in tank sludge may be in the form of colloidal particles. Depending on the pH and ion concentrations of the surrounding solution, these particles may attract each other to form a porous network of particle chains, also known as a gel. The formation of a colloidal gel can impact several aspects of tank waste processing. For example, the formation of a colloidal gel can change a low-viscosity Newtonian suspension into a highly-viscous shear-thinning fluid. In another example, the efficiency of solid-liquid separation through sedimentation depends on the final sediment density, which may be dramatically reduced if a colloidal gel is formed.

The rheological and sedimentation properties of the waste depend both on the strength of connection between individual particles and the structure of the particle networks that form. Areas of interest include: effect of processing (e.g., retrieval, transport, solid/liquid separations) on rheological properties of waste; colloid behavior and flocculation; particle size distributions; surface charge and interfacial properties; and mechanical mixing effects (e.g., erosion, deagglomeration). Models must be developed to predict when gels will form in retrieval, wash, and leach solutions.

Need Timing: 4-10 years

IV. Benefit:

The research described here has large potential impact on retrieval, transport and treatment of tank waste. There are large economic risks associated with the plugging of a transport line, the failure of a solid-liquid separation process or the formation of a gel during a processing step. The results of this research would be used to identify situations of potential risk during tank waste processing.

Benefit code: check all that apply:

✓ Cost Savings ✓ Risk Reduction ✓ Enabling Knowledge

This science need supports the following Hanford tanks technology need(s):
RL-WT023 Prediction of Solid Phase Formation in Hanford Tank Waste Solutions

V. Contacts:

For more information, contact:

Catherine Louie, DOE-RL TWRS (509) 376-6834 catherine_s_louie@rl.gov
Loni Peurrung, PNNL (509) 373-0201 lm_peurrung@pnl.gov

Hanford Site Science Need
Tanks Subgroup

Identification No.: RL-WT050-S

Need Title: Effect of Organic Constituents on Waste Processing

FY99 Site Priority Ranking:

I. Functional Need:

Safe, effective, and efficient waste processing to minimize the volume of the HLW stream.

II. Problem Description:

An understanding of the chemistry of organic constituents (including complexants) in tank wastes is needed to support the Phase II privatization request for proposals. In particular, partitioning of radionuclides between the liquid and solid phases in the waste is hindered by organic complexants present in the wastes. The complexation of radionuclides must be controlled to separate the waste into high- and low-level fractions effectively. This may entail destroying the complexants or removing the dissolved radionuclides using advanced separation processes. Also, there are safety concerns associated with organic-containing wastes. Radiolytic and thermal reactions of organics with nitrate and nitrite salts in HLW produce flammable and toxic gases: hydrogen, nitrous oxide, and ammonia. Wastes that contain organics may combust if allowed to dry out. Changing waste storage conditions may alter organic aging to increase gas production. However, changes that accelerate aging of organic complexants would facilitate separation of radionuclides.

III. Science Need Description:

Factors that influence separation and safety issues and steps for treatment and mitigation may be result from learning the products, mechanisms, and kinetics of organic reactions that occur under conditions of waste storage, retrieval, and processing. Reactions induced by heat and radiation need to be studied to assess hazards and develop methods for organic destruction. Understanding is needed of how ammonia is produced in the wastes. Also, an understanding is needed of the role of oxygen and metal ion redox catalysts in promoting gas production and organic aging. The studies should include organics chemicals that were added to tank wastes and their aging products, as well as organic chemicals and materials that may be used in processing the wastes. As an alternative to destroying chelators, the design and development of relevant advanced separation materials is needed.

Need Timing: 1-3 years

IV. Benefit:

This science will provide benefits by providing enabling knowledge about organic tank waste chemistry that will result in 1) improved risk assessment 2) reduced risks associated with storage and processing, and 3) improved processing performance.

Benefit code: check all that apply:

✓ Cost Savings ✓ Risk Reduction ✓ Enabling Knowledge

V. Contacts:

For more information, contact:

Catherine Louie, DOE-RL TWRS	(509) 376-6834	catherine_s_louie@rl.gov
Loni Peurrung, PNNL	(509) 373-0201	lm_peurrung@pnl.gov

Hanford Site Science Need
Tanks Subgroup

Identification No.: RL-WT051-S

Need Title: Foam Generation and Stability

FY99 Site Priority Ranking:

I. Functional Need:

Safe, effective and efficient waste storage, retrieval and transport, including the prevention of pipe plugging, foam generation, and transport line pressurization.

II. Problem Description:

Flammable gases, including hydrogen, ammonia, and nitrous oxide, are generated and retained in the high-level waste stored in Hanford tanks. The presence of these flammable gases pose a number of safety concerns. A better understanding of gas transport mechanisms and waste properties is needed to ensure that the tanks are maintained in a safe condition and that retrieval and waste processing are conducted in a safe manner. During retrieval operations, retained gases may breakup into very fine bubbles, or foams, that are easily entrained into downstream processing equipment. Depending on the type and configuration of the equipment, these entrained gases may accumulate within the equipment, presenting safety concerns.

In addition, waste retrieval and transport operations may generate foams composed primarily of entrained air. These foams may lead to plugging or over-pressurization of transport lines.

III. Science Need Description:

The formation of foam and its stability must be understood well enough to estimate the amount of flammable gases that would be entrained into downstream processing equipment. Scientific knowledge is needed to quantify the stability of generated foams as a function of major waste type groupings and chemical components. In addition, an understanding of the mechanisms of foam generation during waste operations is needed.

Transport of waste slurries containing bubbles may lead to complications in transport operations such as pump cavitation, additional foam generation, and possibly over-pressurization of the transport lines. Existing bubbles of any size distribution, when subjected to the high shear fields inside of the pump impeller and within the cross-site transfer lines, are likely to break up into much smaller sizes, thus increasing their number density. The stability of these bubbles in the waste slurries is again a critical issue. In addition, an understanding is needed of the transport properties of bubbly waste slurries in the transport lines.

During waste retrieval operations, foams can also be created by entraining air into the waste. An understanding of how foams can be created by entrainment of air is needed.

Need Timing: 4-10 years

IV. Benefit:

Understanding how to identify and avoid situations where foam formation may occur will minimize the risk of equipment damage and system failure due to the presence of foams. Understanding how to identify and avoid situations where flammable gases may be carried to other processing equipment will reduce the flammable gas safety hazard and risk. By understanding how to avoid transporting flammable gases, fewer controls and less redundant safety equipment will be needed to accomplish the waste retrieval and transport operations.

Benefit code: check all that apply:

✓ Cost Savings ✓ Risk Reduction _ Enabling Knowledge

V. Contacts:

For more information, contact:

Catherine Louie, DOE-RL TWRS	(509) 376-6834	catherine_s_louie@rl.gov
Loni Peurrung, PNNL	(509) 373-0201	lm_peurrung@pnl.gov

Hanford Site Science Need
Tanks Subgroup

Identification No.: RL-WT052-S

Need Title: Characterization of Organic Species in Waste Feed to LAW and HLW Treatment Facilities

FY99 Site Priority Ranking:

I. Functional Need:

Measurement of the amount of certain RCRA and TSCA organic compounds in waste feed to the private contractors that may impact process and plant design.

II. Problem Description:

For acceptance at the repository, the immobilized high-level waste (IHLW) form cannot contain significant amounts of more than 200 RCRA or TSCA organic species. ILAW must meet LDRs, which also forbid a large number of hazardous constituents. In addition, a number of compounds known as toxic air pollutants will have to be addressed in permitting of the facilities. (Savannah River's tank waste is not listed waste, so this is not an issue at DWPF.)

While the waste feed to the private contractors will contain many RCRA organics, the private contractors' process will have to destroy or remove these compounds in order to meet the restrictions above. The quantity of each of these compounds present in the waste feed stream to the private contractors will need to be established so that they can design their facility and demonstrate that they can meet the permitting requirements. DOE, the regulators, and the private contractors will have to resolve which organization will perform which analyses for compliance. DOE is making an effort as part of its planning phase to provide additional information for environmental planning. This will involve characterization of organic components in tank waste. Most of these compounds can be analyzed by current methods with some modification or development of sample preparation techniques. There may be a limited set of compounds important to environmental planning that will require a more significant effort in method development. This set is currently being reviewed by DOE and Ecology.

III. Science Need Description:

Development of analytical methods to address DOE and regulatory requirements. The analyses could use existing analytical tools but would require the development of sample preparation steps, calibration, and method validation for their application to organic species in tank waste.

Need Timing: The completion of this effort must be targeted for input to DOE early in FY2000.

IV. Benefit:

Development of these methods will support environmental planning for permitting of the private contractors' facilities. If methods developed can demonstrate that certain RCRA and TSCA compounds are not present in the waste, the contractors may be able to design more simple processes, saving money. If no method is developed and if RCRA compounds are later shown to be present in the output streams of the plant, the plants may have to shut down and retool, and significant cost will be incurred.

Benefit code: check all that apply:

✓ Cost Savings ✓ Risk Reduction ✓ Enabling Knowledge

V. Contacts:

For more information, contact:

Catherine Louie, DOE-RL TWRS	(509) 376-6834	catherine_s_louie@rl.gov
Loni Peurrung, PNNL	(509) 373-0201	lm_peurrung@pnl.gov

Hanford Site Science Need
Tanks Subgroup

Identification No.: RL-WT053-S

Need Title: Contaminant Mobility Beneath Tank Farms

FY99 Site Priority Ranking:

I. Functional Need:

To 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.

II. Problem Description:

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, bore-hole logging in SX Tank Farm revealed cesium-137 at depths of 130 feet, 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 TWRS Vadose Zone Expert Panel concluded that cesium migration was poorly understood and that insufficient data were available to validate migration models.

Without knowledge about the distribution of contaminants beneath the tank farms, and without the ability in hand to predict contaminant movement, it will be impossible to assure the public that the DOE can predict:

a) the impact of leaks during sluicing of the tanks during cleanup, and

b) the impact of leaving the tanks (and their associated subsurface contamination) in place.

Furthermore, the vadose zone cleanup schedule for the 200 Areas could be delayed if the mobility status of deeply distributed contaminants is unknown or inadequately characterized well in advance. For example, if it is eventually determined that retrieval of TRU-contaminated soil down to 40 m or more beneath PFP cribs is required, the cleanup schedule could be greatly impacted due to financial requirements for excavation and handling costs that could approach 1 billion dollars or more. Similar excavation requirements for leaking 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.

III. Science Need Description:

Colloidal transport mechanisms. Studies are needed to evaluate the importance of colloids in enhancing the migration of radionuclides.

Soil fixation/binding mechanisms. 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:

1) extraction of pore fluid (free fraction) and the "reverse" of laboratory sorption studies (i.e., leaching or desorption studies) using actual contaminated media, and

2) assessment of the role of potential chemical reactions induced by the soil mineral fraction.

For example, what is the role of iron (II) rich silicate minerals (pyroxenes) present in Hanford soils on reduction-sorption of transuranics? Acid hydrolysis due to the acidity of the effluent may have enhanced the reducing capability of iron (II) rich minerals and resulted in irreversible sorption of transuranics (Johnson and Hodges, 1997, *Second Symposium on Hydrogeology of Washington*, abstracts). Hot, high-pH media (original tank waste) also modify the soil matrix in unpredictable ways. Silicate minerals dissolve and reprecipitate, colloids may form, etc. Actual modified media is needed to evaluate existing conditions. Some work of the latter type is planned for FY98 (as part of the TWRS Vadose Characterization Program). Additional or supplemental work is needed for a comprehensive assessment of 200 Area soil column disposal and tank farm sites.

Development of a modeling tool. A computer code should be developed to model the migration of radionuclides due to tank leakage incorporating the unique considerations described above (e.g., high pH, colloidal transport, moderately unsaturated to saturated conditions, etc.). The model should combine time and spatially-dependent geochemical modeling with transient moisture flow and contaminant transport and allow the determination of modeling and data uncertainties. The simulator must handle geometrically complex objects and a large number of chemical species. The code should be structured to economically address the quantification of sensitivity of responses to uncertain physical and geochemical model parameters. Transport phenomena should include not only transport through homogenous media but also transport through fractured and preferred vertical flow paths (such as clastic dikes). This effort should build on the work that Jacobs Engineering has already done as part of the Hanford Tanks Initiative.

Need Timing: 4-10 years

IV. Benefit:

Benefit code: check all that apply:

✓ Cost Savings ✓ Risk Reduction ✓ Enabling Knowledge

This science need supports the following Hanford tanks technology need(s):
RL-WT061 Reactive Barriers to Contaminant Migration

V. Contacts:

For more information, contact:

Catherine Louie, DOE-RL TWRS	(509) 376-6834	catherine_s_louie@rl.gov
Loni Peurrung, PNNL	(509) 373-0201	lm_peurrung@pnl.gov

Hanford Site Science Need
Tanks Subgroup

Identification No.: RL-WT054-S

Need Title: Solids Yield and Deagglomeration

FY99 Site Priority Ranking:

I. Functional Need:

To predict how much sludge the mixer pumps will stir up inside double-shell tanks (DSTs).

II. Problem Description:

Correlations have been developed through scaled mixer pump testing to predict how much sludge will be mixed to a pumpable slurry by the DST mixer pumps. These correlations have some uncertainties associated with them that must be resolved.

One of the largest uncertainties in mixer pump performance is waste shear strength. Shear strength measurements have been made on samples in the hot cell but may not truly represent the in-tank values. To make accurate and defensible mixer pump performance predictions, the in situ shear strength of the sludge must be known at the waste temperature expected during mixer pump operation. Disruption of waste samples during core sampling and extrusion may significantly decrease the sludge shear strength. Conversely, hot cell measurements are usually made at temperatures lower than those expected during retrieval, and this may bias the hot cell shear strength measurements too high. Both these effects must be quantified before hot cell shear strength measurements can be used to make mixer pump performance predictions.

Another uncertainty in the mixer pump performance correlations is the effect of interstitial fluid dilution (varying ionic strength) on the strength of the sludge near the sludge/slurry interface. Decreases in the ionic strength may decrease the cohesion between sludge particles, thereby facilitating sludge mobilization and mixing. This effect is not addressed in the existing correlations, and it should be evaluated.

III. Science Need Description:

Addressing these two major uncertainties in the mixer pump prediction correlations will likely require two, fully independent studies. One study is needed to improve the reliability of waste shear strength measurements. The second study is needed to address the effects of ionic strength changes and deagglomeration on the performance of mixer pumps.

The first study will require either that in situ shear strength measurements be made or that tests be performed on sludge simulants in an effort to bound the magnitude of the core sampling and extrusion disruption effects. Measurement of sludge strength in situ is the technically preferred option, but costs may be prohibitive. Regardless of whether in situ strength measurements are made, waste samples will need to be tested in the hot cell at elevated temperatures to simulate the conditions during mixer pump operation. These high-temperature shear strength measurements are needed to quantify the decrease in strength expected to occur when interstitial salt crystals dissolve as temperature is increased. This temperature effect may be significant enough that concerns related to inadequate mixer pump performance can be eliminated for some tanks. Once this study is completed, the existing mixer pump performance correlations can be applied to the improved shear strength estimates to more accurately predict sludge mobilization in the DSTs.

The second study will require the development of a more fundamental understanding of the microscale mechanisms that result in the resistance of sludge to impinging mixer pump jets. Sludge erosion resistance is due to a combination of cohesive forces acting between particles. Only some of these forces are sensitive to changes in ionic strength due to dilution. A determination must be made of which forces are most important so that the effects of ionic strength changes on sludge mobilization resistance can be predicted. Some testing using waste simulants and possible waste samples may be required. Once complete, this study will allow the prediction of how much improvement in mixer pump performance can be expected when the supernate ionic strength is reduced.

Need Timing: 4-10 years

IV. Benefit:

This activity supports Phase II of TWRS Privatization by allowing specification of retrieval performance. Moreover, during Phase I it is DOE's responsibility to provide feed to the privatization vendors. If the mixer pumps don't perform as well as is currently expected, DOE and its contractors might not be able to meet their feed delivery obligations and could lead to breach of contract.

Benefit code: check all that apply:

✓ Cost Savings ✓ Risk Reduction ✓ Enabling Knowledge

This science need supports the following Hanford tanks technology need(s):
RL-WT013 Establish Retrieval Performance Evaluation Criteria

V. Contacts:

For more information, contact:

Catherine Louie, DOE-RL TWRS (509) 376-6834 catherine_s_louie@rl.gov
Loni Peurrung, PNNL (509) 373-0201 lm_peurrung@pnl.gov

Hanford Site Science Need
Tanks Subgroup

Identification No.: RL-WT055-S

Need Title: Tank Integrity Verification

FY99 Site Priority Ranking:

I. Functional Need:

Conceptual approaches for verifying the integrity of waste tanks before retrieval or before turnover to or from a private vendor.

II. Problem Description:

Prior to single-shell tank waste retrieval, a verification or characterization of tank integrity is needed in order to choose appropriate retrieval technologies. This knowledge is also needed to support liability issues associated with transfer of ownership of the tanks under the privatization scenario envisioned for Phase II. Currently, the applicability of existing technologies that could perform this assessment for single-shell tanks is not understood or the modifications necessary have not been identified. Potentially, visual, ultrasonic or electrical techniques could be applicable. An understanding or characterization of the integrity of both the steel liner and its concrete shell is needed.

III. Science Need Description:

The degradation mechanisms of the tanks needs to be better understood in order to predict tank lifetimes. In addition, non-destructive assay methods should be evaluated for applicability to single-shell tanks. These could include existing or new conceptual approaches for integrity verification.

Need Timing: 4-10 years

IV. Benefit:

This work reduces risk during retrieval of waste, supports decisions on retrieval methods, and addresses liability issues associated with turnover of tanks and their return to DOE during Phase II of privatization.

Benefit code: check all that apply:

✓ Cost Savings ✓ Risk Reduction ✓ Enabling Knowledge

This science need supports the following Hanford tanks technology need(s):
- RL-WT026 Tank Leak Detection Systems for Underground SSTs
- RL-WT027 Tank Leak Mitigation Systems

V. Contacts:

For more information, contact:

Catherine Louie, DOE-RL TWRS	(509) 376-6834	catherine_s_louie@rl.gov
Loni Peurrung, PNNL	(509) 373-0201	lm_peurrung@pnl.gov

Hanford Site Science Need
Tanks Subgroup

Identification No.: RL-WT056-S

Need Title: Half-Lives of Se-79 and Sn-126

FY99 Site Priority Ranking:

I. Functional Need:

Measure the half-lives of Se-79 and Sn-126 to within 10%.

II. Problem Description:

The half-lives of Se-79 and Sn-126 are uncertain, causing uncertainties in predicted doses. For the disposal of immobilized low-activity Hanford tank waste, Sn-126 is the most important isotope in inadvertent intruder scenarios and Se-79 is the next most important isotope for the groundwater scenario. There exists one measurement of Se-79 (1949). However, the value reported (less than 65,000 years in ORNL-499 report on page 45) is in contradiction with fission yield systematics. A reanalysis of the conversion of the raw data into a half-life value has found that the reported half-live is low by a factor of 10. (For more information see Nuclear Data Sheets, Vol. 70 (1993) 437.

Recently (J. Radioanal. Nucl. Chem. Letters Vol 212 (1996) 93) a new value was measured for Sn-126 (2.5×10^5 y) using the UK fission yield for normalization. This replaces a value (~100,000 years) published in an abstract (Bull. Amer. Phys. Soc. Vol. 3 (1958) 165).

III. Science Need Description:

Measurements of the half-lives of Se-79 and Sn-126 are needed to within +/- 10%. Immobilized waste will be disposed of starting in 2002. This information is needed to determine if additional separations are needed and if special operational handling is necessary.

Need Timing: 4-10 years

IV. Benefit:

Technical:: Se-79 is the second most important radionuclide for long-term protection of the environment. There are significant incentives in the contracts with private vendors for greatly reducing the amount of the most-important radionuclide, Tc-99. Since the estimated dose is linearly proportionally to the inverse of the half-life, an uncertain half-life in Se-79 will greatly affect the estimated dose. It should be noted that the only measurement is for a bound of the half-life.

Sn-126 is the most important radionuclide in the protection of inadvertent intruders. Present calculations ("Hanford Low-Level Tank Waste Interim Performance Assessment") indicate that using the previously accepted half-life value, that if any of the 177 Hanford tanks have concentrations 4 times the average tank concentration, then performance objectives would not be meet. The newly measured value increases the margin by only 2.5. If tank concentrations are too high, additional separations or special disposal facility operations would be required.

Environmental Safety & Health: The estimated dose is inversely proportional to the half-life. For the inadvertent dose, Sn-126 is by far the most important nuclide. For the groundwater scenario, Se-79 will drive the estimated doses if significant amounts of Tc-99 are removed.

Cost Savings Potential (Mortgage Reduction): Lower values of half-live could mean an decrease in the height of waste acceptable in the disposal facility, particularly for Sn-126, causing significant greater area and hence construction cost. The amount of the change will depend on the difference in half-life found and the amount of conservatism required in the disposal decision. Doubling the area of disposal facility could require construction costs of hundred's of millions of dollars.

Benefit code: check all that apply:

✓ Cost Savings ✓ Risk Reduction ✓ Enabling Knowledge

V. Contacts:

For more information, contact:

Catherine Louie, DOE-RL TWRS	(509) 376-6834	catherine_s_louie@rl.gov
Loni Peurrung, PNNL	(509) 373-0201	lm_peurrung@pnl.gov
Fred Mann, FDNW	(509) 376-5728	frederick_m_mann@rl.gov

Hanford Site Science Need
Tanks Subgroup

Identification No.: RL-WT057-S

Need Title: Materials for Long-Term Waste Isolation

FY99 Site Priority Ranking:

I. Functional Need:

New subsurface waste disposal facilities should incorporate new and innovative materials ideally suited for each waste type and disposal environment. These materials would serve as alternatives to the typical materials (e.g., concrete, steel) that are known to have degradation problems.

II. Problem Description:

New waste disposal facilities should be designed to be as durable as possible to meet the appropriate disposal requirements. The materials used in the facilities should be chosen in part because they are ideally suited for the waste type and disposal environment. For example, standard concrete vaults use steel reinforcement that is known to cause spalling and cracking as the steel corrodes and expands. New materials may be able to provide an equivalent level of strength without the associated corrosion-induced cracking (a significant degradation mechanism in concrete).

III. Science Need Description:

The greatest needs are to identify those new materials that show the greatest promise of benefits with respect to waste disposal in the subsurface and to develop the data and models necessary to demonstrate their durability and performance for the lifetime of the disposal facility. In order for barriers involving getters to be considered, these barriers must withstand long-term performance assessment integrity assumptions that normal engineered structures do not withstand. Natural materials (e.g., minerals) that have the ability to self-heal fractures are highly desirable. Natural materials have the additional advantage that performance data over the long term are potentially available.

The goal of DOE is to protect the environment for at least 1,000 years, while NRC only recognizes manmade materials (particularly concrete) as lasting at most 500 years. Thus, the design life of new systems should be at least 1,000 years.

Need Timing: 4-10 years

IV. Benefit:

More durable materials for disposal facilities could decrease long-term public exposure and increase the lifetime of the disposal facility.

Benefit code: check all that apply:

✓ Cost Savings ✓ Risk Reduction _ Enabling Knowledge

V. Contacts:

For more information, contact:

Catherine Louie, DOE-RL TWRS (509) 376-6834 catherine_s_louie@rl.gov
Loni Peurrung, PNNL (509) 373-0201 lm_peurrung@pnl.gov

Commentary on FY 1999 Technology Needs Process

The FY 1999 Technology Needs for Tanks were compiled by Fluor Daniel Hanford, Inc., and its major subcontractor, Lockheed Martin Hanford Corporation. The Science Needs have been carried forward from last year without revision, and without significant additional review. All of the needs have been linked to specific WBS elements within the MYWP, providing traceability to baseline activities.

FY 1998/1999 Tanks Science and Technology Needs Crosswalk

Old (FY 1998)	New (FY 1999)	Need Title	Changes in FY 1999 Revision
RL-WT01	RL-WT01	Technetium-99 Analysis in Hanford Tank Waste and Contaminated Tank Farm Areas	Updated: substantively unchanged.
RL-WT02		In-Tank Core Sampling...Off-Riser Capability	Deleted - safety issue driving this needs is sufficiently resolved.
RL-WT03		Large Volume (3-5 l) Sludge and Supernate Sampler	Replaced: This need is being partially addressed by RL-WT09
RL-WT04	RL-WT04	DST Corrosion Monitoring	Updated
RL-WT05	RL-WT05	Remote Inspection of High-Level Waste Tanks	Updated: substantively unchanged.
RL-WT06		Identification and Management of Chromium and Other Problem Constituents for HLW Vitrification	Updated: substantively unchanged.
RL-WT07		Hanford Capsule Initiative (HCI): A Processing Demonstration of Cs/Sr Capsules for Final Disposition	Not included: processing capsules remain a need, but it is long-term and is a much lower priority.
RL-WT08		Advanced Methods for Achieving Low-level Waste Volume Minimization	Deleted: not carried forward by DOE-WDD/WIT.
RL-WT09	RL-WT09	Representative Sampling and Associated Analysis to Support Operations and Disposal	Updated: substantively unchanged.

Old (FY 1998)	New (FY 1999)	Need Title	Changes in FY 1999 Revision
RL-WT010		ILAW Product Acceptance Inspection and Test Methods	Deleted: not carried forward by DOE-WDD/WIT.
RL-WT011		IHLW Product Acceptance Inspection and Test Methods	Deleted: not carried forward by DOE-WDD/WIT.
RL-WT012		Secondary Waste Product Acceptance Inspection and Test Methods	Deleted: not carried forward by DOE-WDD/WIT.
RL-WT013	RL-WT013	Establish Retrieval Performance Evaluation Criteria	Updated: substantively unchanged.
RL-WT014		Alternative to Baseline Tank Waste Mixing Systems	Replaced by RL-WT060.
RL-WT015	RL-WT015	Standard Method for Determining Waste Form Release Rate	Updated: substantively unchanged.
RL-WT016	RL-WT016	Glass Monolith Surface Area	Updated: substantively unchanged.
RL-WT017	RL-WT017	Long-Term Testing of Surface Barrier	Updated: substantively unchanged.
RL-WT018	RL-WT018	Testing of Sand-Gravel Capillary Barrier	Updated: substantively unchanged.
RL-WT019		Getter Materials	Replaced by RL-WT061
RL-WT020		Service Integrity Testing of HLW Tanks and Piping	Replaced: this need is being encompassed by new need RL-WT058, and updated need RL-WT026.
RL-WT021	RL-WT021	Cleaning, Decontaminating and Upgrading Hanford Pits	Updated.
RL-WT022	RL-WT022	Tank Knuckle NDE	Updated: substantively unchanged.
RL-WT023	RL-WT023	Prediction of Solid Phase Formation in Hanford Waste Solutions	Updated.

Old (FY 1998)	New (FY 1999)	Need Title	Changes in FY 1999 Revision
RL-WT024	RL-WT024	Enhanced Sludge Washing Process Data	Updated: need is focused on Phase 2 privatization support.
RL-WT025	RL-WT025	Remote Sensing Of Gas Retention In HLW Slurries	Not carried forward by DOE.
RL-WT026	RL-WT026	Tank Leak Detection Systems for Underground Single-Shell Waste Storage Tanks (SSTs)	Updated: substantively unchanged.
RL-WT027	RL-WT027	Tank Leak Mitigation Systems	Updated: substantively unchanged.
RL-WT028		Waste mobilization enhancement	Replaced: merged with RL-WT014 - now RL-WT060.
RL-WT029	RL-WT029	Data and Tools for Performance Assessments	Updated: substantively unchanged.
RL-WT030		Contaminant Mobility Beneath Tank Farms	Science need RL-WT053-S.
RL-WT031-S	RL-WT31-S	Rapid Waste Characterization	Unchanged
RL-WT032-S	RL-WT32-S	Monitoring of Key Waste Physical Properties During Retrieval and Transport	Unchanged
RL-WT033-S	RL-WT33-S	Chemistry of Problem Constituents for HLW Vitrification	Unchanged
RL-WT034-S	RL-WT34-S	Long-Term Performance of LAW Forms	Unchanged
RL-WT035-S	RL-WT35-S	Moisture Flow and Contaminant Transport in Arid Conditions	Unchanged
RL-WT036-S	RL-WT36-S	Alternate Waste Form Development	Unchanged
RL-WT037-S	RL-WT37-S	Sludge Treatment	Unchanged

Old (FY 1998)	New (FY 1999)	Need Title	Changes in FY 1999 Revision
RL-WT038-S	RL-WT38-S	Process Models for Sludge Treatment	Unchanged
RL-WT039-S	RL-WT39-S	Advanced Methods for Achieving LLW Volume Minimization	Unchanged
RL-WT040-S	RL-WT040-S	Mechanisms of Line Plugging	Unchanged
RL-WT041-S	RL-WT041-S	Radionuclide Partitioning	Unchanged
RL-WT042-S	RL-WT042-S	Flammable Gas Generation, Retention, and Release in HLW Tanks	Unchanged
RL-WT043-S	RL-WT043-S	Effect of Human and Natural Influences on Long-Term Water Distribution	Unchanged
RL-WT044-S	RL-WT044-S	Distribution of Recharge Rates	Unchanged
RL-WT045-S	RL-WT045-S	Vadose Zone Flow Simulation Tool Under Arid Conditions	Unchanged
RL-WT046-S	RL-WT046-S	Getter Materials	Unchanged
RL-WT047-S	RL-WT047-S	Tritium Separations	Unchanged
RL-WT048-S	RL-WT048-S	Innovative Methods for Radionuclide Separation	Unchanged
RL-WT049-S	RL-WT049-S	Effect of Processing on Waste Rheological and Sedimentation Properties	Unchanged
RL-WT050-S	RL-WT050-S	Effect of Organic Constituents on Waste Processing	Unchanged
RL-WT051-S	RL-WT051-S	Foam Generation and Stability	Unchanged

Old (FY 1998)	New (FY 1999)	Need Title	Changes in FY 1999 Revision
RL-WT052-S	RL-WT052-S	Characterization of Organic Species in Waste Feed to LAW and HLW Treatment Facilities	Unchanged
RL-WT053-S	RL-WT053-S	Contaminant Mobility Beneath Tank Farms	Unchanged
RL-WT054-S	RL-WT054-S	Solids Yield and Deagglomeration	Unchanged
RL-WT055-S	RL-WT055-S	Tank Integrity Verification	Unchanged
RL-WT056-S	RL-WT056-S	Half-Lives of Se-79 and Sn-126	Unchanged
RL-WT057-S	RL-WT057-S	Materials for Long-Term Waste Isolation	Unchanged
	RL-WT058 (draft)	Improved Method for Transfer Line Leak Testing	Pending
	RL-WT059 (draft)	Laboratory Development and Field Demonstration of Reactive Barriers to Limit Contaminant Migration from SSTs	New FY 1999 need in first draft statement, replaced by RL-WT061
	RL-WT060	PHMC Retrieval and Closure - Hanford/SRS Waste Mixing Mobilization	New
	RL-WT061	Reactive Barriers to Contaminant Migration	New
	RL-WT062	PHMC DST Retrieval - Hanford DST Transfer Pump Improvements	New
	RL-WT063	PHMC Retrieval and Closure - Hanford SST Saltcake Dissolution Retrieval	New

Old (FY 1998)	New (FY 1999)	Need Title	Changes in FY 1999 Revision
	RL-WT064	PHMC Retrieval and Closure - Hanford Past Practice Sluicing Improvements	New
	RL-WT065	Direct Inorganic and Organic Analyses of High-Level Waste	New

FY 1999 SPENT NUCLEAR FUEL TECHNOLOGY NEEDS

ID#	NEED TITLE
RL-SNF01	Contaminant Mapping of K-Basins
RL-SNF02	Decontamination of K-Basin Pool
RL-SNF03	Fixatives for K-Basin
RL-SNF04	Multi-Canister Overpack (MCO) Monitoring Methods
RL-SNF05	Underwater Fuel Rack Cutting System
RL-SNF06	Sludge Treatment System

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

CONTAMINANT MAPPING OF K-BASINS

Identification No.: RL-SNF01
Date: September, 1998

Program: Spent Nuclear Fuel (SNFP)
OPS Office/Site: Richland Operations Office/Hanford Site
Operable Unit (if applicable): N/A
Waste Stream: Radioactively contaminated surfaces with loose or dispersible contamination.
Waste Management Unit (if applicable): N/A
Facility: K-Basins

Site Priority Ranking: High

Need Title: Contaminant Mapping of K-Basin

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

Current Baseline Technology: No appropriate technology has been identified.

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 an inch to 125 feet.

Schedule Requirements: The removal of fuel, debris, and sludge from the K-Basins is scheduled for completion in August 2001. 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 December 2005.

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.

PBS No.	***WBS No.***	***TIP No.***
RL-WM01	1.3.1	N/A

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/exposure concerns.

Regulatory: TPA Milestones M-34-04 through M-34-11 have been proposed for K-Basin Deactivation and are out for public comment.

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

Cost Savings Potential (Mortgage Reduction): Current mapping methods may not be capable of remote operation or operation underwater.

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

Other: None identified.

Consequences of Not Filling Need: A method has not been identified for the remote mapping of radioactive contaminants in a submerged location. Lack of appropriate technology will slow deactivation activity with the K-Basin pools. It will also result in a conservative and costly approach for decontamination.

Outsourcing Potential: N/A

End User: Chris Thompson, SNFP Operations, (509) 372-0598

Site Technical Point(s)-of Contact: Eric Gerber, FDH (509) 376-9356, Bruce Makenas, DESH (509) 376-5447, Alden Segrest, DESH, (509) 373-9287; Jim Frederickson, DESH, (509) 373-2059, Don Engelman, NHC (509) 372-6536

Contractor Facility/Project Manager: Jim Frederickson, SNF Process Engineering, (509) 373-2059

DOE End-User/Representative Point-of-Contact: Russ Warren, DOE-RL (509) 376-7330

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

DECONTAMINATION OF K-BASIN POOL

Identification No.: RL-SNF02
Date: September, 1998

Program: Spent Nuclear Fuel (SNFP)
OPS Office/Site: Richland Operations Office/Hanford Site
Operable Unit (if applicable): N/A
Waste Stream: Beta and Gamma contamination that is embedded in concrete.
Waste Management Unit (if applicable): N/A
Facility: KE-Basin

Site Priority Ranking: Very High

Need Title: Decontamination of K-Basin Pool

Need Description: 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 HEPA filtration system exists at either basin.)

Current Baseline Technology: No appropriate baseline technology has been identified.

Functional Performance Requirements: A decontamination method is needed that minimizes worker exposure, secondary waste generation, cost, and risk and it 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 an 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.

Schedule Requirements: The removal of fuel, debris, and sludge from K-Basin is scheduled for completion in August 2001. Decontamination of the pool will proceed shortly thereafter. Completion of the K-Basin Deactivation program is currently scheduled for December 2005.

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.

PBS No.	***WBS No.***	***TIP No.***
RL-WM01	1.3.1	Candidate

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 as the water in the pool currently serves as a radiation shield. Any remaining residual contaminants must be fixed in place after water removal since the basin does not have a HEPA filtration system.

Regulatory: TPA Milestones M-34-04 through M-34-11 have been proposed for K-Basin Deactivation and are out for public comment.

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

Cost Savings Potential (Mortgage Reduction): 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.

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.

Consequences of Not Filling Need: A method has not been identified for the decontamination of the KE-Basin pool. Lack of an appropriate method will slow completion of basin deactivation thereby slowing Hanford cleanup progress.

Outsourcing Potential: N/A

End User: Chris Thompson, SNFP Operations, (509) 372-0598

Site Technical Point(s)-of Contact: Eric Gerber, FDH (509) 376-9356, Bruce Makenas, DESH (509) 376-5447, Alden Segrest, DESH, (509) 373-9287; Jim Frederickson, DESH, (509) 373-2059, Don Engelman, NHC (509) 372-6536

Contractor Facility/Project Manager: Jim Frederickson, SNF Process Engineering, (509) 373-2059

DOE End-User/Representative Point-of-Contact: Russ Warren, DOE-RL (509) 376-7330

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

FIXATIVES FOR K-BASIN

Identification No.: RL-SNF03
Date: September, 1998

Program: Spent Nuclear Fuel (SNFP)
OPS Office/Site: Richland Operations Office/Hanford Site
Operable Unit (if applicable): N/A
Waste Stream: Radioactively contaminated surfaces with loose or dispersible contamination.
Waste Management Unit (if applicable): N/A
Facility: K-Basins

Site Priority Ranking: High

Need Title: Fixatives for K-Basin

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

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

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 20-25 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 an inch to 125 feet.

Schedule Requirements: The removal of fuel, debris, and sludge from the K-Basins is scheduled for completion in August 2001. Decontamination of the pool will proceed shortly thereafter. Completion of the K-Basin Deactivation program is currently scheduled for December 2005.

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 since neither basin has HEPA filtration. In areas where decontamination is not feasible, dispersible contamination is fixed in place.

PBS No.	*WBS No.*	*TIP No.*
RL-WM01	1.3.1	N/A

Justification for Need:

Technical: Dispersible radioactive contamination presents safety/exposure concerns.

Regulatory: TPA Milestones M-34-04 through M-34-11 have been proposed for K-Basin Deactivation and are out for public comment.

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

Cost Savings Potential (Mortgage Reduction): Current fixative methods require periodic replacement and increase life cycle costs.

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

Other: None identified.

Consequences of Not Filling Need: Use current technology at high maintenance cost.

Outsourcing Potential: N/A

End User: Chris Thompson, SNFP Operations, (509) 372-0598

Site Technical Point(s)-of Contact: Eric Gerber, FDH (509) 376-9356, Bruce Makenas, DESH (509) 376-5447, Alden Segrest, DESH, (509) 373-9287; Jim Frederickson, DESH, (509) 373-2059, Don Engelman, NHC (509) 372-6536

Contractor Facility/Project Manager: Jim Frederickson, SNF Process Engineering, (509) 373-2059

DOE End-User/Representative Point-of-Contact: Russ Warren, DOE-RL (509) 376-7330

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

MULTI-CANISTER OVERPACK (MCO) MONITORING METHODS

Identification No.: RL-SNF04
Date: September, 1998

Program: Spent Nuclear Fuel
OPS Office/Site: Richland
Operable Unit: N/A
Waste Stream: Multi-Canister Overpack (MCOs)
Waste Management Unit: N/A
Facility: Canister Storage

Site Priority Ranking: Very High

Needs Title: Multi-Canister Overpack (MCO) Monitoring Methods

Needs Description: The Tri Party Agreement (TPA) schedule requires the removal of spent nuclear fuel from the K Basins and dry storage at the Canister Storage Building (CSB). The project baseline seals the fuel in welded canisters called MCOs for interim storage. The current technical baseline has identified process validation monitoring of selected MCO prior to welding to confirm process prediction. A technique to monitor the welded MCOs needs to be available to support anticipated requirement changes during the 40-year interim storage period. At least one stakeholder group has implied a need for this long term monitoring.

Functional Performance Requirements: Monitoring needs to be able to measure the identified parameters of concern. These are currently projected to be MCO internal pressure, oxygen content, and potentially hydrogen content and weld condition. The design of the MCO requires that these measurements be made using non-invasive techniques. The technology will sense conditions through the MCO boundary and have the following sensitivity; pressure to about 10% (range 20 to 450 psi), oxygen concentration too about 1% (zero to four volume percent), and if needed hydrogen concentration above four volume percent and at least a visual weld inspection.

The technology will have to perform in a confined arrangement, CSB storage tubes annular space (space between the tube wall and the MCO).

Schedule Requirements: A deployable method needs to be available to support monitoring of the welded MCO in about 2003. This is when all the fuel will have been removed from K Basins and the MCOs welded at the CSB.

Problem Description: The challenge of this need is the measurement will be taken through a pressure boundary (a stainless steel wall or shield plug) and while the MCOs are inside storage tubes that have only several inches of clearance. While not desirable because of the potential handling accidents the MCOs could be removed for the storage tubes for access if no in situ alternative is found. The radiation levels vary but are calculated as up to 1100 rem/hr at contact.

PBS No.	***WBS No.***	***TIP No.***
RL-WM02	1.3.2	N/A

Justification for Need:

Technical: N/A

Regulatory: There currently is no baseline project requirement for MCO internal monitoring once they have been welded.

Environmental Safety & Health: N/A

Cost Saving Potential: N/A

Cultural/Stakeholder Concerns: It is anticipated that there will be a need to monitor the MCOs during the 40-year interim storage period. The DNFSB has indicated their expectation for this long term monitoring to DOE. Other stakeholder may also request long term monitoring if it does not affect fuel removal for the K Basins. Therefore, a new technology to monitor the MCO after they are welded and in storage is desirable.

Other: N/A

Consequences of Not Filling Need: Potential to have to use destructive techniques to monitor MCOs. This could create several new hazards and hardware development well beyond what is currently envisioned at the CSB.

Outsourcing Potential: N/A

Current Baseline Technology: None; the only testing currently envisioned would affect the MCO pressure boundary.

End User: Chris Thompson, SNFP Operations, (509) 372-0598

Site Technical Point(s)-of Contact: Darrell Duncan, DESH (509) 372-1013; Bruce Makenas, DESH (509) 376-5447; Jim Frederickson, DESH, (509) 373-2059, Don Engelman, NHC (509) 372-6536

Contractor Facility/Project Manager: Jim Frederickson, SNF Process Engineering, (509) 373-2059

DOE End-User/Representative Point-of-Contact: Russ Warren, DOE-RL (509) 376-7330

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

UNDERWATER FUEL RACK CUTTING SYSTEM

Identification No.: RL-SNF05
Date: September, 1998

Program: Spent Nuclear Fuel (SNFP)
OPS Office/Site: Richland Operations Office/Hanford
Operable Unit: N/A
Waste Stream: Contaminated metal racks
Waste Management Unit: N/A
Facility: K-Basin

Site Priority Ranking: Very High

Needs Title: Underwater Fuel Rack Cutting System

Needs Description: The K-Basins need to be emptied prior to decontamination and decommissioning. Due to high levels of radiation in the basin, it is desirable that the water remain in the basin (as shielding) until after decontamination of the basin walls and floor. After the fuel is removed from the basin, the fuel racks will need to be removed, then the sludge removed from the floor, then finally decontamination of the walls and floor begins. Thus, the fuel racks will need to be cut up in place, remotely and underwater, and removed in pieces for disposal.

Functional Performance Requirements: A system is necessary which will be able to operate remotely, underwater, in a high radiation environment. This system must cut the steel racks underwater and retrieve pieces that are cut. Since water clarity and new waste streams will be an issue for this, and following operations, it should be able to capture metal shavings or pieces that are generated and minimize waste volume as much as practical.

Schedule Requirements: The fuel racks need to be dismantled prior to December 5, 2005, to comply with milestone pertaining to removal of sludge and debris. System design and procurement will be completed in the Years 2001 and 2002. Deployment is likely early in the year 2003 so that racks can be removed prior to sludge removal.

Problem Description: The racks are located underwater in a high radiation field. The cutting device must work underwater and must be operated remotely. The mounting of a robotic arm, if required, above the pool is difficult. Clarity in the pool to assist with visual operations is an issue. Cut pieces have to be grasped and removed. While robotic/cutting technology has been readily demonstrated in other conditions, the combination of conditions at K-Basin offers a particular engineering challenge.

PBS No.	*WBS No.*	*TIP No.*
RL-WM01	1.3.1	Candidate

Justification for Need:

Technical: The fuel rack must be removed before retrieval of the sludge from the bottom of the basin.

Regulatory: N/A

Environmental Safety & Health: N/A

Cost Saving Potential: N/A

Cultural/Stakeholder Concerns: N/A

Other: N/A

Consequences of Not Filling Need: It will not be possible to complete cleanup of K-Basins.

Outsourcing Potential: N/A

Current Baseline Technology: No cutting technology is currently identified.

End User: Chris Thompson, SNFP Operations, (509) 372-0598

Site Technical Point(s)-of Contact: Don Precechtel, DESH, (509) 376-3329; Bruce Makenas, DESH (509) 376-5447; Jim Frederickson, DESH, (509) 373-2059; Don Engelman, NHC (509) 372-6536

Contractor Facility/Project Manager: Jim Frederickson, SNF Process Engineering, (509) 373-2059

DOE End-User/Representative Point-of-Contact: Russ Warren, DOE-RL (509) 376-7330

TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

SLUDGE TREATMENT PROCESS

Identification No.: RL-SNF06
Date: September, 1998

Program: Spent Nuclear Fuel (SNFP)
OPS Office/Site: Richland Operations Office/Hanford
Operable Unit: N/A
Waste Stream: Sludge to the TWRS
Waste Management Unit: N/A
Facility: K-Basin

Site Priority Ranking: Very High

Needs Title: Sludge Treatment Process

Needs Description: The K-Basins sludge needs to be removed from the K-Basins prior to decontamination and decommissioning (D&D). The sludge needs to be treated prior to transfer to the Double-Shell Tank (DST) System to meet the Tank Farms Waste Acceptance Criteria. The K-Basins sludge is currently outside the criteria for transfer to the DST system A treatment process is needed to process the sludge so that it can safely be deposited into DST AW-105.

Functional Performance Requirements: A treatment system is necessary which will be able to operate remotely in a high radiation environment, chemically dissolve the sludge and co-precipitate the fissile material and poisons in such a manner that the fissile material will not be concentrated in the DST system and the sludge will not cause other safety problems during storage at the DST.

Schedule Requirements: The sludge needs to be removed prior to February 28, 2001, to comply with Trip-Party Agreement (TPA) milestone pertaining to removal of sludge and debris. Deployment is scheduled for the year 2000.

Problem Description: The K-Basins sludge does not meet TWRS Waste Acceptance Criteria. The sludge is any material in the K-Basins pools that is less than or equal to 0.64cm (0.25in) 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 sludge is contaminated with PCBs. This material needs to be processed to remove or destroy the PCBs, convert the organics to a stable form that will not generate gases, correct a criticality issue and meet other TWRS waste criteria.

PBS No.	*WBS No.*	*TIP No.*
RL-WM01	1.3.1	Candidate

Justification for Need:

Technical: The K-Basins sludge must be removed from the basin in order to D&D the facility.

Regulatory: TPA milestones are as follows:
M-34-08: September 30, 2000, Initiate K East Basin sludge removal.
M-34-09-T01: February 28, 2001, Complete K Basins debris removal.
M-34-10: August 31, 2001, Complete K Basins sludge removal.

Environmental Safety & Health: N/A

Cost Saving Potential: N/A

Cultural/Stakeholder Concerns: N/A

Other: N/A

Consequences of Not Filling Need: It will not be possible to complete cleanup of K-Basins.

Outsourcing Potential: N/A

Current Baseline Technology: None identified.

End User: Chris Thompson, SNFP Operations, (509) 372-0598

Site Technical Point(s)-of Contact: Bruce Makenas, DESH (509) 376-5447; Frank Moore, NHC (509) 373-4079; Jim Frederickson, DESH, (509) 373-2059; Don Engelman, NHC (509) 372-6536

Contractor Facility/Project Manager: Jim Frederickson, SNF Process Engineering, (509) 373-2059

DOE End-User/Representative Point-of-Contact: Russ Warren, DOE-RL (509) 376-7330

Commentary on FY 1999 Science and Technology Needs Process

The FY 1999 Science and Technology Needs for Spent Nuclear Fuel were developed by Fluor Daniel Hanford, Inc. (FDH) and its major subcontractor, Duke Engineering and Services Hanford, Inc. (DESH). This draft revision represents six technology needs. Three FY 1998 technology needs were transferred from the Decontamination and Decommissioning category. There are three new Technology needs statements.

FY 1998-1999 SPENT NUCLEAR FUEL NEEDS CROSSWALK

Old (FY98)	New (FY99)	Need Title	Changes in FY 1999 Revision
RL-DD012	RL-SNF01	Contaminant Mapping of K-Basins	Transferred from D&D to new SNF category. To be reviewed through MWFA Subgroup.
RL-DD013	RL-SNF02	Decontamination of K-Basin Pool	Transferred from D&D to new SNF category. To be reviewed through MWFA Subgroup.
RL-DD014	RL-SNF03	Fixatives for K-Basin	Transferred from D&D to new SNF category. To be reviewed through MWFA Subgroup.
	RL-SNF04	Multi-Canister Overpack (MCO) Monitoring Methods	Emergent need.
	RL-SNF05	Underwater Fuel Rack Cutting System	Emergent need.
	RL-SNF06	Sludge Treatment System	Emergent need.

APPENDIX

HANFORD'S FY 1999 SCIENCE AND TECHNOLOGY NEEDS UPDATE PROCESS

Objective:
Develop and improve science and technology needs statements for Hanford projects (within the PHMC and ERC) so that industrial providers and technology developers can provide effective solutions to reduce project cost and risk.

Background:
The motivation for the FY 1999 needs effort was to effectively seek and deploy superior technologies that can reduce project cost and risk. A clear statement of need is an essential starting point to justify the investment in improved technologies. It is the DOE's expectation that new technologies will be applied to reduce baseline cost.

Solutions for high priority needs will be solicited from industrial providers and technology developers as appropriate. As part of that effort, the EM programs dedicated to technology development and deployment will be pursued to apply their resources to Hanford needs.

Process:
Input from Hanford's projects was required for completing the FY 1999 Science and Technology Needs report. The information required to define technology needs is outlined in Attachment 1 - *(Annotated Outline of Technology Need Statement).*

Since the Hanford Science and Technology Needs document has been issued on an annual basis for the past several years, the emphasis for the FY 1999 revision was to focus on data quality and completeness, linkage to project baseline documentation, and achieving improved representation from PHMC and ERC projects. Specific activities to support the FY 1999 edition included:

(1) Validation and Update of Previously Defined Needs -- Reviewed FY 1998 edition to verify that the technology need still exists, and assure all entries are accurate, current, and clearly defined. If a previously identified technology need no longer existed or was transferred to another project, the disposition was documented. Prior year science needs were also reviewed for applicability.

(2) Identification of New Needs.-- Increased the number of projects participating in the needs process. For example, technology needs from Analytical Laboratories SNF Project, and Liquid Effluent Treatment facilities were not incorporated in prior years but were solicited and incorporated in this FY 1999 edition. As appropriate, new science needs were also identified.

(3) Writing with Commercial Sector as Target Audience -- Improvements were needed on the technology needs to clearly define the sections entitled "Technology Performance Requirements" and the "Schedule Requirements." Improved definitions in these areas help the technology developers and commercial sector to determine whether their current technologies meet the need, or whether they could develop and deliver the needed technology on time.

(4) Interrogation of Project Baseline Documents -- The MYWPs and other baseline or strategic planning documents for each project were referenced and used as a basis for identifying opportunities for improved technologies, and for identifying when decisions are to be made to select specific technologies for field application.

(5) User Buy-In from Plant/Project Managers -- Prior year editions of the Technology Needs only specified "Technical Points of Contact," for a given technology need. To strengthen the concept of "user buy-in," the Project Manager or facility/plant manager was identified and requested to concur with the needs from a specific project or facility. This additional concurrence not only adds credence to the need statement, but also increases the likelihood of Hanford receiving leveraged funding from non-baseline sources (e.g., the private sector, EM-50, and other Federal Programs) to support any necessary R&D or demonstration/deployment activities.

In addition to the design and implementation of the Needs identification process described above, FDH Technology Management coordinated the process of needs prioritization, and integration of needs across projects. FDH also facilitated the packaging and distribution of Hanford's science and technology needs report for FY 1999. The basic scope involved with each of these activities are described below:

Prioritization -- The FY1999 needs documented the prioritization of Science and Technology needs as approved by the STCG Subgroups.

Integration Across Projects -- In order to facilitate the integration of technology needs across projects, the technology needs will continue to be placed on the STCG home page and listed by both Focus Area and by functional categories/subcategories. The current categories include Characterization, Decontamination, Waste Treatment, Waste Handling and Packaging, Disposal, and Personnel Protection. This matrix serves as a basis for communication among projects/contractors with related technology needs.

Packaging and Distribution -- FDH Technology Management supported the packaging and distribution of FY 1999 needs. Hard-copy distribution and web-site access of the final needs report was published through DOE-RL.

In a parallel path with the science and technology needs effort, the PHMC and ERC were involved in the identification of Technology Insertion Points (TIPs). A TIP can be described as a discrete milestone where a specific technology is selected for use on a given project. TIPs are viewed as opportunities for improved technologies to be considered for project work. TIPs can be associated with documented decisions such as: Records of Decision (RODs) that define cleanup approaches; Requests for Proposals to perform baseline work; key technology application selection points, new project startups, etc. FY 1998 was a transition year for the introduction and preliminary identification of TIPs. Starting in FY 1999, TIPs will be specified in the Multi-Year Work Plans (MYWPs) for each site project. At the time of publishing this FY 1999 needs report, the FY 1999 MYWPs for each of Hanford's major projects were undergoing reviews. Candidate TIPs, however, were developed for consideration by major projects at Hanford. Examples of these candidate TIPs are provided in Attachment 2.

[Copies of Hanford's FY 1999 Science and Technology Needs report can be obtained by calling FDH Technology Management (372-6800), or electronically on www.pnl.gov/stcg/needs.stm]

-ATTACHMENT 1-
ANNOTATED OUTLINE OF TECHNOLOGY NEEDS STATEMENT

Identification No.:
Date:

Program:
OPS Office/Site:
Operable Unit (if applicable):
Waste Stream:
Waste Management Unit (if applicable):
Facility:

***Site Priority Ranking*:**

High, Medium or Low

***Need Title*:**

Provide a short descriptive title (one line or less).

***Need Description*:**

- Start with a brief description of the technology need.
- Provide background. What is the baseline approach, and why is it deficient or vulnerable?
- Identify "magnitude of the problem" (projected volume of waste, number of remediation sites, etc.).

***Functional Performance Requirements*:**

Identify the specific functional performance requirements that must be demonstrated to meet this need completely. Distinguish between hard specific requirements (such as "must be able to survive highly caustic chemical environments") and tradeable preferences (such as "prefer real-time instrument output, but will consider some delay if accuracy is improved"). Quantitative requirements are preferred.

Schedule Requirements:

Identify your need dates and link them to the Program's baseline schedule. Be sure to explain how this need fits into the overall chronology of your process (e.g., Treatment, Storage, and Disposal [TSD] process). Be sure to include the status of current funding and project plans.

***Problem Description*:**

Provide enough detail that a waste stream manager, a principal investigator (PI), or a commercial vendor will be able to understand the details of the problem and be able to respond with an appropriate proposal to address the problem. Does a technology currently exist that will address this need? Can an existing technology be modified to meet this need now? Is basic research required to address the need?

Project Baseline Summary (PBS) No.	***Work Breakdown Structure (WBS) No.*:**	***TIP No.:***

Provide PBS, WBS and TIP numbers, as applicable. These identifiers are site-specific. The intent is to tie the needs to other documents.

***Justification For Need*:**

Technical:

Provide a brief statement, which may be redundant with the Problem Description.

Regulatory:

Identify Regulatory Requirements/Drivers. For example, is it required for a Treatment Plan associated with a Tri-Party Agreement milestone?

Environmental Safety & Health:

List concerns related to any As Low As Reasonably Achievable (ALARA) needs, the Occupational Health and Safety Act, etc.

Cost Savings Potential (Mortgage Reduction):

Discuss the magnitude of potential cost savings.

Cultural/Stakeholder Concerns:

Are any commitments, agreements, etc. (that are not of a regulatory nature) with any other non-Department of Energy (DOE) agencies or groups (e.g., Tribal Nations, State, and other Federal agencies) driving this need? For example, will stack gas emissions be a problem or concern to stakeholders.

Other:

Do we have a current commitment to DOE? Is the solution required to satisfy a DOE Order?

Consequences of Not Filling Need:

Briefly discuss the consequences; maybe waste will have to remain in storage if treatment is not identified, or we will continue using the old, high-cost solution. Do any regulatory impacts, possible fines, or legal implications exist?

Privatization Potential:

If known, identify size of potential future market. Does solution apply to the DOE complex only, or can it be used in industry? Does a private company have a process or solution that looks promising, but is not yet proven? Does any partnering with industry currently exist? Identify other potential applications if they are known.

Current Baseline Technology:

Describe the current baseline technology (if any). Indicate "N/A" if none exists. Identify the cost of applying the current baseline technology. State the length of time necessary to complete the task using the baseline technology.

End-User:

Identify the site organization(s) that will implement the needed technology. Also note the accountable contractor facility manager

Site Technical Point-of-Contact:

Identify the contractor Point-of-Contact (POC) who will be responsible for providing additional information, if required, and who will be responsible to follow efforts to address this need. List phone, facsimile, and Email numbers.

Contractor Facility/Project Manager:
Identify the appropriate contractor or Facility/Project Manager.

DOE End-User/Representative Point-of-Contact:

Identify the DOE POC who will be responsible for providing additional information, if required, and who will be responsible to follow efforts to address this need. List phone, facsimile, and Email numbers.

-ATTCHMENT 2-
CANDIDATE TECHNOLOGY INSERTION POINTS (TIPs)

The following table includes titles of draft Technology Insertion Points (TIPs) that were developed in July 1998 for review by Hanford's major projects and for incorporation in the FY 1999 Multi-Year Work Plan (MYWPs). Following this table are examples of one or more candidate TIPs for each of Hanford's major projects. The FY 1999 MYWPs (including TIPs) are expected to be finalized during the first quarter of FY 1999. Updated description of the TIP significance, scope and schedule will be available as the MYWPs are approved.

TIP TITLE	NEED STATEMENT NUMBER
DECONTAMINATION AND DECOMMISSIONING	
Evaluate Improved Cesium Capsule Leak Detection Systems for WESF	RL-DD01
Select Deactivation Technologies for Evaluation in 231-Z	RL-DD02, -DD03, -DD04
Select Deactivation Technologies for PFP Cleanout	RL-DD02, -DD03, -DD04
Select RCRA Closure Methods/Technology for 324 Building Piping Systems	RL-DD046
Select Integrity Assessment Method for Cesium and Strontium Capsules at WESF	RL-DD041
MIXED WASTE	
Select Remote Macroencapsulation Technology	RL-MW01
Select Remote Controlled Volume Reduction Technology	RL-MW02
Select Remote Characterization Technology	RL-MW03
Select Remote Decontamination Technology	RL-MW04
Select Non-Destructive Assay Technology	RL-MW013

TIP TITLE	NEED STATEMENT NUMBER
SUBSURFACE CONTAMINATION	
Select Enhanced Treatment, In or Ex-Situ of Carbon Tetrachloride Plume in 200 Area	RL-SS01
Select Enhanced Treatment, In or Ex-Situ of Strontium 90 Plume in 100 Area	RL-SS07
Select Technologies for Defining Subsurface Objects in Burial Grounds and Landfills	RL-SS10
Select Technologies for Excavation, Capping, Characterization, and Treatment for Soils and Burial Grounds for 100, 200 and 300 Areas	RL-SS17, RL-SS20
WASTE TANKS	
Select a Product Acceptance Inspection and Test Methodology	Pending
Select Retrieval Technology for First SST Farm	RL-WT013
Select DST Mixing Technology	RL-WT060
Determine Improved Methods for Cleaning and Decontamination of Hanford Pits	RL-WT021
Select a Detection Method for Remote Sensing of Gas Retention in Slurries	Pending
Select a Tank Leak Mitigation System	RL-WT027
Select a Leak Detection for Waste Transfer Lines	Pending
Select a Technology to Remediate Inactive Miscellaneous Underground Storage Tanks (IMUSTs)	Pending
SPENT NUCLEAR FUEL	
Select Decontamination Method for K-Basin Pool	RL-SNF02
Select Fuel Rack Cutting System	RL-SNF05
Select Sludge Treatment Process	RL-SNF06

Decontamination & Decommissioning

TIP Title: Select Deactivation Technologies for PFP Cleanout

Need Statements: RL-DD02 - Glovebox Volume Size Reduction System for PFP
RL-DD03 - Terminal Cleanout and TRU Waste Decontamination of PFP
RL-DD04 - TRU Waste Fixatives for PFP

Scope: This TTP involves the selection of technologies to be deployed in PFP (234-5Z) to support terminal cleanout. The technologies include glovebox size reduction, duct remediation and decontamination methods. The selected technology will be based on the "bake-off" testing and evaluation of competing technologies demonstrated in 231-Z.

Significance: Without proper decontamination and size reduction of PFP's high-volume equipment containing TRU material (e.g., gloveboxes, ducting, piping, etc.) the packaging and disposal cost of associated waste destined for WIPP would become cost prohibitive. Proper selection of technologies will significantly reduce risk to workers and life-cycle cleanout cost.

Timing: Specific dates have not been established for this TIP, but should be immediately after the 231-Z technology evaluations have been completed (i.e., approximately 2002).

Waste Management

TIP Title: Select Remote Characterization Technology

Need Statement: RL-MW03 - Remote Characterization to Distinguish TRUW from Non-TRUW Portions of Various-Sized Debris in a High Beta/Gamma Field

Scope: A large fraction of stored and future-generated debris from the various Hanford programs is expected to be a mixture of TRU and non-TRU contaminated items. Developing a detection capability for TRUW will allow separation and consolidation of TRU items. As a consequence, the total processing cost may be reduced since the treatment cost for non-TRU may be significantly lower than for TRUW processing. In addition, reducing TRU debris volume will help keep the total volume of Hanford TRU waste within the planned disposal capacity at WIPP.

The TRU non-destructive sorting capability must be able to determine TRU contamination levels in a high beta-gamma dose rate environment and remotely handle TRU items over a wide range of sizes, shapes, weights, materials of construction and types and levels of contamination. Debris may include pieces up to 22 meters long and five meters wide. The system must generate high quality data (precise and accurate) to allow identification of TRU items with a high degree of confidence. Near real-time detection capability would be a plus, as it could support segregation during equipment removal/retrieval operations.

Significance: Much of the equipment and other debris from some facilities has been or may be categorized as RH TRU waste although significant portions many be non-TRU. It is likely that the total volume of RH TRU waste from Hanford (including tank debris waste) may approach the RH capacity at WIPP unless TRU and non-TRU can be sorted. A sorting technology is needed to support the M-91facility.

Timing: Conceptual design of the M-91 milestone facility is projected to begin July 1999.

SUBSURFACE CONTAMINANTS

Tip Title: Soil and Burial Ground Remediation for 100, 200, and 300 Areas

Need Statement: RL-SS10 – Improved Technologies Detection/Delineation Burial Ground Contents

Scope: This TIP involves the selection of technologies to be deployed in the 100, 200 and 300 Areas to address characterization, excavation, capping and treatment of contaminated soils and buried object. These technologies will provide cost effective methods for defining Land Ban and buried objects. This will support more cost effective remedial actions.

Significance: Without advance information on Land Ban and buried objects impacts to remedial action schedules and budgets could take place that will affect overall baselines for these projects.

Timing: These technologies are needed now to support overall remediation strategy for the first 45 burial ground and landfill sites in the 100 Areas. Design is scheduled to begin in FY 2001.

Waste Tanks

TIP Title: Select Retrieval Technology for First SST Farm

Need Statement: RL-WT013 - Establish Retrieval Performance Evaluation Criteria

Scope: Retrieval of waste from SSTs during Phase 2 will require a range of capabilities that have not been deployed at Hanford. This TIP will compare the baseline technology (sluicing) to alternative technologies. In addition to the technical approach, there may be contracting alternatives that can be considered.

Significance: Retrieval of waste from the 149 SSTs will take decades to complete, with an estimated cost of several billion. Because the tanks are old and may leak if fluids are introduced, technologies other than sluicing will be evaluated that minimize the risk of losing waste to the soil, minimize cost, and maximize operational flexibility and reliability. The programmatic impact resulting from a substantial loss of waste to the vadose zone has not been quantified, but would be expected to be unacceptably high. Further, some waste types and articles cannot be removed using sluicing techniques, so closure actions may require enabling capability to remove wastes to an acceptable level.

Timing: The decision on retrieval technologies and contracting approaches for the first SST farm will need to be included with the RFP for Phase 2 privatization. The TIP must precede the RFP preparation.

Spent Nuclear Fuel

TIP Title: Select Decontamination Method for K-Basin Pool

Need Statement: RL-SNF02 - Decontamination of K-Basin Pool

Scope: Contamination at the KE-Basin fuel storage pool exists as a "bathtub ring" and as deposits of varying thicknesses throughout the sides and bottom of the concrete pool. The primary radioactive constituents of this contamination are cesium and strontium. The upper level of the basin wall has been treated with epoxy and the water level raised to provide shielding. A decontamination method is needed to minimize worker exposure, secondary waste generation, cost and risk.

Traditional methods of decontamination would be to provide additional shielding, and decontaminate in air, with the additional costs associated with controlling the resultant contamination spread. A different technology is desired, which could be used to decontaminate the concrete sides and bottom in water.

Significance: The water level at the pool is used for shielding. The water cannot be removed until either the contamination is removed or additional shielding is provided. Traditional methods are costly, and create a hazard due to the potential for airborne contamination. This contamination represents an additional, immediate worker exposure concern and a long-term environmental concern.

Timing: Decontamination of the pool will proceed after removal of the fuel, debris and sludge from the basin. This is scheduled to begin in FY 2001. This TIP is milestone number S10-99-950.

Title: Select Fuel Rack Cutting System

Need Statement: RL-SNF05 – Underwater Fuel Rack Cutting System

Scope: The racks which hold the canisters of fuel at the K-basins will need to be removed and disposed. Because of the contamination and resultant radiation level in the basin, the fuel racks will need to be cut up and removed with a remote system. This system will need to operate underwater, in order to maintain shielding.

Significance: Removal of the fuel racks is a necessary step in removing the debris and cleaning the K-basin. Without removal of the racks, it will not be possible to complete clean-up of the basin, resulting in a continued hazard to the environment.

Timing: The cutting system will likely be deployed early in FY 2000, in order to dismantle and remove the racks prior to sludge removal. This TIP is Milestone number S04-00-400, and is scheduled for completion 8/31/00.

TIP Title: Select Sludge Treatment Process

Need Statement: RL-SNF06 – Sludge Treatment System

Scope: After the K-basin fuel is removed from the basin, treated, and moved into safe interim storage, the sludge from the pool will be removed, treated with a separations process, and moved to the tank farms or ERDF. A sludge treatment process will be chosen, and facilities designed and constructed to process the sludge.

Significance: Without treatment, there is no path to disposal for the K-basin sludge. So the sludge would remain in the basin, and would remain a hazard to the environment.

Timing: The sludge treatment process TIP is Milestone number S04-00-300, and is scheduled for completion 8/31/00.

Distribution of Memorandum:
September 1998

U.S. Department of Energy
T. D. Anderson, EM-53
J. M. Augustenborg, WPD
M. J. Barainca, EM-50
Jo-Ann Bassi, EM-53
L. K. Bauer, AME
P. M. Beam, EM-40
D. L. Biancosino, STP
G.G. Boyd, EM-50
M. S. Broido, ER-74
D. A. Brown, STP
Skip Chamberlain, EM-53
C. R. Cooley, EM-50
E. B. Dagan, WPD
J. W. Day, STP
John DeGregory, EM-50
C. W. DeRemer, EM-2
J. L. Elizondo, ID
T. T. Evans, EM-54
J. A. Frey, STP
D. W. Geiser, EM-53
K. D. Gerdes, EM-53
M. A. Gilbertson, EM-52
M. J. Glasper, STP
J. D. Goodenough, AMT
C. A. Hansen, AMW
P. W. Hart, FETC
R. F. Hirsch, ER-73
M. A. Hunemuller, TWR
J. M. Hyde, EM-53
S. W. Johnson, EM-54
J. E. Kinzer, TWR
P. M. Knollmeyer, AMW
M.A. Krebs, ER-1
C. D. Krop, EM-54
D. C. Langstaff, TPD
J. M. Lankford, EM-54
J. C. Lehr, EM-44
S. C. Lien, EM-53
Dan Lillian, EM-53
C. S. Louie, WDD
P. W. Lurk, EM-53
L. S. Mamiya, STP
B. M. Mauss, STP
Jaffer Mohiuddin, EM-53
J. L. Murphy, AME
C. L. Nalezny, EM-53
J. P. Neath, STP
W. A. Owca, ID
D. J. Pepson, EM-38
K. G. Picha, EM-32
R. A. Pressentin, STP
James Rice, SNL
E. I. Rizkalla, EM-40
R. M. Rosselli, AMT
S. N. Saget, STP
F. R. Serier, AMT
C. H. Sink, EM-50
A. C. Tortoso, RPD
D. E. Trader, STP
J. S. Walker, EM-53
D. D. Wodrich, TWR
S. M. Wolf, EM-54
J. A. Wright, SR
L. W. Yarborough, AL
Betsy Yonker, ID

OFF SITE
Jimmy Bell, BCI
Pam Brown, HAB
John Carberry, DUPONT
Gregory Choppin, FSU
Paul Clayton, OGI
Jim Cochran, WSU
Roger Collis, ETP
Allen Croff, MMES
Rico Cruz, NPIN
Paul Danielson, NPIN
Gary Eller, LANL
Robert Erdmann
Joe Gentilucci, JAG
Dib Goswami, ECOLOGY
Barbara Harper, YIN
Stuart Harris, CTUIR
Thomas Hirons, LANL
Earl Holtzscheiter, WSRC
Ken Hubbard, UM
Doug Huston, OOE
Moses Jaraysi, ECOLOGY

Arvid Jensen, LMITCO-ID
Dawn Kaback, CCEM
Roy Koch, PSU
Bruce Kowalski, UW
Alvin Kwiram, UW
Jim Lee, SNL
Brenda Lewis, WSRC
Todd Martin, HAB
C. P. McGinnis, MMES
Jerry Morin, WSRC
Tom Post, EPA
Gordon Rogers, HAB
Richard Scanlan, OSU
Wally Schulz
F. R. Serier, RPS
Jean'ne Shreeve, UI
Robert Smith, WSU
Stan Sobczyk, NPIN
Peter Spencer, OHSU
Harold Sullivan, LANL
John Swanson
Robert Swenson, MSU
Larry Tavlarides, SU
Tom Thomas, LMITCO-ID
Major Thompson, WSRC
Steadman Upham, UO
Nancy Uziemblo, ECOLOGY
George Vandegrift, ANL
Paul Wang, STL
Jack Watson, ORNL
Tom Weber
J. R. Wilkinson, CTUIR
Tom Woods, YIN

ON SITE CONTRACTORS

J. F. Adams, PNNL
R. W. Allen, PNNL
T. L. Anderson, FDH
J. G. April, BHI
J. F. Bagley, PNNL
S. A. Bailey, PNNL
E. G. Baker, PNNL
W. F. Bonner, PNNL
D. M. Boyd, PNNL
R. A. Brouns, PNNL
T. M. Brouns, PNNL
J. L. Buelt, PNNL
B. A. Carteret, PNNL
S. D. Colson, PNNL
T. J. Doherty, PNNL
D. D. Doneen, PNNL
T. H. Dunning, PNNL
R. M. Ecker, PNNL
S. C. Foelber, BHI
T. A. Fryberger, PNNL
J. L. Fuller, PNNL
B. A. Garrett, PNNL
R. E. Gephart, PNNL
R. L. Gruel, PNNL
M. S. Hanson, PNNL
R. D. Hanson, FDH
J. S. Hartman, PNNL
J. O. Heaberlin, PNNL
S. W. Heaberlin, PNNL
J. O. Honeyman, LMHC
B. E. Hubbard, FDH
M. C. Hughes, BHI
P. K. Kearns, PNNL
K. J. Koegler, BHI
D. W. Koppenaal, PNNL
W. L. Kuhn, PNNL
J. D. LaFemina, PNNL
S. D. Liedle, BHI
W. J. Martin, PNNL
G. L. McCormick, BWHC
G. W. McNair, PNNL
G. L. McVay, PNNL
G. B. Mellinger, PNNL
T. L. Page, PNNL
T. Paluszkiewicz, PNNL
P. M. Marmo, FDH
L. M. Peurrung, PNNL
R. F. Potter, BHI
B. A. Pulsipher, PNNL
M. J. Quadrel, PNNL
R. K. Quinn, PNNL
S. A. Rawson, PNNL
B. F. Saffell, PNNL
S. N. Schlahta, PNNL
P. A. Scott, PNNL
B. D. Shipp, PNNL
K. L. Soldat, PNNL

S. L. Stein, PNNL
T. L. Stewart, PNNL
J. J. Thomas, PNNL
M. J. Truex, PNNL
D. B. Van Leuven, FDH
W. C. Weimer, PNNL
J. D. White, BHI
R. E. Wildung, PNNL