CH2M-17786

CH2MHILL
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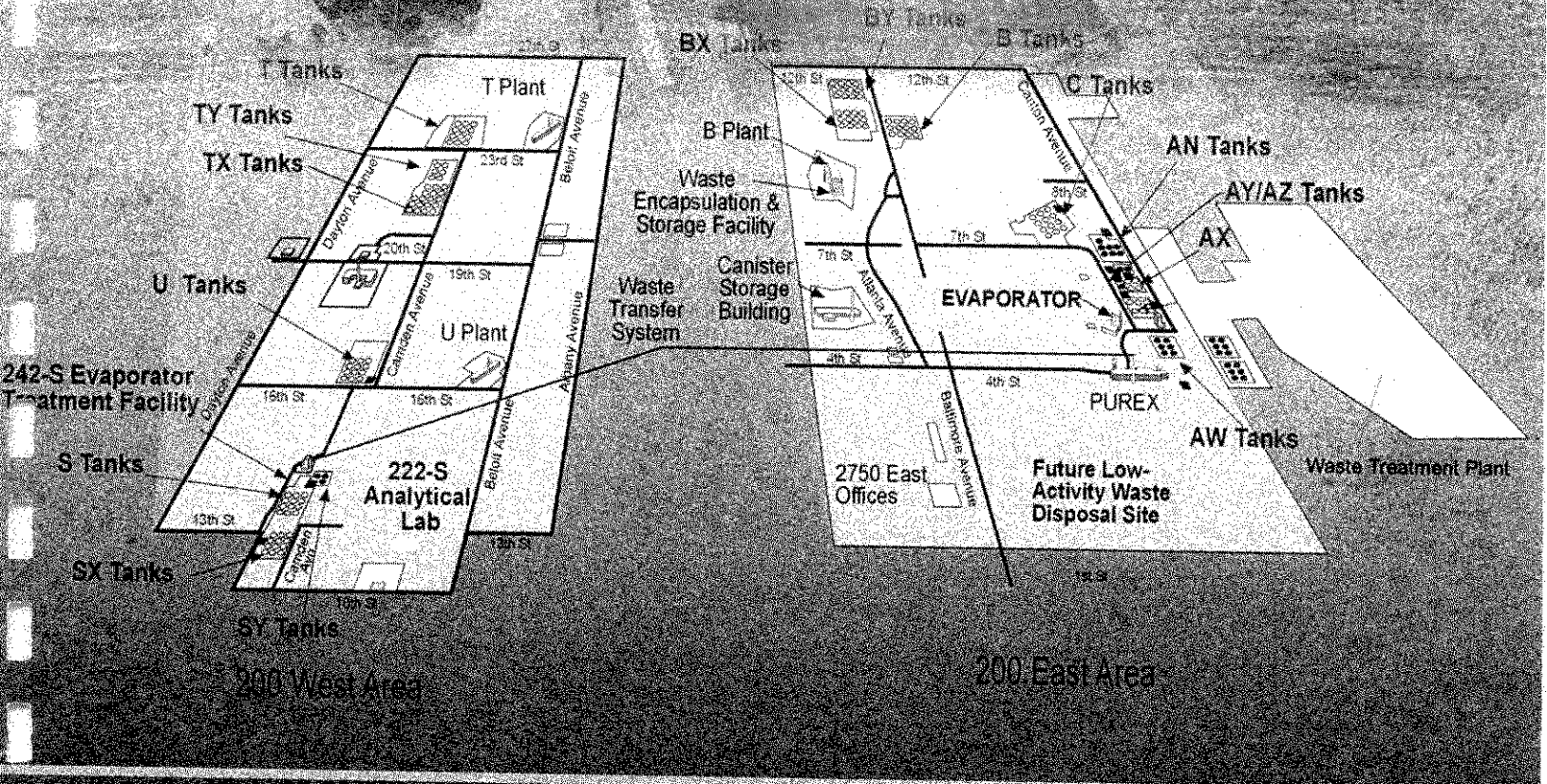
TECHNOLOGY OPPORTUNITIES ROADMAP

FY02 ANNUAL TECHNOLOGY OPPORTUNITIES FOR THE HANFORD SITE

Office of River Protection



INFORMATION CLEARANCE REVIEW AND RELEASE APPROVAL

Part I: Background Information

Title: CH2M HILL Technology Opportunities Roadmap	Information Category: ☐ Abstract ☐ Journal Article ☐ Summary ☐ Internet ☐ Visual Aid ☐ Software ☐ Full Paper ☒ Report ☐ Other
Document Number: CH2M-17786, Rev 0	Date: Sept 2003
Author: K. A. Gasper	
Purpose of Document: Provide CH2M HILL baseline technology opportunities and associated responses	

Part II: External/Public Presentation Information

Conference Name:	
Sponsoring Organization(s):	
Date of Conference:	Conference Location:
Will Material be Handed Out? ☐ Yes ☐ No	Will Information be Published? ☐ Yes ☐ No (If Yes, attach copy of Conference format instructions/guidance.)

Part III: CH2M HILL Document Originator Checklist

Description	*Yes*	*N/A*	*Signature*
Information Product meets Administrative Manual requirements?	☒	☐	K A Gasper 10/1/03
Technical Checklist completed? (Attach checklist)	☐	☐	
If product contains pictures, Safety review completed?	☐	☒	

Part IV: CH2M HILL Internal Review

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Subject Matter Expert	SPMA	10/1/03	Kenneth A Gasper 10/1/03
Responsible Manager	SPMA for Closure	10/1/03	Richard E Raymond
Other:			

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Description	*Yes*	*No*	
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A-6003-508 (09/02)

INFORMATION CLEARANCE REVIEW AND RELEASE APPROVAL (Page 2)

Part VI: Final Review and Approvals

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CH2M HILL Office of Chief Counsel	☒	☐	10/7/03
DOE-ORP Public Affairs/Communications	☒	☐	
Other: DOE-ORP Billie Mauss	☑	☐	Billie Y Mauss 10/8/03
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APPROVED FOR RELEASE OFFICIAL DOCUMENT Date 10/13/2003

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What is/are the ascension numbers associated with CH2M HILL internal processing documentation? I004212 2- clearance

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CH2M-17786
Revision 0

CH2MHILL Technology Opportunities Roadmap

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September 2003

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

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Richland, Washington

Contractor for the U.S. Department of Energy
Office of River Protection under Contract DE-AC27-99RL14047

Janis Aardal — Clearance Approval
10-13-2003 — Date
N/A — Release Approval (stamp)

Approved for Public Release
(Upon receipt of Clearance approval)
Further Dissemination Unlimited

For use with Technical Documents (when appropriate)	
EDC-	FMP-
EDT-	ECN-
Project No.:	Division: CH2M
Document Type: RPT	Page Count: 357

For use with Speeches, Articles, or Presentations (when appropriate)							
Abstract		Summary		Full Paper		Visual Aid	
Conference Name:							
Conference Date:							
Conference Location:							
Conference Sponsor:							
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Executive Summary

This CH2M HILL Technology Opportunities Roadmap is intended to provide a concise, visually oriented representation of technology opportunities and associated disposition paths as they relate to the current CH2M HILL work scope and life cycle River Protection Project (RPP) mission.

The Roadmap is structured to achieve four primary objectives:

1) Collect technology needs/opportunities identified by staff working within separate projects into a consolidated CH2M HILL overview.
2) Identify and assess the value of technology opportunities within the context of the life cycle RPP mission for long-term and strategic planning breakthroughs.
3) Identify technology challenges that may be appropriately addressed by vendors and private industry.
4) Identify additional Department of Energy (DOE) resources external to CH2M HILL to address technology opportunities.

The Technology Opportunities Roadmap is a tool to help CH2M HILL management, at all levels of the organization, understand where the greatest technology-related uncertainties exist, where technology investments can provide the maximum benefits and impacts to either: 1) increase the efficiency with which the work can be performed (thereby freeing funds for additional work); 2) resolve uncertainties in baseline work plans to ensure project success within schedule and budget; or 3) accelerate project schedules. This Roadmap will assist CH2M HILL management to implement a strategy to focus financial resources on those opportunities that will provide the most significant schedule, cost, risk reduction and safety impacts in the overall tank waste cleanup, management, and closure efforts.

The benefits of this roadmap include its use as:

- a management cross-check tool to ensure that identified technical challenges and technology opportunities are reflected in updated and accelerated project baselines
- a tool to support CH2M HILL project managers in development of the scope and budget estimates needed to address their high-priority risks and opportunities
- a reference for detailed project planning so that both near- and longer-term investments can be addressed consistently across the entirety of CH2M HILL's mission
- a communication vehicle to ensure that integrated technology priorities are communicated to DOE for incorporation into DOE's plans and budgets (including EMSP and other R&D programs) to meet near-term and longer-term challenges that fall outside current Site budget realities
- a cross-reference and checklist for capturing the status of technical responses and other activities associated with working to close out technology opportunities and technical challenges
- a tool for communicating unmet technology needs to vendors and ensuring that promising technology from vendors is incorporated into CH2M HILL planning.

As a critical foundation to the Roadmap, the FY 2003 Technology Opportunity Statements identify technology infusion opportunities that could mitigate project risks, accelerate schedule, and reduce cost within the CH2M HILL contract scope. Appendix A of this document includes updated versions of all of those Technology Opportunity Statements. Other sections of this document describe the impacts of actions intended to address these opportunities, in terms of cost, schedule, and risk mitigation.

Technology opportunities are prioritized as high-, medium-, or low-priority based on the following criteria:

- The magnitude of the potential cost benefit;
- The time urgency and how soon implementation is needed in order to achieve needed benefits;
- ease of implementation; and
- magnitude of the resulting risk reduction.

The DOE Office of Science and Technology (OST) was recently restructured and will no longer organizationally process CH2M HILL technology needs/opportunities, so CH2M HILL is finding alternative ways to obtain technology solutions to key needs/opportunities. Adequately defined and prioritized Technology Opportunity Statements are a time-proven tool to help mitigate project risks, accelerate schedules, and reduce costs. The Technology Opportunity Statements in Appendix A also served as the basis for preparation of Technical Challenge Sheets (see Appendix B), which were used to communicate publicly with vendors and other DOE sites in efforts to identify potential effective solutions.

Each of the Technology Opportunities will be dispositioned as part of the FY04 budget formulation process. The status of each of the 72 CH2M HILL Technology Opportunities is noted as "active", "inactive", "closed" or "deferred" based on feedback obtained via interviews with the Principal Technical Point(s) of Contact for each Technology Opportunity Statement. These interviews were conducted during July and early August 2003. For those Technology Opportunities that are still active, the current or recommended disposition paths (e.g., CH2M HILL program funding, technical exchanges with other sites, pursuit of Environmental Management Science Program (EMSP) funding, EM-50 Alternatives projects, or SBIR) are identified.

Finally, this document provides an assessment of what Technology Opportunities are missing or unfunded that could adversely impact successful implementation of the IMAP execution strategies. This "technology gap analysis" identifies areas where investment may be needed, but where no CH2M HILL project investment is currently being made or planned in the identified needed timeframe. The roadmapping efforts provide useful information on the technology-related efforts being funded and the role of Technology Opportunities play in helping CH2M HILL achieve mission acceleration goals.

The gap analysis evaluates the following issues:

- if technology needed to accomplish a PBI is unfunded;
- impacts of the CH2M HILL and Waste Treatment and Immobilization Plant (WTP) schedule and scope changes on technology opportunities;
- whether CH2M HILL currently identified "tough problems" are addressed by Technology Opportunity Statements;
- if there are gaps in technology required to address key risks identified in the IMAP.

Section 6 delineates the specifics of this analysis, and concludes that there are no "critical gaps" identified at this time. There are, however, a number of observations made that may warrant a closer examination of the technology opportunity from an overall CH2M HILL perspective to accomplish Performance-Based Incentives (PBIs) and mitigate critical risks to the overall success of the RPP, particularly in the areas of tank infrastructure, Double Shell Tank (DST) space availability and integrity, and reduction of worker exposure to hazardous environments and radiation dose.

Acronyms

AEAT	AEA Technologies
CAM	continuous air monitoring
D&D	decontamination and decommissioning
DOE	Department of Energy
DST	double-shell tank
EIS	Environmental Impact Statement
EM	DOE Office of Environmental Management
EMAT	electromagnetic acoustic transducer
EMSL	Environmental Molecular Sciences Laboratory
EMSP	Environmental Management Science Program
ESP	Environmental Simulation Program
ESTD	Energy Technology Development Group (PNNL)
ETF	Effluent Treatment Facility
FIU	Florida International University
FTE	full-time equivalent
FY	fiscal year
HCET	Hemispheric Center for Environmental Technology
HEPA	high-efficiency particulate air
HLW	high-level waste
HPMP	Hanford Performance Management Plan
IHLW	immobilized high-level waste
ILAW	immobilized low-activity waste
IMAP	Integrated Mission Acceleration Plan
ITP	Integrated Technology Plan
LAW	low-activity waste
LBNL	Lawrence Berkeley National Laboratory
LDMM	leak detection, monitoring, and mitigation
LLW	low-level waste
LVDG	low-volume density gradient
MAAP	Mission Acceleration Action Plan
MSE	MSE Technology Applications, Inc.
MSU-DIAL	Mississippi State University Diagnostic Instrumentation and Analysis Laboratory
NDE	non-destructive examination
NEPA	National Environmental Policy Act
NHC	Numatec Hanford Corporation
NOI	Notice of Intent
ORP	Office of River Protection
OSHA	Occupational Safety and Health Administration
OST	DOE Office of Science and Technology
PBI	performance-based incentive
PFP	Plutonium Finishing Plant
PNNL	Pacific Northwest National Laboratory
POC	point of contact
PUREX	Plutonium Uranium Extraction
R&D	research and development
RFI	Request for Information

Acronyms (continued)

RFP	Request for Proposals
RPP	River Protection Project
S&T	science and technology
SBIR	Small Business Innovation Research
SC	DOE Office of Science
SRS	Savannah River Site
SST	single-shell tank
TBD	to be determined
TFA	Tanks Focus Area
TFC	Tank Farm Contractor
TRIDEC	Tri-City Industrial Development Council
TRU	transuranic
TSAFT	tandem synthetic aperture focusing technique
VOC	volatile organic compound
WBS	work breakdown structure
WIPP	Waste Isolation Pilot Plant
WIR	waste incidental to reprocessing
WTP	Waste Treatment and Immobilization Plant

1.0 Introduction

1.1 Background

Approximately 53 million gallons of highly radioactive wastes are stored in 177 large underground tanks at the Hanford Site. That waste, resulting from production of plutonium for the nation's nuclear defense program, has been accumulating since 1944. In 1998, Congress established the Office of River Protection (ORP) to manage the retrieval, treatment, and disposal of the Hanford tank waste and to then close the tanks in compliance with the Tri-Party Agreement between the U.S. Department of Energy (DOE), the U.S. Environmental Protection Agency, and the Washington State Department of Ecology (Ecology 1989). To implement its mission, ORP manages the River Protection Project (RPP).

Previous planning and integration efforts have identified that new technologies and approaches are needed to reduce RPP costs, accelerate the schedule, and provide a technical baseline that is robust, yet sufficiently flexible. Several technology-planning studies have been conducted and documented, including a strategic-level assessment of science and technology (S&T) challenges and opportunities for the Hanford Site (DOE 2001). During FY 2001, ORP enhanced its S&T planning and integration efforts by using the roadmapping process to create an Integrated Technology Plan (ITP), which was well-received by DOE as a positive step to positively impact and help manage technology planning and integration at Hanford (PNNL and CH2M HILL 2002).

The ITP presented a comprehensive discussion of the S&T advances needed to ensure successful completion of the entire ORP mission. Roadmapping methodology was used selectively to complement existing technology planning processes and to provide a framework for integrating near-term baseline technology issues with life-cycle technical challenges that have no readily available solutions or whose existing solutions are too expensive or pose unacceptable risks.

That roadmapping effort began with identifying critical decisions and performance targets for the RPP. The roadmapping process shows how these are interrelated and the times when technology solutions and/or scientific data are needed. An important focus of the ITP was to identify the critical times for these decisions and performance targets and, further, to highlight when technical developments need to begin so that the solutions and/or data are available in time to have impact.

The RPP continues to face significant risks and uncertainties that must be managed successfully. One key approach available to manage RPP risks and uncertainties is strategic planning of research and development (R&D) efforts to reduce project uncertainties and to create efficiencies though the insertion of science and technology (S&T) advancements. Although many of these risks and uncertainties are programmatic, only those challenges that have a significant technology component are considered in this current Roadmap.

1.2 Purpose of the Technology Opportunities Roadmap

This CH2M HILL Technology Opportunities Roadmap is intended to provide a concise, visually oriented representation of baseline technology opportunities and associated responses (i.e., accelerated cleanup technologies) as they relate to the current CH2M HILL work scope. Since ORP's ITP is nearly 18 months old, an interim check-up is in order to reconfirm the path

forward. This Roadmap is a tool to help CH2M HILL management identify where the greatest project uncertainties exist, where investment can provide the maximum benefit and impact to either 1) increase the efficiency with which the work can be performed (thereby freeing funds for additional work) 2) resolve uncertainties in baseline work plans to ensure project success within schedule and budget or 3) accelerate project completion. This document will provide a tool to help CH2M HILL management focus financial resources on technology opportunities that will provide the most significant schedule, cost, and safety impacts in the overall tank management and closure effort.

The benefits of this roadmap include its use as:

- a management crosscheck tool to ensure that identified technical challenges and technology opportunities are reflected in updated and accelerated project baselines
- a tool to support CH2M HILL project managers in development of the scope and budget estimates needed to address their priority risks and opportunities
- a reference for detailed project planning so that both near- and longer-term investments can be addressed consistently across the entirety of CH2M HILL's mission
- a communication vehicle to ensure integrated technology priorities are communicated to DOE for incorporation into DOE's plans and budgets (including EMSP and other R&D programs) to meet near-term and longer-range challenges that fall outside current Site budget realities
- a cross-reference and checklist for capturing the status of technical responses and other activities associated with working to close out technology opportunities and technical challenges.
- a tool for communicating unmet technology needs to vendors and ensuring that promising technology from vendors is incorporated into CH2M HILL planning.

The DOE Office of Science and Technology (OST) was recently restructured and will no longer organizationally process CH2M HILL technology needs/opportunities, so CH2M HILL is finding alternative ways to obtain technology solutions to key needs/opportunities. Adequately defined and prioritized Technology Opportunity Statements are a time-proven tool to help mitigate project risks, accelerate schedules, and reduce costs. The Technology Opportunity Statements in Appendix A also served as the basis for preparation of Technical Challenge Sheets (see Appendix B), which were used to communicate publicly with vendors and other DOE sites in efforts to identify potential effective solutions.

The technology opportunities in this document are based on the results of two technology workshops held in September and December 2002. Workshop participants reviewed current and future activities, cost and schedule plans, main technical challenges, and risks for each CH2M HILL scope area. They generated lists of technology opportunities to reduce cost, accelerate schedule, and address challenges and risks. Technology Opportunity Statements and associated data were updated to reflect revised CH2M HILL mission objectives defined in their current performance-based incentives (PBIs).

However, CH2M HILL conducted a mission alignment process in the spring of 2003, which resulted in major organizational changes. As a result, it was important for the new organization representatives to review the Technology Opportunity Statements to ensure that they were still considered valid. These reviews were conducted in the summer of 2003, and each of the Technology Opportunities was updated and dispositioned as part of this process. The status of each of the 72 CH2M HILL Technology Opportunities is noted as either "active", "inactive", "deferred", or "closed" (see Table 4.1) based on feedback obtained via

interviews with the Technical Points of Contact. For those Technology Opportunities that are still active, the current or recommended disposition path (i.e., CH2M HILL program funding, technical exchanges with other sites, pursuit of EMSP funding, EM-50 Alternatives projects, or SBIR) is described. Finally, the risk to the accelerated baseline if the Technology Opportunity is not funded is summarized and updated with the latest information. In a few cases, no new (i.e., post-mission alignment process) Technical Point of Contact was identified, so the Technology Opportunity Statement was not updated in any substantial manner, and the December 2002 version is included in Appendix A for traceability and completeness.

1.3 Objectives of the Technology Opportunities Roadmap

The Roadmap is structured to achieve four primary objectives:

1) Collect technology needs/opportunities identified by staff working within separate projects into a consolidated CH2M HILL overview.
2) Identify and assess the value of technology opportunities within the context of the life cycle RPP mission for long-term and strategic planning breakthroughs.
3) Identify technology challenges that may be appropriately addressed by vendors and private industry.
4) Identify additional Department of Energy (DOE) resources external to CH2M HILL to address technology opportunities.

CH2MHILL Overview—Within a "results-oriented" project-based structure, technology needs/opportunities are addressed within each project for their specific application. The process of collecting needs/opportunities from separate projects provides the perspective to assess needs and opportunities from a single corporate viewpoint. Similar opportunities from different sources are combined so that technology opportunities may be addressed more efficiently and separate projects may leverage efforts rather than invest wholly and separately by themselves. Viewing technology opportunities from the perspective of CH2M HILL as a whole can help fine-tune the budgeting process assuring maximum benefit for the resources invested. Resources expended separately to address opportunities may be leveraged and shared between projects; or opportunities that can't justify investing for a single project may justify investing for solutions when considering benefits to the whole company.

Long-Term Viewpoint—Among the contract expectations upon CH2M HILL is that it will perform long-term and strategic planning beyond the period of its contract toward the life cycle of the RPP (ref. Contract Sec. C.2. (a) (1)). Additionally, CH2M HILL has been required to "...provide support to DOE-ORP planning and integration activities... The Contractor shall provide support in: 1) corporate strategic planning, 2) policy development, 3) management information systems, and 4) baseline management and reporting. Studies and analyses include identification and development, in conjunction with DOE, of breakthroughs that significantly improve baseline performance and life-cycle costs or improve work processes (ref. Contract Sec. C.2. (a) (2) (vi))." This Technology Roadmap provides one such communication vehicle, whereby opportunities for technology to achieve the required "breakthroughs" can be captured and analyzed to help refine long-term mission planning. The priority identified for each technology opportunity recognizes its long-term benefit to the RPP mission, as well as the role technology opportunities can play as tools to help accomplish contract Performance-Based Incentives (PBIs).

Technology Challenges—A part of the Technology Roadmap that has already been implemented is to recognize specific technology opportunities that may be addressed by

products already offered by vendors in the market. The "challenge" for CH2M HILL technology integration is to locate the vendors with applicable solutions and connect them with project staff. A subset of the Technology Opportunities have been reformatted into 23 Technology Challenge sheets for widespread public distribution to vendors. These have been distributed through presentation at Waste Management '03, at vendor forum exchanges, and through targeted conventional and electronic mailings. Updates for these Technology Challenges are included as part of this Roadmap document.

Additional Resources for Technology Opportunities—DOE sponsors other programs to develop and deliver technologies to accomplish its mission. To properly direct these programs, DOE relies on input from its prime contractors to identify and prioritize the opportunities for technology breakthroughs in order to save time and taxpayer dollars. This Technology Roadmap proposes resource pathways to address technology opportunities for clean up of Hanford tank wastes. CH2M HILL management may use the roadmap as a tool to identify gaps between mission acceleration plans and available resources. Other resource programs may also use the Technology Roadmap as they plan and justify their future work scope in order to provide continued value to DOE.

1.4 Structure of the Technology Opportunities Roadmap

Figure 1.1 shows the path forward for using the CH2M HILL Technology Opportunity Statements as part of the roadmapping and analysis process. The key pieces of this figure are described in the following sections of this document:

- Summary and Background of Technology Opportunities – Section 2.0
- Elements of the Data Crosswalk – Section 3.0
- Disposition of each Technology Opportunity Statement using all the data elements – Section 4.0
- Technology Data Crosswalk and Roadmap – Section 5.0
- Gap Analysis and Conclusions – Sections 6.0
- CH2M HILL Technology Opportunity Statements – Appendix A

Furthermore, this roadmap will be more useful as tool if a consistent and familiar structure is used to put technology-related elements into context. The RPP is composed of five major, interrelated technical functions that cover all technical activities necessary for achieving the RPP mission to complete the cleanup of Hanford's tank waste (ORP 2001):

- ***Store***—Store waste safely until it can be retrieved for treatment and disposal.
- ***Retrieve***—Retrieve waste from all tanks to the extent needed for closure and transfer it to the Waste Treatment and Immobilization Plant (WTP).
- ***Treat***—Separate waste into two fractions, remove key radionuclides from the low-activity waste streams to be disposed on the Hanford Site, incorporate these radionuclides into the HLW stream, immobilize both waste streams, and package the waste in containers for storage and disposal.

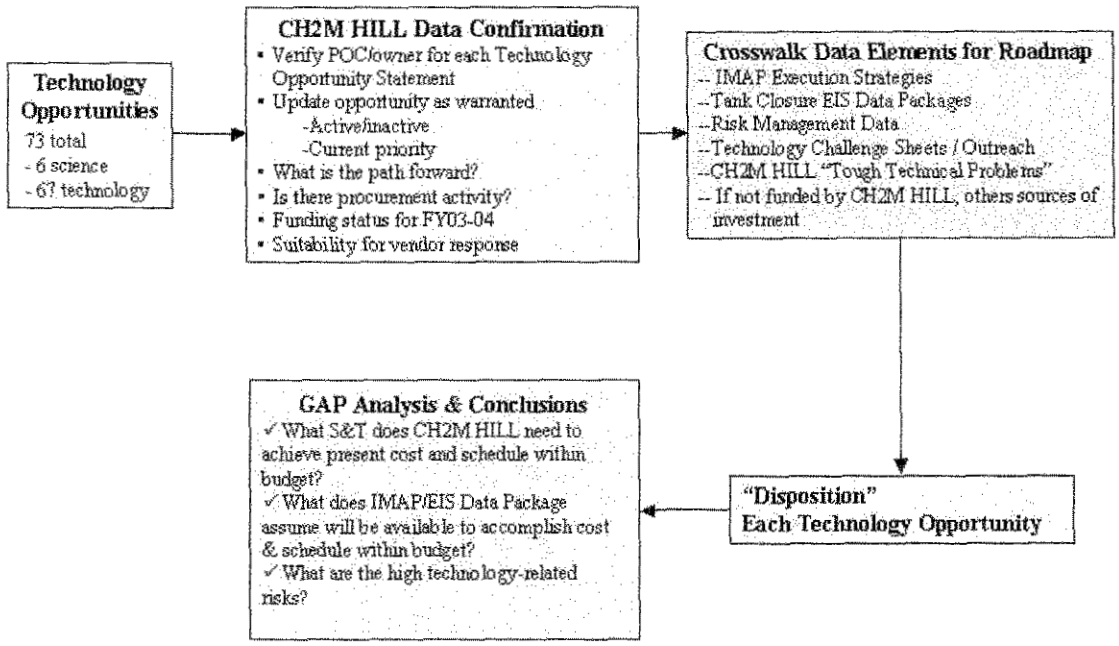

Figure1-1 Technology Opportunities Roadmap Path Forward

- ***Dispose***—Dispose of immobilized low-activity waste (ILAW) onsite in near-surface disposal facilities, store immobilized HLW (IHLW) onsite until it can be shipped to an offsite geologic repository, process and turn over TRU wastes for onsite storage and eventual shipment to the Waste Isolation Pilot Plant (WIPP), and dispose of secondary waste.
- ***Close***—Close (or deactivate, decommission, and transfer) all RPP facilities and infrastructure and establish long-term monitoring capability for sites and facilities.

The conceptual logic and the major technical activities required to complete the RPP mission are presented in Figure 1.2. The *Integrated Mission Acceleration Plan* or IMAP (RPP-13678) describes this work scope in terms of five results-oriented execution strategies:

1. Retrieve and Close SSTs, DSTs, and Tank Farms
2. Provide Waste Feed Delivery to Satisfy Accelerated WTP Processing rates
3. Process Waste via Supplemental/Alternate Treatment/Disposal
4. Enhance Regulatory and Stakeholder Interactions
5. Improve Mission Support and Work Management Systems

The first three strategies are the technical strategies designed to complete the physical work within the required time frames. The fourth and fifth are enabling strategies that provide the regulatory and work management framework required to effectively execute the technical strategies. This combined structure will be used to put the data element components together into a useful crosswalk to examine connectivities and gaps (see Section 5).

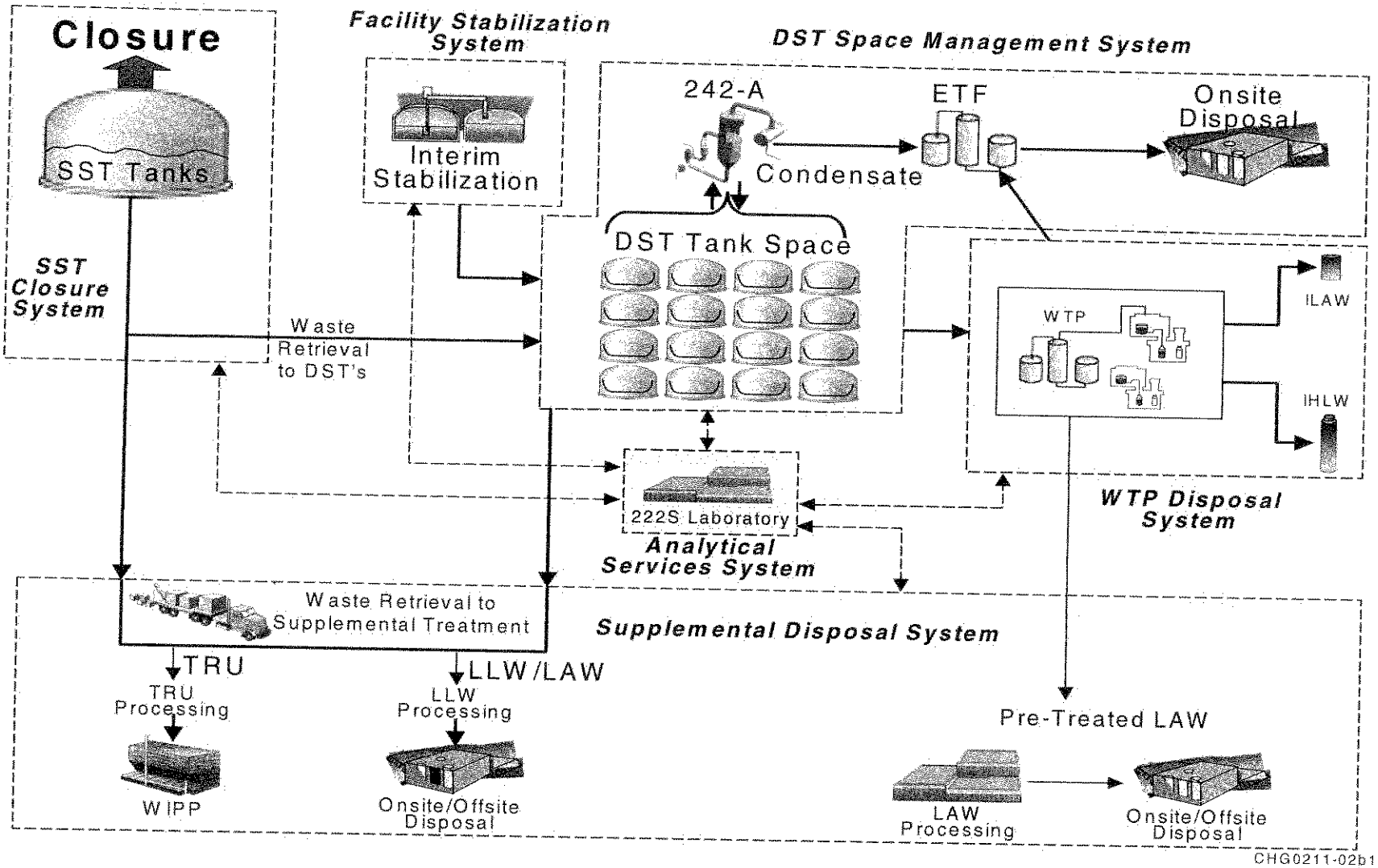

Figure1-2 CH2M HILL Mission Logic Flowchart

2.0 Summary of CH2M HILL Technology Opportunities

As the Hanford Tank Farm Contractor (TFC), CH2M HILL is expected to be good stewards of government resources and implement effective, acceptable solutions. CH2M HILL is expected to "identify the areas of highest risk, and seek and apply innovative technical solutions." This document is the latest in ongoing efforts to not only demonstrate compliance with these expectations and requirements, but also to ensure that baseline cost, schedule, and risk and current acceleration efforts are an integral part of the evaluation of technology initiatives, resulting in a reliable prioritization of future investments.

The FY 2003 Technology Opportunity Statements identify technology infusion opportunities that could mitigate project risks, accelerate schedule, and reduce cost within the CH2M HILL contract scope. Appendix A of this document includes the Technology Opportunity Statements organized by their historical "Assigned Tracking Number" (also known as "Technology Opportunity Number"). Other sections of this Roadmap describe what impacts actions that address these opportunities are expected to have on cost, schedule, and risk. Technology opportunities are labeled as high, medium, or low priority based on the following criteria:

- How large the potential cost benefit is,
- How soon implementation is needed in order to achieve benefits,
- How easy implementation is expected to be, and
- How high the resulting risk reduction is.

In recent years, CH2M HILL has worked closely with ORP and DOE's Office of Science and Technology (OST) through its Tanks Focus Area (TFA), as well as with the Pacific Northwest National Laboratory (PNNL) and Numatec Hanford Corporation (NHC), to identify science and technology needs/opportunities and paths forward to address those needs/opportunities and mitigate the associated technical and programmatic risks to RPP mission success. The previous S&T Roadmap to support tank farm scope is documented in the *Office of River Protection FY2002 Integrated Technology Plan* (PNNL and CH2M HILL, February 2002).

This Technology Opportunities Roadmap is the next logical step in using roadmapping methodology to positively impact technology planning and integration for the RPP, and for specifically the workscope for the TFC. This Roadmap uses as key input the Technology Opportunity Statements resulting from the September and December 2002 workshops, as updated in mid-2003. Adequately defined and prioritized Technology Opportunity Statements have proven to be an integral tool to efficient utilization of partnerships to mitigate project risks, accelerate schedules, and reduce costs. The Technology Opportunity Statements in Appendix A also served as the basis for preparation of Technical Challenge Sheets (see Appendix B), which were used to communicate publicly with vendors and other DOE sites in efforts to identify potential effective solutions.

Table 2.1 lists all the CH2M HILL FY03 Technology Opportunity Statements that were the starting point for this roadmapping exercise, organized by the following technical functions:

a. Safe Storage-Operations and Maintenance
b. Safe Storage-Life Extension Project
c. Retrieval and Transfer-Equipment
d. Retrieval and Transfer-Waste Inventory and Properties
e. Closure

f. Disposal
g. Supplemental Treatment

Technology opportunities in this Roadmap are at various stages of maturity and/or implementation. Each opportunity is typically addressed by CH2M HILL projects via the following process:

- Definition of the opportunity
- Identification of potential solutions
- Evaluation of potential solutions (cost, schedule, risk-mitigation benefits)
- Go-no go decision to implement
- Go-no go decisions to continue at key steps in the implementation
- Deployment
- Lessons learned; follow-on actions.

This document contains all identified technology opportunities, regardless of stage of implementation, as well as justifications for merging or deleting items from the previous compilation. As such, this roadmap is one foundation basis for investment decisions, ranging from the limited budgets required to identify and evaluate solutions for selected technology opportunities, to the more substantial budgets required to initiate or continue specific technology implementations.

As shown in Table 2.1, 72 Technology Opportunity Statements were prepared by CH2M HILL to describe the opportunities for science and technology (S&T) to have positive impacts on the RPP mission, and specifically the CH2M HILL workscope (see Appendix A). Six of these are designated to be "science" opportunities (designated by an "S" in the FY03 Opportunity Number), while the remaining 66 are designated as "technology" opportunities. The Technology Opportunity Statements in Table 2.1 are categorized by both of the frameworks described in Section 1.0 (i.e., RPP technical functions and IMAP execution strategies) in order to provide a reference point both backward and forward in planning documentation. For ease of use and reference, however, the Technology Opportunity Statements themselves are organized numerically (i.e., by their WT-xxx designation) in Appendix A.

The priority system used to characterize the Technology Opportunity statements as a result of the September and December 2002 workshops was as follows:

> ***High Priority (H)*** – Critical to the success of the RPP, and a solution is required to achieve the current cost and schedule baselines.
>
> ***Medium Priority*** (M) – Provides substantial benefit to the RPP (e.g., moderate to high life-cycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays).
>
> ***Low Priority (L)*** – Provides opportunities for significantly lower cost savings or risk reduction, may reduce the uncertainty in RPP success.

Priorities (H, M, or L) were assigned to the Technology Opportunity Statements in December 2002 and are still contained in the statements in Appendix A in section 9a of each statement. These were supplemented with additional information and the prioritization methodology for the Technology Opportunity Statements was enhanced in the summer of 2003 as shown in the

priority grid below. In this new priority grid, priorities (as available) are assigned for schedule impact, cost savings, implementation magnitude, and baseline risk reduction. The new prioritization results are also presented in the Technology Opportunity Statements in Appendix A, in Section 9b of the statement, as updated by the Technical or Principal Point of Contact for each statement.

9b	**Priority**		
	Schedule Impact	☐ HIGH	Needed to meet PBIs
		☐ MED	Needed to meet mission targets (2033 closure)
		☐ LOW	Can improve mission targets or no schedule impact
	Cost Savings	☐ HIGH	>$1B total life-cycle savings
		☐ MED	>$100M but <$1B total life-cycle savings
		☐ LOW	<$100M total life-cycle savings
	Implementation Cost/Schedule	☐ HIGH	<$10M and <2 yrs.
		☐ MED	>$10M and <2 yrs or <$10M and > 2 yrs.
		☐ LOW	>$10M and > 2yrs. or significant technical risk
	Baseline Risk Reduction	☐ HIGH	The baseline technical solution has not been proven at large scale or on actual radioactive waste.
		☐ MED	The baseline technical solution has been demonstrated at large scale but not implemented in radioactive operations.
		☐ LOW	The baseline technical solution has been implemented at Hanford.

Table 2-1 Technology Opportunity Statements by Execution Strategy and Technical Function

FY03 Technology Opportunity Number*	Technology Opportunity Statement Title	IMAP Execution Strategy	RPP Technical Function	Priority**
Safe Storage – Operations and Maintenance				
WT072	Automation of Tank Farm Field Processes and Wireless Communication	Improve Mission Support and Work Management Systems	Safe Storage - Operations and Maintenance	H
WT104	Cleanable HEPA Filter	Improve Mission Support and Work Management Systems	Safe Storage - Operations and Maintenance	M
WT105	Coalescer for Tank Waste in Pits and Airborne Contamination	Improve Mission Support and Work Management Systems	Safe Storage - Operations and Maintenance	M
WT107	Grab Sampling Dose Reduction	Improve Mission Support and Work Management Systems	Safe Storage - Operations and Maintenance	L
WT108	In-Tank Camera and Lighting	Improve Mission Support and Work Management Systems	Safe Storage - Operations and Maintenance	M
WT109	Radiation Survey	Improve Mission Support and Work Management Systems	Safe Storage - Operations and Maintenance	M
WT116	VOC Treatment and Monitoring	Improve Mission Support and Work Management Systems	Safe Storage - Operations and Maintenance	M
WT123	CAMs Reliability	Improve Mission Support and Work Management Systems	Safe Storage - Operations and Maintenance	H
WT124	Replace Annulus Monitoring Flake Boxes with Newer Technology	Improve Mission Support and Work Management Systems	Safe Storage - Operations and Maintenance	L
WT125	Interstitial Liquid Level Measurement in SSTs	Improve Mission Support and Work Management Systems	Safe Storage - Operations and Maintenance	M
WT126	Line Unplugging/Plug Location	Improve Mission Support and Work Management Systems	Safe Storage - Operations and Maintenance	H
WT127	Maintenance Tracking System	Improve Mission Support and Work Management Systems	Safe Storage - Operations and Maintenance	L
WT128	Develop/Find Predictive Maintenance Tools	Improve Mission Support and Work Management Systems	Safe Storage - Operations and Maintenance	M
WT129	Spray-on Shielding	Improve Mission Support and Work Management Systems	Safe Storage - Operations and Maintenance	M

* Also known as "Assigned Tracking Number".

** As recorded in Section 9a of the statement.

FY03 Technology Opportunity Number*	Technology Opportunity Statement Title	IMAP Execution Strategy	RPP Technical Function	Priority**
Safe Storage – Life-Extension Project				
WT004 / WT079-S	Double-Shell Tank (DST) Corrosion Chemistry and Monitoring/pH Probes	Improve Mission Support and Work Management Systems	Safe Storage - Life-Extension Project	H
WT022	Improving the Tandem Synthetic Aperture Focusing Technique (TSAFT) for Flaw Characterization in the Inaccessible Portion of the Knuckle Region of the Double-Shell Tanks (DSTs)	Improve Mission Support and Work Management Systems	Safe Storage - Life-Extension Project	M
WT106	Double-Shell Tank (DST) Transfer Piping Non-Destructive Examination (NDE) Tools	Improve Mission Support and Work Management Systems	Safe Storage - Life-Extension Project	H
WT111	Remote Tank Wall Repair	Improve Mission Support and Work Management Systems	Safe Storage - Life-Extension Project	H
WT130	Asbestos Encapsulation for Insulation Removal	Improve Mission Support and Work Management Systems	Safe Storage - Life-Extension Project	L
WT131	Contamination Lock-Down Surface Coating	Improve Mission Support and Work Management Systems	Safe Storage - Life-Extension Project	H
WT132	Deactivate Inactive Systems in DST/SSTs	Improve Mission Support and Work Management Systems	Safe Storage - Life-Extension Project	TBD
WT133	Improved DST Integrity NDE Tools: Electromagnetic Acoustic Transducer (EMAT)	Improve Mission Support and Work Management Systems	Safe Storage - Life-Extension Project	H
WT134	AZ Tank Farm Upgrades	Improve Mission Support and Work Management Systems	Safe Storage - Life-Extension Project	M
Retrieval and Transfer – Equipment (SST Retrieval)				
WT021	Improve Pit Remote Operation Tools	Retrieve and Close SSTs, DSTs, and Tank Farms	Retrieval and Transfer - Equipment (SST Retrieval)	H
WT009	Representative Sampling to Support Retrieval and Transfer of DST Waste to WTP for Treatment and Disposal	Retrieve and Close SSTs, DSTs, and Tank Farms	Retrieval and Transfer - Equipment (SST Retrieval)	L
WT026 / WT027	Tank Leak Detection, Monitoring and Mitigation (LDMM) Systems	Retrieve and Close SSTs, DSTs, and Tank Farms	Retrieval and Transfer - Equipment (SST Retrieval)	M
WT032	Control of Retrieved Waste Dilution	Retrieve and Close SSTs, DSTs, and Tank Farms	Retrieval and Transfer - Equipment (SST Retrieval)	M
WT054	Mixer Pump Mobilization Performance Prediction (formerly Solids Yield During Mixer Pump Mobilization)	Retrieve and Close SSTs, DSTs, and Tank Farms	Retrieval and Transfer - Equipment (SST Retrieval)	H

FY03 Technology Opportunity Number*	Technology Opportunity Statement Title	IMAP Execution Strategy	RPP Technical Function	Priority**
WT060	Hanford/SRS Waste Mixing Mobilization	Retrieve and Close SSTs, DSTs, and Tank Farms	Retrieval and Transfer - Equipment (SST Retrieval)	H
WT062	Variable Suction Level Transfer Pump	Retrieve and Close SSTs, DSTs, and Tank Farms	Retrieval and Transfer - Equipment (SST Retrieval)	L
WT089	Single-Shell Tanks (SSTs) Retrieval with Minimal Water Addition	Retrieve and Close SSTs, DSTs, and Tank Farms	Retrieval and Transfer - Equipment (SST Retrieval)	H
WT135	Response to Potential Line Leak	Retrieve and Close SSTs, DSTs, and Tank Farms	Retrieval and Transfer - Equipment (SST Retrieval)	M
WT136	Installation of New Risers in SSTs (Single-Shell Tanks)	Retrieve and Close SSTs, DSTs, and Tank Farms	Retrieval and Transfer - Equipment (SST Retrieval)	H
WT137	Removal/Decontamination of In-tank Equipment	Retrieve and Close SSTs, DSTs, and Tank Farms	Retrieval and Transfer - Equipment (SST Retrieval)	L
WT148	Sluicing Enhancement and Cost Reduction	Retrieve and Close SSTs, DSTs, and Tank Farms	Retrieval and Transfer - Equipment (SST Retrieval)	H
WT149	Transport of SST Waste with Little Water	Retrieve and Close SSTs, DSTs, and Tank Farms	Retrieval and Transfer - Equipment (SST Retrieval)	H
WT159	Remote Pit Cleanout and Riser Preparation	Retrieve and Close SSTs, DSTs, and Tank Farms	Retrieval and Transfer - Equipment (SST Retrieval)	M
Retrieval and Transfer – Waste Inventory and Properties (SST Retrieval)				
WT063	Hanford SST Saltcake Dissolution Retrieval	Retrieve and Close SSTs, DSTs, and Tank Farms	Retrieval and Transfer - Waste Inventory and Properties (SST Retrieval)	H
WT088	Advanced Approaches for Reducing Waste Volume Stored in DSTs	Retrieve and Close SSTs, DSTs, and Tank Farms	Retrieval and Transfer - Waste Inventory and Properties (SST Retrieval)	H

FY03 Technology Opportunity Number*	Technology Opportunity Statement Title	IMAP Execution Strategy	RPP Technical Function	Priority**
WT090	Chemical Behavior of Sludge Wastes	Retrieve and Close SSTs, DSTs, and Tank Farms	Retrieval and Transfer - Waste Inventory and Properties (SST Retrieval)	L
WT091	Chemical and Physical Behavior of Saltcake Wastes	Retrieve and Close SSTs, DSTs, and Tank Farms	Retrieval and Transfer - Waste Inventory and Properties (SST Retrieval)	H
WT112	Chemical Dissolution of Water Insoluble Wastes from Single-Shell Tanks (SSTs)	Retrieve and Close SSTs, DSTs, and Tank Farms	Retrieval and Transfer - Waste Inventory and Properties (SST Retrieval)	L
WT113	Selective Species Removal	Retrieve and Close SSTs, DSTs, and Tank Farms	Retrieval and Transfer - Waste Inventory and Properties (SST Retrieval)	L
WT138	Physical Behavior of Sludge Wastes	Retrieve and Close SSTs, DSTs, and Tank Farms	Retrieval and Transfer - Waste Inventory and Properties (SST Retrieval)	M
WT139	Best-Basis Inventory Improvement	Retrieve and Close SSTs, DSTs, and Tank Farms	Retrieval and Transfer - Waste Inventory and Properties (SST Retrieval)	H
Closure				
WT035-S	Moisture Flow and Contaminant Transport in Arid Conditions	Retrieve and Close SSTs, DSTs, and Tank Farms	Closure	M
WT044-S	Distribution of Recharge Rates	Retrieve and Close SSTs, DSTs, and Tank Farms	Closure	H
WT046-S	Getter Materials in the Vadose Zone	Retrieve and Close SSTs, DSTs, and Tank Farms	Closure	M
WT053-S	Contaminant Mobility Beneath Tank Farms	Retrieve and Close SSTs, DSTs, and Tank Farms	Closure	M
WT061	Reactive Barriers to Contaminant Migration	Retrieve and Close SSTs, DSTs, and Tank Farms	Closure	L
WT102	Post-Retrieval Evaluation: In-Situ Characterization	Retrieve and Close SSTs, DSTs, and Tank Farms	Closure	H
WT115	Technology to Support Post-Retrieval Evaluation of SSTs	Retrieve and Close SSTs, DSTs, and Tank Farms	Closure	H

FY03 Technology Opportunity Number*	Technology Opportunity Statement Title	IMAP Execution Strategy	RPP Technical Function	Priority**
WT140	Post-Closure Monitoring	Retrieve and Close SSTs, DSTs, and Tank Farms	Closure	L
WT150	Characterization of waste inventory in ancillary equipment	Retrieve and Close SSTs, DSTs, and Tank Farms	Closure	L
WT151-S	Getter Materials for Tank Fill	Retrieve and Close SSTs, DSTs, and Tank Farms	Closure	M
Disposal				
WT016	Glass Monolith Surface Area	Provide Waste Feed Delivery to Satisfy Accelerated WTP Processing Rates	Disposal	M
WT017	Long-Life Waste Isolation Surface Barrier	Provide Waste Feed Delivery to Satisfy Accelerated WTP Processing Rates	Disposal	L
WT066	Compositional Dependence of the Long-Term Performance of Glass as a Low-Activity Waste Form	Provide Waste Feed Delivery to Satisfy Accelerated WTP Processing Rates	Disposal	L
WT157	Strategy for Long-Term Performance Testing and Comparison of Performance For Different Waste Forms	Provide Waste Feed Delivery to Satisfy Accelerated WTP Processing Rates	Disposal	H
WT158	Tailored Disposal Systems	Provide Waste Feed Delivery to Satisfy Accelerated WTP Processing Rates	Disposal	H
Supplemental Treatment				
WT141	Development and Demonstration of Bulk Vitrification Treatment Technology	Process Waste via Supplemental/Alternate Treatment/Disposal	Supplemental Treatment	H
WT142	Cast Stone	Process Waste via Supplemental/Alternate Treatment/Disposal	Supplemental Treatment	H
WT143	Tank Waste Denitration	Process Waste via Supplemental/Alternate Treatment/Disposal	Supplemental Treatment	L
WT144	Fractional Crystallization	Process Waste via Supplemental/Alternate Treatment/Disposal	Supplemental Treatment	L
WT145	Qualify Steam Reforming Process for LAW Treatment	Process Waste via Supplemental/Alternate Treatment/Disposal	Supplemental Treatment	H
WT146	Sulfate Removal	Process Waste via Supplemental/Alternate Treatment/Disposal	Supplemental Treatment	L
WT147	TRU Treatment Technology	Process Waste via Supplemental/Alternate Treatment/Disposal	Supplemental Treatment	H
WT152	Supplemental Pretreatment Technologies	Process Waste via Supplemental/Alternate Treatment/Disposal	Supplemental Treatment	H

FY03 Technology Opportunity Number*	Technology Opportunity Statement Title	IMAP Execution Strategy	RPP Technical Function	Priority**
WT153	Transport of Packaged and Bulk Waste	Process Waste via Supplemental/Alternate Treatment/Disposal	Supplemental Treatment	M
WT154	Alternative Waste Streams	Process Waste via Supplemental/Alternate Treatment/Disposal	Supplemental Treatment	M
WT155	Alternative Glasses for Hanford	Process Waste via Supplemental/Alternate Treatment/Disposal	Supplemental Treatment	L
WT156	Re-use of Existing Facilities	Process Waste via Supplemental/Alternate Treatment/Disposal	Supplemental Treatment	L

The 72 Technology Opportunity Statements can be summarized as shown in Table 2.2 by IMAP Execution Strategy. This table shows that 44% of the technology opportunities relate to retrieval and closure, 32% relate to safe storage, 17% relate to supplemental treatment, and 7% relate to disposal.

Table 2-2 Characterization of Technology Opportunity Statements

IMAP Execution Strategy	# of Opportunities in this Execution Strategy	RPP Technical Function	# of Opportunities in This Technical Function
Improve Mission Support and Work Management Systems	23	Safe Storage – Operations and Maintenance	14
Improve Mission Support and Work Management Systems	32%	Safe Storage – Life-Extension Project	9
Retrieve and Close SSTs, DSTs, and Tank Farms		Retrieval and Transfer – Equipment (SST Retrieval)	14
Retrieve and Close SSTs, DSTs, and Tank Farms	32	Retrieval and Transfer – Waste Inventory and Properties (SST Retrieval)	8
Retrieve and Close SSTs, DSTs, and Tank Farms	44%	Closure	10
Provide Waste Feed Delivery to Satisfy Accelerated WTP Processing Rates	5 7%	Disposal	5
Process Waste via Supplemental/Alternate Treatment/Disposal	12 17%	Supplemental Treatment	12

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3.0 Technology Opportunities Data Crosswalk Elements

This Roadmap is the latest in a series of technology planning efforts related to tank waste. With many changes occurring in the RPP over the past 18 months, focus was on identifying technology gaps where further management consideration may be needed, that cannot be gleaned from analyzing any single document or data element. Critical to any roadmapping effort is the crosswalk and analysis of the key components of planning the program. This chapter of the Roadmap, therefore, presents the key components comprising the data elements of the Roadmap and subsequent analysis of that data.

3.1 Integrated Mission Acceleration Plan

The Integrated Mission Acceleration Plan (IMAP) describes technical, regulatory, and management strategies and the associated action plans to accelerate closure of the Hanford Site tank farms. Successful execution of the IMAP will result in significant improvement in the River Protection Project (RPP) life-cycle cost and schedule. The IMAP integrates requirements and performance across all systems that are part of the RPP. The IMAP results-oriented Execution Strategies are outlined below. The near-term and long-term achievements from successful completion of these strategies are shown in Table 3.1. These elements from the IMAP are used as part of the unifying structure, along with the RPP Technical Functions to link Technology Opportunities to the other data elements.

1. **Retrieve and Close Single-Shell Tanks (SST), Double-Shell Tanks, and Tank Farms**
   Disposition waste from all 149 SSTs by 2018 within the established budget profile, reducing hazards to the workers, the public, and the environment while significantly reducing the program life-cycle costs.

2. **Provide Waste Feed Delivery to Satisfy Accelerated Waste Treatment Plant (WTP)Processing Rates**
   Deliver waste feed to the WTP and receive and disposition treated waste products per the WTP schedule and the System Plan to support the RPP mission completion.

3. **Process Waste via Supplemental/Alternate Treatment/Disposal**
   Implement environmentally responsible and cost effective non-WTP supplemental treatment and processing techniques that will reduce double-shell tank space usage and the planned loading on the WTP. The need and plan for implementation of supplemental low-activity waste processing for waste pretreated in the WTP will be established. TRU and LLW processing are also encompassed by this strategy.

4. **Enhance Regulatory and Stakeholder Interactions**
   Work in a collaborative manner with the Washington State Department of Ecology, the U.S. Environmental Protection Agency, Washington State Department of Health, Tribal Nations, other U.S. Department of Energy sites, and stakeholder groups to develop and implement a responsible, progressive and efficient regulatory approach that meets established requirements while optimizing stakeholder involvement, regulatory reviews, approvals, and implementation.

5. **Improve Mission Support and Work Management Systems**
   Make fundamental business changes, including changing work processes to achieve operations and management efficiencies that will allow funding to be allocated for waste retrieval, tank closures, and supplemental waste treatment and disposal on an accelerated schedule. Work practices will be tailored to the hazards involved in compliance with established Integrated Safety Management Systems and environmental management principles.

As shown in Figure 3.1, implementation of the IMAP improves the schedule significantly from the August 2002 *Hanford Performance Management Plan* (HPMP) and even more significantly from the March 2002 Baseline. The IMAP actions drive acceleration of closure activities and mission completion. Specific schedule improvements that result from the focus on closure are summarized for convenience in Table 3.2.

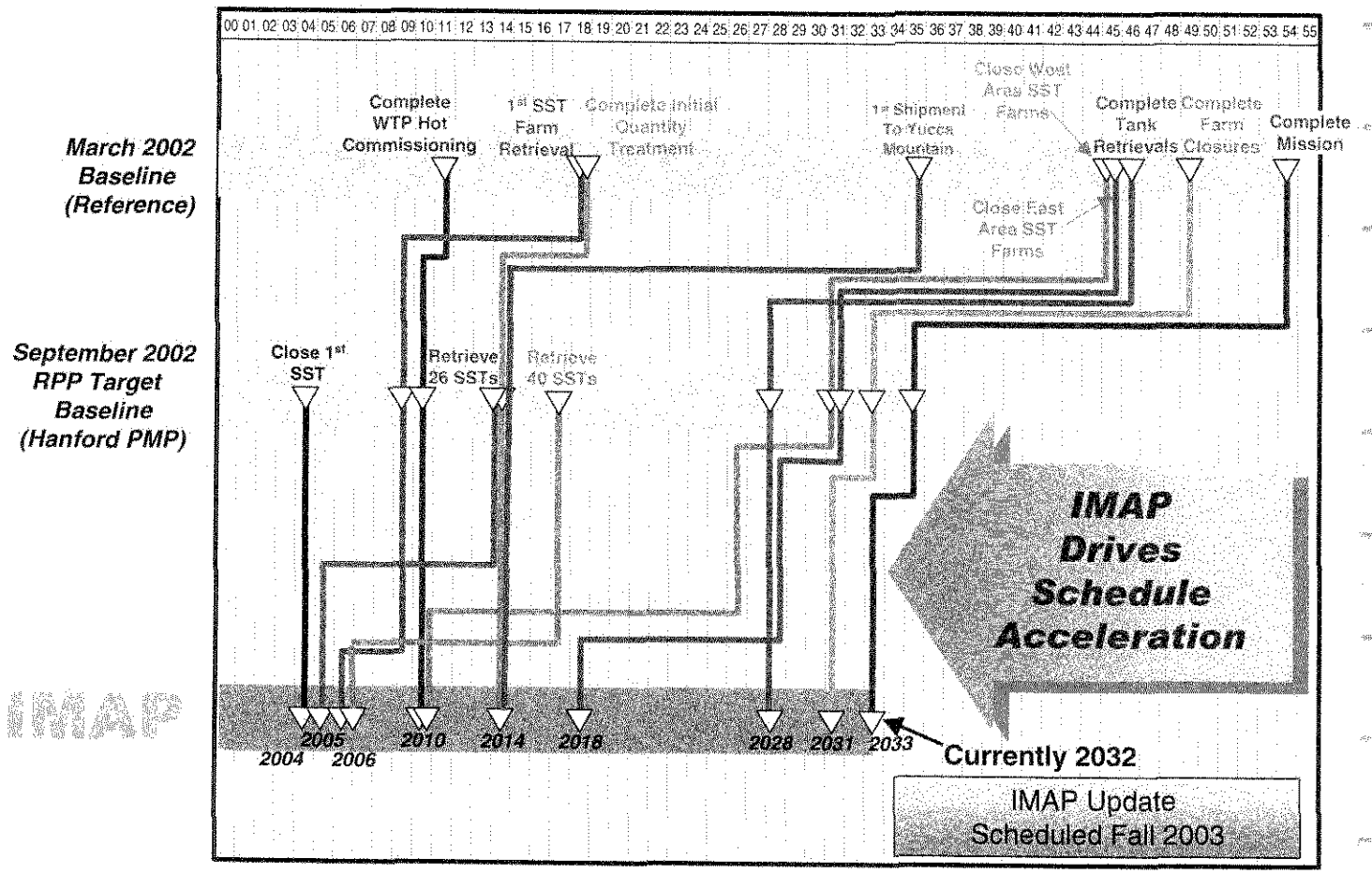

Figure 3-1 IMAP Acceleration of Mission Schedule

Table 3-1 IMAP Strategies Produce Results

IMAP Strategy	Planned Achievements FY 2003 to FY 2006*	Planned Achievements FY 2007 to FY 2034*
1. Retrieve and Close SSTs, DSTs, and Tank Farms	• 40 tanks selected for early retrieval and closure • **Select/implement proven retrieval systems on the 40 tanks** • Up to 40 SSTs interim closed by 2006 (10 years ahead of HPMP) • Two SST farms interim closed by 2006 (three years ahead of HPMP) – major step in overall footprint reduction fort the tank farms • 244-AR Vault interim stabilization completed in 2003 • Interim stabilization of SSTs completed in FT 2004 • **9.4 million gallons of additional usable DST space gained** • **Dry Retrieval/SST Waste Staging option evaluated and implemented if feasible** • **Targeted SST waste retrieved directly to Supplemental Processing, avoiding DSTs and WTP**	• **Interim closure of West Area SST Farms by 2010 (20 years ahead of HPMP)** • **All SST Farms closed by 2018 (13 years ahead of HPMP)** • **DSTs, WTP, and RPP facilities interim closed by 2033 (two years ahead of HPMP)** • **Evaluate and improve performance of retrieval systems to optimize performance, safety, schedule, and cost** • **DST space managed efficiently based on WTP and supplemental processing performance**
2. Provide Waste Feed Delivery to Satisfy Accelerated WTP Processing Rates	• Integrated Optimization Schedule for feed delivery established and implemented • Develop and implement an "Implementation Plan" that will form the contract basis for feed delivery to the WTP • Construction of immobilized high-level waste storage facility completed in 2006 to store 880 canisters • Projects completed in time to support feed delivery requirements to WTP • **Alternatives evaluated and implemented as feasible to optimize meeting mission needs (feed projects, storage/disposal projects)**	• Evaluate project schedule and scope based on ongoing WTP progress and supplemental treatment progress • **Optimize the RPP life cycle through optimal glass production** • **Flexible and more efficient waste feed qualification improving life-cycle costs**
3. Process Waste via Supplemental / Alternate Treatment / Disposal	• **750,000 gallons of transuranic waste removed from SSTs and processed using supplemental technology** • **250,000 gallons of low-activity waste/low-level waste retrieved and disposed using supplemental treatment technology** • **Evaluate steam reforming, bulk vitrification, cast stone, and other supplemental processing technologies that could be implemented to minimize quantity of waste sent to WTP**	• **Remote-handled transuranic waste retrieved from DSTs and processed** • **Implementation of cost-effective supplemental processing optimized, reducing waste sent to WTP** • **Alternative processing of waste pretreated in WTP implemented by**

* Bullets having a significant S&T component are shown in **bold** print.

IMAP Strategy	Planned Achievements FY 2003 to FY 2006*	Planned Achievements FY 2007 to FY 2034*
	• **Technologies selected for physical demonstration on real waste (to use in supplemental processing of waste pretreated in WTP)**	**2010** • **Low-activity waste glass processing reduced by up to 80% from March 2002 Baseline**
4. Enhance Regulatory and Stakeholder Interactions	• Tank Closure EIS completed by April 2004 • Review and approval process of regulatory documents required for tank closure optimized, reducing the review cycle from 28 months to less than 12 months • Permit review and approval for selected supplemental processing approach in less than 15 months after submission • Templates for standardized functions and requirements documents and closure plans developed and implemented • Risk-based closure criteria evaluated and implemented • Timely and efficient Waste Incidental to Reprocessing (WIR) determination process developed and implemented • Meet regulatory commitments consistently • Agreements with the Waste Isolation Pilot Plant and Yucca Mountain for receipt of RPP waste established	• Continued improvements in partnering among ORP, the Tank Farm Contractor, and the Regulators • Trust and confidence in performance achieved
5. Improve Mission Support and Work Management Systems	• Organization aligned to accelerated mission and tank closure focus from prior Management and Operations mission • Authorization basis documents restructured to hazards associated with tank closures for SSTs, eliminating unnecessary conservatism • Work planning and work control process streamlined, optimizing the time period and costs associated with implementing field activities • Integrated Mission Execution Schedule implemented and schedule accountability instilled at all levels • CH2M HILL Hanford Group, Inc. contract modified, streamlining technical requirements, eliminating non-essential reporting and reviews, and establishing ORP oversight at Level 2 of the WBS • Internal/external review and approval processes optimized, eliminating serial reviews • Infrastructure support consolidated and reduced as tank farm footprint is reduced	• **Lessons learned in near-term work implemented, increasing efficiencies and accelerating accomplishments in this time frame**

Table 3-2 IMAP and HPMP Milestones

Accomplishment Milestone	HPMP Schedule	IMAP Schedule
Retrieve first 26 SSTs	FY 2014	FY 2005
Retrieve 14 more SSTs	FY 2016	FY 2006
Demonstrate supplemental technology on real waste	FY 2008	FY 2004
Close 2 SST Farms	FY2009	SY2006
Retrieve and treat 750,000 gallons of TRU waste	FY 2012	FY 2006
Treat and dispose 250,000 gallons of LLW/LAW	FY 2011	FY 2006
Close 200-West Area SST Farms	FY 2030	FY 2010
Close 200-East Area SST Farms	FY 2031	FY 2018
Complete mission	FY 2035	FY 2033

As shown in Table 3.2, the closure of 40 SSTs will be completed 10 years ahead of the HPMP schedule; the closure of the 200-West Area SST farms is completed 20 years ahead of the HPMP schedule; and the closure of all SST farms is to be completed 13 years ahead of the HPMP schedule.

All activities to support IMAP are included in the Integrated Mission Execution Schedule, the primary tool for work execution and management of accountability for work planned. The IMAP schedule is aggressive and results-oriented, while recognizing that some significant technical, regulatory, and management issues require resolution. These risks are recognized and accepted.

The IMAP identifies 30 Mission Acceleration Action Plans (MAAPs) that must be performed on schedule to facilitate completion of IMAP closure schedule activities. About 35% of these MAAPs have a significant technology component, which support the 5 IMAP Execution Strategies. The MAAPs each have several activities that must be completed on the schedule defined in the MAAPs to successfully support the five Execution Strategies. The 72 Technology Opportunities are crosswalked to the 5 IMAP Execution Strategies for purposes of this Roadmap.

3.2 Tank Closure EIS Data Packages

Figure 3.2 illustrates key components of the River Protection Project system as defined by Notice of Intent (NOI) alternatives supporting the environmental impact statement. It also illustrates relationships between components of the No Action alternative (e.g., obtain prior NEPA coverage – designated by an unshaded box) and the other five Notice of Intent action alternatives. This structure and information was used to help appropriately connect the data elements in the crosswalk. As shown, the River Protection Project system consists of four major components:

- *Single-shell tank system* (i.e., storage, retrieval, closure, and decontamination and decommissioning) – This includes waste retrieval and storage for 149 single-shell tanks, ancillary equipment (e.g., pipes and pits), and soils (from surface to interface with groundwater) within single-shell tank farms and/or waste management area boundaries, as defined by the Notice of Intent alternatives.

- *Double-shell tank system* (i.e., storage, retrieval, closure, and decontamination and decommissioning) – This includes waste retrieval and storage for existing and new

double-shell tanks, as well as ancillary equipment and soils within double-shell tank farms, as defined by the Notice of Intent alternatives.

- *Waste treatment facilities* (pretreatment and immobilization facility construction, operations, and decontamination and decommissioning) – This includes existing and new facilities required to complete waste treatment as defined by the Notice of Intent alternatives.

- *Waste disposal facilities* (i.e., interim storage and disposal of treated waste, including construction, operations, and decontamination and decommissioning) – This component includes facilities under contract (i.e., existing and new storage and disposal facilities required to complete waste disposal as defined by the Notice of Intent alternatives).

DOE proposes to retrieve waste from the 149 single-shell tank (SST) and 28 double-shell tank (DST) systems and to close the SST farms in a manner that complies with federal and Washington State requirements and protects the human environment. Closure of the DSTs and the Waste Treatment Plant (WTP) are not part of the proposed action because they are active facilities needed to complete waste treatment. The proposed EIS for retrieval, treatment and disposal of Hanford Tank Wastes and for closure of 149 single-shell tanks (68 FR 1052) will provide further updates of activities addressed in the Hanford Defense Waste (DOE. 1987) EIS and the TWRS EIS. In terms of waste storage, the proposed Hanford Tank Closure Environmental Impact Statement (68 FR 1052) is expected to analyze the use of the existing waste storage system and evaluate the need for new storage systems. Variations on the timing of waste retrieval and the technologies used (continuing from past-practice sluicing to dry waste retrieval) are expected to be evaluated to support an understanding of the extent of waste retrieval needed to meet applicable closure requirements.

DOE proposes to immobilize the retrieved waste in the WTP and through supplemental treatment technologies such as bulk vitrification, containerized cast stone, steam reforming, and sulfate removal, and to package the immobilized waste for onsite disposal or offsite shipment and disposal in licensed and/or permitted facilities. Options evaluated for waste treatment include treating all wastes in an enhanced WTP, treating wastes in the WTP plus WTP supplemental treatments, or treating the waste in the WTP plus supplemental treatment in the tank farms. Options evaluated for waste disposal include disposing of the waste onsite using existing or new facilities, disposing of the waste at offsite government facilities, or disposing of the waste at onsite and offsite commercial facilities.

DOE proposes to close the SST farms (i.e., tanks, ancillary equipment, and soils) within the tank farm area by 2028. The tanks would be filled with materials to immobilize the residual waste, prevent long-term degradation of the tanks, and discourage intruder access. Finally, alternatives for tank closure will be evaluated based on extent of waste retrieval, options for soil excavation, and options for surface barriers.

Associated support buildings, structures, laboratories, and the treatment facilities would be decontaminated and decommissioned in a cost-effective, legally compliant, and environmentally sound manner. Under the proposed action, DOE is expected to use existing, modified, or (if required) new systems to assure waste storage and management capability during retrieval and treatment (68 FR 1052).

Figure 3.3 is an illustrative, not definitive, chart that was developed during the internal scoping process to assist with framing of the alternatives (DOE/ORP-2003-09, Rev. 0). Individual data

packages were used as sources of information on the technical basis for the alternatives and for what is currently known or understood regarding the key variables associated with the alternatives.

Figure 3-2 Tank Closure EIS System – Relationships Among Key Components for Notice of Intent Alternatives

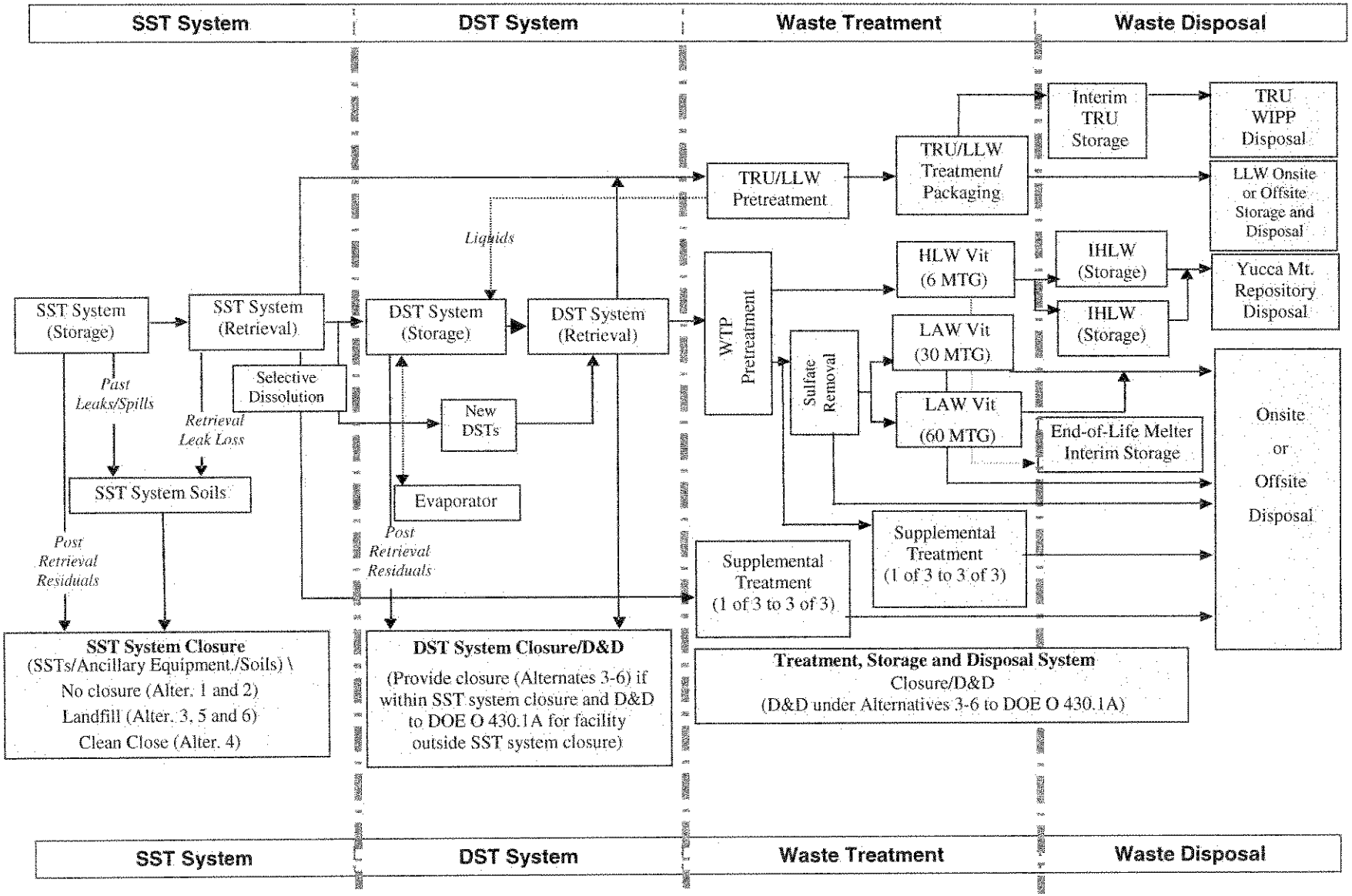

Figure 3-3 Alternative Component Matrix for Tank Closure EIS

	Waste Storage (Storage in tanks pending retrieval)			Waste Retrieval						Waste Treatment						Waste Disposal (Disposal of Immobilized TRU, LLW & LAW)			Tank System Closure					
				Retrieval Leakage (Volume in gallons of waste lost during retrieval per tank)			Residual Tank Waste at Closure (%)			WTP Waste Treatment			Supplemental Non WTP Waste Treatment						Post-Retrieval Remediation (Tank/Ancillary Equipment and Contaminated Soil)			Surface Barrier/Post-Closure Care		
	Current	Modify Existing	New Capacity	Minimal	Nominal	Bounding	Extensive Retrieval (0.1)	Nominal Retrieval (1.0)	Lower Limit of Technology (10.0)	New Vitrification Capacity	Enhanced and/or Modified Vitrification	Supplemental LAW Immobilization	None	LLW	TRU	ILAW Trench	Hanford Site	DOE or Commercial Offsite	None	In Situ	Ex Situ Partial	None	Modified RCRA	Hanford
1. No Action	▲					▲		▲ (a)			▲ (b)		▲			▲	▲		▲			▲		
2. Implement the 1997 Record of Decision (with modifications)	▲					▲		▲		▲	▲		▲			▲	▲		▲			▲		
3. Landfill Close Tank Farms/ Onsite and Offsite Waste Disposal	▲				▲			▲			▲	▲		▲	▲		▲	▲		▲				▲
4. Clean Close Tank Farms/ Onsite and Offsite Waste Disposal		▲			▲		▲				▲	▲		▲	▲		▲	▲			▲	▲		
5. Accelerated Landfill Closure/ Onsite and Offsite Waste Disposal			▲			▲			▲		▲	▲		▲	▲		▲	▲		▲			▲	
6. Landfill Closure/Onsite and Offsite Waste Disposal		▲		▲				▲			▲	▲		▲			▲	▲		▲			▲	

Notes: (a) Waste would be retrieved to HFFACO limit; however, waste would only be retrieved from tanks required to feed the WTP (i.e., 25-50% of total waste volume).
(b) WTP would operate for the life cycle of the facility or to approximately 2046.

DOE = U.S. Department of Energy
HFFACO = *Hanford Federal Facility Agreement and Consent Order*
ILAW = immobilized low-activity waste
LAW = low-activity waste
LLW = low-level waste
RCRA = *Resource Conservation and Recovery Act of 1976*
TRU = transuranic
WTP = Waste Treatment Plant

3.3 CH2M HILL Risk Management Register

Technical risk management encompasses the risks that the physical system will not perform as designed or planned, and/or that the waste will not behave as predicted. Identifying and managing technical risks becomes a key activity in support of mission acceleration as new technologies and techniques are introduced to the Hanford tank farms. Technical risks are identified, associated mitigation actions are placed in the Mission Execution Schedule, and information is tracked to completion (CH2M HILL, March 2003).

Generally speaking, the mission acceleration strategies were developed to reduce and eliminate the risks that the tank waste poses to the environment and the public. Given the evolution of the RPP over the last 18 months, this Roadmap updates the previous analysis done where "technology-related risks" and their relationship to key decisions/performance targets for the TFC are examined.

Appendix C contains the technology-related risk information from the CH2M HILL Risk Management Register (dated 1/23/03). This information is organized by crosswalking the contractor-identified risks to the RPP Critical Risks. This categorization provides a bottoms-up perspective of project-level risks and how they relate to long-term RPP mission success. Both the categorization scheme by RPP Critical Risk and key points from the contractor-level detail information is crosswalked in Section 5 to the Technology Opportunity data set to provide roadmap insight.

3.4 Technical Challenges

A number of technology opportunities may be amenable to off-the-shelf technology and, therefore, suitable for vendor solutions. Vendor outreach efforts include distribution of Technical Challenge Sheets and CH2M HILL participation in vendor forums and open houses.

In February 2003, twenty-four Technical Challenge Sheets (see Table 3.3) were prepared to share selected technology opportunities with vendors. Technical Challenge Sheets are not RFIs or RFPs and there is no guarantee that they will result in procurements. They are intended as a mechanism for CH2M HILL to share potential needs with vendors.

Table 3-3 FY03 Technical Challenge Sheets

No.	FY03 Technical Challenge Title	Related FY03 Technology Opportunity Number	Current Status of Technical Challenge
1	Cleanable HEPA filter	WT104	Closed
2	Coalescer for Tank Waste in Pits and Airborne Contamination	WT105	Closed
	Contamination Lock-Down Surface Coating	WT131	Closed
3	In-tank Camera and Lighting	WT108	Closed
4	Radiation Survey	WT109	Closed
5	Develop/Find Predictive Maintenance Tools	WT128	Closed
6	Spray-on Shielding	WT129	Closed

No.	FY03 Technical Challenge Title	Related FY03 Technology Opportunity Number	Current Status of Technical Challenge
7	Double-Shell Tank (DST) Transfer Piping Non-Destructive Examination (NDE) Tools	WT106	Active
8	Remote Tank Wall Repair	WT111	Closed
9	Tank Leak Detection, Monitoring, and Mitigation (LDMM) Systems	WT026 / WT027	Active
10	Control of Retrieved Waste Dilution	WT032	Closed
11	Hanford/SRS Waste Mixing Mobilization	WT060	Closed
12	Single-Shell Tanks (SSTs) Retrieval with Minimal Water Addition	WT089	Closed
13	Response to Potential Line Leak	WT135	Closed
14	Installation of New Risers in SSTs	WT136	Closed
15	Sluicing Enhancement and Cost Reduction	WT148	Closed
16	Transport of SST Waste with Little Water	WT149	Closed
17	Remote Pit Cleanout and Riser Preparation	WT159	Closed
	Removal/Decontamination of In-tank Equipment	WT021	Closed
	Improved Pit Remote Operations Tools	WT137	Closed
18	Chemical and Physical Behavior of Saltcake Wastes	WT091	Closed
19	Post-Retrieval Evaluation: In-Situ Characterization	WT102	Active
	Technology to Support Post-Retrieval Evaluation of SSTs	WT115	
20	Strategy for Long-Term Performance Testing and Comparison of Performance For Different Waste Forms	WT157	Active
21	Tailored Disposal Systems	WT158	Active
22	TRU Treatment Technology	WT147	Closed
23	Supplemental Pretreatment Technologies	WT152	Closed
24	Transport of Packaged and Bulk Waste	WT153	Closed

Technical Challenge Sheets are short summaries of the key needs to be addressed by vendor-supplied technology. In some cases, the Technical Challenge Sheet is a combination of several Technology Opportunity Statements.

The Technical Challenges were updated in August 2003, closing all but five of them, as also shown in Table 3.3. The remaining five Technical Challenge Sheets are provided in Appendix B and also on the CH2M HILL website at http://www.hanford.gov/chgcp under the links to CH2M HILL Procurement.

The disposition of Technical Challenges is integrated with CH2M HILL Technology Integration and DOE-ORP Small Business Program activities. A small business vendor symposium highlighting contracting opportunities was held on February 18, 2003, that included an overview of CH2M HILL's Technical Challenges. CH2M HILL participated in the monthly vendor forum again on April 15, 2003, and also in the July 15, 2003. CH2M HILL had a booth at DOE's 4th Annual Small Business Conference held in Albuquerque May 12-15, 2003, (see http://www.smallbusiness-outreach.doe.gov/). CH2M HILL also had a booth at the Waste Management 2003 meeting in Tucson February 23-27, 2003. CH2M HILL will be a part of the Bridging Partnerships Small Business Vendor Symposium to be held on August 14, 2003 at the Red Lion Hotel in Pasco and sponsored by DOE, the State of Washington, the Hanford Prime Contractors, PNNL, and the Tri City Industrial Development Council (TRIDEC). Information on the Technical Challenges will be provided to small businesses that express interest in tank waste solutions at this and other vendor forums.

A vendor database was developed to support and track vendor outreach efforts and responses. The database contains verified contact information for approximately 256 vendors, subject matter experts, related site experience experts, and Small Disadvantaged Business contacts.

Vendor outreach has resulted in a diversity of responses. These responses are categorized in the transactions shown in Table 3.4. Table 3.5 identifies the number of vendors responding specifically to Technical Challenge Sheets. Figure 3.3 shows the process flow associated with dispositioning vendor responses. Ultimately, the technical POC and CH2M HILL management proposes for the technology to be integrated into the baseline. The number of vendor responses to each of the Technology Opportunities Statements is noted in the Crosswalk table in Section 5.

Table 3-4 Vendor Transactions

Category	Transaction	Reasoning	Disposition
Previous Vendor	Ask for information	Does the vendor have anything new to add?	If yes, send to technical POC. If no, disposition based on results of previous evaluation.
Innovative and/or Potentially Viable Solution	Ask for concept paper or available documentation.	Potential baseline or alternative technology	Send to technical POC.
Potentially Viable Solution Proposed by an Organization Receiving Earmarked Funds	Ask organization to prepare a proposal. After CH2M HILL review and concurrence, submit proposal to EM-50 for funding.	Potential baseline or alternative technology	Send to technical POC.
Request for Information on RFP	None	None	Refer to procurement.

Category	Transaction	Reasoning	Disposition
Provide Input on RFI	Ask for information	Document information and broaden or narrow subsequent RFP.	Refer to procurement.
No Response	None	None	Evaluate status as vendor challenge.

Through the Technical Challenge activities, a total of 35 Technology Opportunity Statements received 53 vendor responses (the same response might apply to several Technology Opportunity Statements) from 27 different vendors as of August 15, 2003. A summary of the vendor responses is presented in Table 3.5.

Table 3-5 Vendor Response Summary

Number of Vendor Responses	Technology Opportunity Number	Technology Opportunity Title	Product Proposed
2	WT021	Improve Pit Remote Operation Tools	§ Viscous liquid grouts § SST retrieval systems concepts
4	WT026	Tank Leak Detection, Monitoring and Mitigation (LDMM) Systems	§ Ion exchange materials § LDMM § Moisture level detector § Air barrier
2	WT032	Control of Retrieved Waste Dilution	§ Process monitor for solid
2	WT060	Hanford/SRS Waste Mixing Mobilization	§ Fluidic mixers § Impeller mixer pumps
1	WT061	Reactive Barriers to Contaminant Migration	§ Ion exchange materials
3	WT089	Single-Shell Tanks (SSTs) Retrieval with Minimal Water Addition	§ SST retrieval systems concepts § Remote deployment systems § Technical assistance
1	WT091	Chemical and Physical Behavior of Saltcake Wastes	§ Saltcake dissolution
4	WT102	Post-Retrieval Evaluation: In-Situ Characterization	§ Planning tools § SST retrieval systems concepts § Remote-deployment systems § Gamma Camera § Optical fiber sensor system
1	WT104	Cleanable HEPA Filter	§ HEPA filter concept
2	WT105	Coalescer for Tank Waste in Pits and Airborne Contamination	§ Coatings § Polyurea
3	WT106	Double-Shell Tank (DST) Transfer Piping Non-Destructive Examination (NDE) Tools	§ SST retrieval systems concepts § Remote deployment systems § Technical assistance
3*	WT108	In-Tank Camera and Lighting	§ Radiation-hardened cameras § Radiation resistant hardware § Remote deployment systems
2	WT109	Radiation Survey	§ Instruments § Mobile vehicle with radiation detectors
3	WT111	Remote Tank Wall Repair	§ SST retrieval systems concepts

* More responses received subsequent to August 15, 2003.

Number of Vendor Responses	Technology Opportunity Number	Technology Opportunity Title	Product Proposed
			§ Remote tank wall repair § Remote deployment systems
2	WT113	Selective Species Removal	§ Plasma mass filter § Ion exchange materials
4	WT115	Technology to Support Post-Retrieval Evaluation of SSTs	§ Gamma camera § SST retrieval systems concepts § Planning tools § Remote deployment systems § Optical fiber sensor system
2	WT128	Develop/Find Predictive Maintenance Tools	§ Modeling tools § Engineering services
4	WT129	Spray-on Shielding	§ Coatings § Remote deployment systems § Sprayable mortar § Polyurea
3	WT131	Contamination Lock-Down Surface Coating	§ Spray material § Coatings § Polyurea
3	WT135	Response to Potential Line Leak	§ LDMM Concepts § Remote systems § Air barriers
2	WT136	Installation of New Risers in SSTs (Single Shell Tanks)	§ Engineering services § SST retrieval system concepts
2	WT137	Removal/Decontamination of In-tank Equipment	§ SST retrieval systems concepts § Viscous Liquid Grouts
2	WT139	Best-Basis Inventory Improvement	§ Remote systems § TWINS Software
1	WT140	Post-Closure Monitoring	§ Moisture level detector
1	WT141	Development and Demonstration of Bulk Vitrification Treatment Technology	§ Sintering process
1	WT142	Containerized Grout	§ Evaluate grout reports
1	WT147	TRU Treatment Technology	§ TRU Treatment
5	WT148	Sluicing Enhancement and Cost Reduction	§ Remote deployment systems § Fluidic mixer § Sluicers § Technical assistance
1	WT149	Transport of SST Waste with Little Water	§ Technical assistance
2	WT151	Getter Materials for Tank Fill	§ Bio-based material § Ceramic
2	WT152	Supplemental Pretreatment Technologies	§ Alternate processes § Remote systems
2	WT153	Transport of Packaged and Bulk Waste	§ Remote systems § Self-guided transport vehicle
1	WT157	Strategy for Long-Term Performance Testing and Comparison of Performance For Different Waste Forms	§ Planning
2	WT158	Tailored Disposal Systems	§ Ceramic waste form § Polymer encapsulation of waste

Number of Vendor Responses	Technology Opportunity Number	Technology Opportunity Title	Product Proposed
2	WT159	Remote Pit Cleanout and Riser Preparation	§ Viscous Liquid Grouts § SST retrieval systems concepts

* The identified technology opportunities were the subject of procurement actions, Request for Information (RFI) and multiple responses, Request for Proposals (RFP) and multiple responses, and in several cases, contract award.

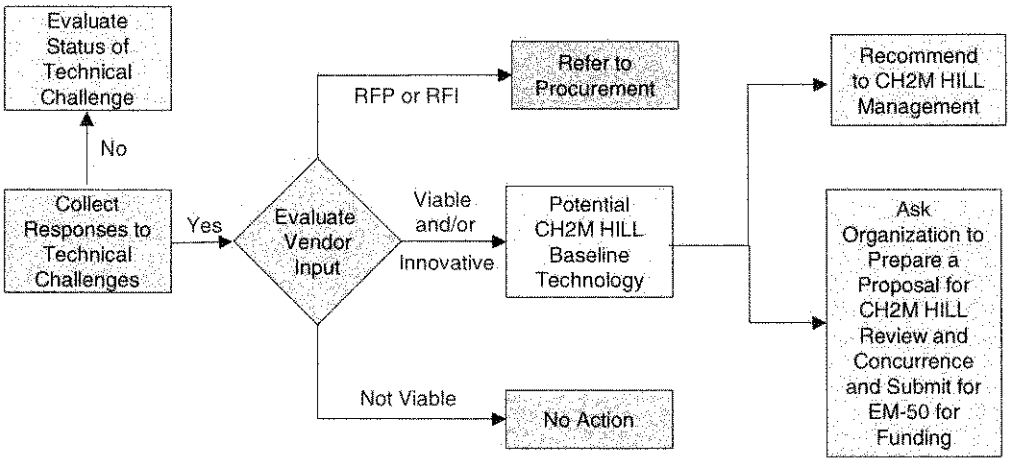

Figure 3-4 Dispositioning Vendor Responses to Technical Challenges

3.5 CH2M HILL Tough Technical Problems

This section, and the remainder of Section 3, present additional data elements important to providing a more complete view of the Technology data crosswalk and roadmap.

A meeting was held on May 28, 2003 to identify the CH2M HILL " tough technical problems" that might yield significant cost and schedule improvements for the RPP mission. From this management exercise, these problems were compiled and then discussed at a June 5 meeting with key PNNL staff involved with creative, economic, and practical robotic systems. PNNL responded to the tough technical problems and identified areas where the Laboratory might be able to help. The results of these discussions, and the meeting minutes are presented in Appendix E, and used in the data crosswalk in Section 5.

3.6 Technical Exchanges

CH2M HILL holds periodic Technical Exchanges with other DOE sites such as the Savannah River Site (SRS) in order to leverage ongoing work at those sites that might be applicable to the Hanford Site. Several Technical Exchanges have been held so far in FY 2003. Each of these is briefly described in Appendix E. The work scope associated with these Exchanges is noted in the Crosswalk Table in Section 5 for completeness.

3.7 Environmental Management Science Program

The DOE Office of Environmental Management (EM) was created in 1989 to address the environmental legacy from over 50 years of nuclear weapons research, production, and testing. This is some of the most technically challenging and complex work of any environmental program in the world. The Environmental Management Science Program (EMSP) was implemented in 1996 in response to a recommendation to EM from the 1995 Galvin Commission Report. This report stated that there is a particular need for long-term, basic research in disciplines related to environmental cleanup. Adopting a science-based approach that includes supporting development and expertise could lead to both reduced cleanup costs and smaller environmental impacts at existing sites and to the development of a scientific foundation for advances in environmental technologies.

EMSP seeks to work directly with staff at DOE sites to identify and collaborate on specific site cleanup problems. It is envisioned that this CH2M HILL Technology Opportunities Roadmap could potentially serve as one basis for developing a more detailed S&T Roadmap to help guide EMSP investments in science to underpin the IMAP acceleration plans for the RPP. The current EMSP projects related to CH2M HILL's mission are summarized in Appendix D. The FY2003 EMSP Principal Investigator Workshop notes are included in Appendix E for reference, and the pertinent data are included in the data crosswalk in Section 5.

3.8 Earmarked Activities

Some EM funds are allocated directly to institutions. CH2M HILL Technology Integration has met with these institutions to identify work scope that matches the Technical Challenges to the capabilities of the institutions. These activities are described in Appendix E and included, as pertinent in the data crosswalk in Section 5.

3.9 EM-50 Projects

EM's Office of Science and Technology (EM-50), or EM-21, Cleanup Technologies beginning in FY04, is expected to have an ongoing technology development budget in some form for the organization. In FY02, EM-50 significant emphasis on concepts where substantial savings might be realized by non-baseline approaches. In FY03, EM-50 identified multiple technical areas of interest at Hanford and allocated a budget to technology development in some, if not all, of these areas. It is anticipated that Acquisition Strategies will be written during the summer of FY03, and the call for proposals will be made early in FY04, with most of the funding to be spent in FY04.

The EM-50 strategy was established in FY02 and continued in FY03. EM-50 funds two types of projects: 1) Technical Assistance, which is mainly directed toward sites that are finishing activities for closure (e.g., Fernald) and 2) Alternatives, which are larger projects directed toward developing non-baseline improvements or backups with potentially significant cost savings. The three Alternatives Projects for Hanford Tank Farms are described in Appendix E, and noted on the data crosswalk in Section 5.

3.10 Small Business Innovative Research

Since its enactment in 1982, as part of the *Small Business Innovation Development Act*, the Small Business Innovative Research (SBIR) Program has helped many small businesses compete for federal research and development awards. The SBIR Program is highly competitive and encourages small businesses to explore their technological potential. By including qualified small businesses in technology development and demonstration initiatives at DOE sites, technology innovation is stimulated and an entrepreneurial spirit is fostered in support of addressing the multitude of technical challenges. Pertinent SBIR projects are included in the Data Crosswalk Table in Section 5. Details of the SBIR initiatives are documented in Appendix E, and pertinent data included in the data crosswalk in Section 5.

4.0 Disposition of Technology Opportunities

This section describes the process used to determine the disposition path for each of the 72 CH2M HILL Technology Opportunities. The status of each of the 72 CH2M HILL Technology Opportunities is noted as either "active", "inactive", "deferred", or "closed" based on feedback obtained via interviews with the Technical Points of Contact. The status categories are defined as follows:

Active – The work scope must be completed now, and activities related to the Technology Opportunity Statement are being funded, although not necessarily by CH2M HILL.

Inactive – The work scope must be completed now, but no activities related to the Technology Opportunity Statement are funded. CH2M HILL's risk mitigation strategy is noted.

Deferred – The work scope has been moved farther out into the future, and the Technology Opportunity Statement is expected to be needed at that time.

Closed – Either the work has already been completed or the work is being done in a different way, so the Technology Opportunity Statement is no longer needed.

For those Technology Opportunities that are still active, the current or recommended disposition path (i.e., CH2M HILL program funding, technical exchanges with other sites, pursuit of EMSP funding, EM-50 Alternatives projects, or SBIR) is described. The risk to the accelerated baseline if the Technology Opportunity is not funded is summarized and included in the table.

The CH2M HILL Technology Opportunity Statements that are not currently funded are further examined using the following steps to complete the disposition process:

- Identify opportunities for "earmarked" technology development organizations (i.e., FIU, MSU-DIAL, AEA Technologies) to direct work scope in FY04 and beyond.
    - *EM-50 "Earmarks" Process* – The opportunity needs to have a majority of fundamental studies, but not a scientific breakthrough component. Those studies could contribute to overall Hanford understanding of underlying phenomena. The "earmark" institution needs to have the needed capabilities or be able to easily develop the capabilities. Many of the Technology Opportunity Statements already call out relevant capabilities at the universities where previous projects existed.

- Identify opportunities for EM-50/EM-21 Alternatives projects.
    - *EM-50/EM-21 Alternatives Process* – The reorganization of EM-50 in FY02 put significant emphasis on concepts where significant savings might be realized by "non-baseline" approaches. During FY03, Hanford has redefined baselines for rapid implementation. Non-baseline technologies with uncertainties may still offer significant savings. Some of these opportunities were identified as good candidates for EM-50 proposals for FY04 and are noted as such in the disposition table.

- Identify opportunities for Office of Science investments (e.g., EMSP).
    - *DOE Office of Science Investments* – The opportunities that appear to be science in nature, as opposed to those with a technology component, have already been communicated to the DOE Office of Science. However, there may be other technology opportunities that include a science aspect (e.g., the need for experimental data or a better basic understanding of the underlying phenomena) that would be good candidates for EMSP funding, and are noted in the disposition table.

- Identify opportunities that can be leveraged with solutions being developed by other DOE sites.

- Provide CH2M HILL management with information on technology opportunities with high potential paybacks for technology investments, to be used for FY04 and/or out-year budget allocation.
    - *River Protection Project Internal Investments* – These Technology Opportunities can provide added value over and above what the baseline projects have already done. There may be cases from a total CH2M HILL perspective where an investment may be warranted if more than one project could share the same or similar opportunity, but neither project can afford to fund the implementation by itself; approval to pursue these projects would be made in concert with ORP.

The results of this disposition exercise are used in the next section, and specifically noted in Table 5.1, to roadmap the data components and examine their implications on technology needs and opportunities and a successful path forward for the accelerated mission completion.

5.0 Technology Data Crosswalk and Roadmap

As described in Section 1.4, the RPP is composed of five major, interrelated technical functions that cover all technical activities necessary for achieving the RPP mission:

- ***Store***—Store waste safely until it can be retrieved for treatment and disposal.
- ***Retrieve***—Retrieve waste from all tanks to the extent needed for closure and transfer it to the Waste Treatment Plant (WTP).
- ***Treat***—Separate waste into two fractions, remove key radionuclides from the low-activity waste streams to be disposed on the Hanford Site, incorporate these radionuclides into the HLW stream, immobilize both waste streams, and package the waste in containers for storage and disposal.
- ***Dispose***—Dispose of immobilized low-activity waste (ILAW) onsite in near-surface disposal facilities, store immobilized HLW (IHLW) onsite until it can be shipped to an offsite geologic repository, and dispose of secondary waste in onsite near-surface disposal facilities.
- ***Close***—Close (or deactivate, decommission, and transfer) all RPP facilities and infrastructure and establish long-term monitoring capability for sites and facilities.

The RPP involves uncertainties, which may be stated as risks to successful completion of the accelerated project as planned in the IMAP. Understanding project risks will help ensure that resources are directed to appropriate activities and will guide the development of risk mitigation actions and contingency plans. Some of the risks identified for the RPP can be mitigated by appropriate actions to develop or adapt science and technology (S&T). Because technology is the focus of this roadmap document, only the technical risks that are related to technology are considered here (as opposed to programmatic risks, which include regulatory risks, political risks, management risks, etc.). As part of the technology roadmap for the RPP, these technical risks can be mapped to the key decisions and performance targets for each of the RPP major technical functions, providing one of the linkages between technology activities and planned work scope. The current CH2M HILL technical risks are contained in Appendix C.

The Technology Opportunity Statements described in Section 2.0 have been updated annually and provide a sound basis for identifying technology activities to be undertaken in support of the RPP. Within the technology roadmap for the RPP, the technology needs are mapped to the key decisions, the performance targets, and the technical risks. Table 4.1 provides the complete data crosswalk information, organized by Technology Opportunity for convenience.

A key focus of this Technology Opportunities Roadmap is to update the key decisions and performance targets for each of the RPP major technical functions associated with TFC activities. Figure 5.1 illustrates the relationship of the Technology Opportunities to the key decisions / performance targets, the IMAP strategies and the RPP functions, similar to that done as part of the Integrated Technology Plan (ITP) for the entirety of the River Protection Project. Figure 5.1 represents an update since the ITP was published in February 2002. The key decisions, the performance targets, and the schedule and milestones have been updated to reflect changes that have occurred due to the new WTP timeline and the new Integrated Mission Acceleration Plan. Figure 5.2 updates the roadmap diagram to put the technology opportunities and key decisions/performance targets into schedule context with milestones and the accelerated schedule for mission completion.

A variety of technology activities are underway or planned to address CH2M HILL Technology Opportunity Statements. These include activities funded by ORP and its contractors, as well as activities funded by EM-50 and EMSP. In some cases, activities are co-funded by multiple organizations. As part of the CH2M HILL Technology Opportunities Roadmap, these technology activities can be mapped to the key decisions and performance targets for each of the RPP major technical functions.

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Table 5.1. Technology Opportunities / Data Crosswalk

Technology Opportunity Statement ID	Technology Opportunity Statement Title	Status	Tough Technical Problems	IMAP Strategy[1]	Disposition Path (Existing or Recommended)	Comments/Issues	CH2M HILL Technical POC and ORP POC	# of Vendor Responses	Risk Priority (H/M/L)	Risk Tracking Number (s)	Risk Statement / Information
WT004 / WT079-S	Double-Shell Tank (DST) Corrosion Chemistry and Monitoring/pH Probes	Active		5	In the first quarter of FY04, an expert panel will address the feasibility of raising level changes in the DSTs. Corrosion probe experts will participate on this panel. EMSP 81898, 81989, and 81866 address safety of HLW tanks.	The risk of DST space shortages due to mission acceleration, including accelerating SST retrievals, has increased, and aggressive risk mitigation efforts are underway. DST corrosion control will be important for raising levels in DSTs.	Gary Duncan, 376-6008 ORP: Vic Callahan		H	DST Space Availability RPP-CR-014, CR-070A	Double Shell Tank integrity must be maintained and space saving initiatives must be successful to avoid replanning of the TFC baseline strategy (including possible tank sequencing adjustments and potential construction of new tanks) and support accomplishment of accelerated cleanup initiatives.
WT009	Representative Sampling to Support Retrieval and Transfer of DST Waste to WTP for Treatment and Disposal	Closed	In-process sampler for Hose-in-Hose Transfer Line (HIHTL)	-	Evaluation of clamshell sampler and off-riser sampler completed in FY03.	Quicker sample / analytical responses would provide more flexibility to the tank system.	Roland Brown, 376-9191		L	Sustained Waste Feed Delivery - RPP-CR-040 Samples – Suitability 628	If additional sampling for tank-to-tank transfer is required, then additional costs will be incurred and delays may occur in providing needed feed to the WTP.
WT016	Glass Monolith Surface Area	Active		3	Limited activities are funded	Minor risk to CH2M HILL; medium risk to RPP. Would impact the acceptability of the already approved Performance Assessment.	Fred Mann, 373-3978 ORP: Phil Lamont, Bob Lober and Rob Yasek		M	Immobilization Waste Package Specification CR-i-03	If the disposal facility performance assessment is not approved due to waste treatment contractor inability to produce suitable ILAW glass, then the construction start date of the storage project is delayed until disposal authorization is granted.
WT017	Long-Life Waste Isolation Surface Barrier	Active (other funding)		3	DOE-EM's S&T program (EM-50) project approved for funding. NETL has begun preparing for RFP and vendor outreach.	Low risk to CH2M HILL. Would have to convince regulators that non-demonstrated final closure component would perform.	Fred Mann, 373-3978 Phil Lamont, Bob Lober, and Rob Yasek		L	New contractor risk CR-xxx	Long-term Hanford-wide need. If a subsurface barrier is not implementable, capping options will be rejected, thus requiring more expensive remediation options.
WT021	Improve Pit Remote Operation Tools	Deferred		5	Issues have been resolved for mission work currently defined. No driver to continue pursuit of alternate technologies.	If highly contaminated pits must be accessed in the future or pits with planned work scope are more contaminated than previously thought, remote technology may be more safe and cost-effective than existing methods. Upgrades to the pit viper have been identified, but are not currently being pursued.	John W. Hobbs, 373-8676	2	H	Pit Condition RPP-CR-034; SST Retrieval Needs RPP-CR-032 W314 [RE16] S-102 [RE09], S-102 [RE10], S-112 [RE10] Radiation & Contamination CR-011	If the tank and pits are not acceptable for use, then design and construction activities will be impacted. If the pits cannot be cleaned to acceptable worker dose levels, then there may be cost increases and schedule delays. If pits (SY, S-12A, S-A, and S-C) are not acceptable for use, then design and construction activities will be impacted. If the pits to be upgraded are in worse physical condition than assumed, then additional repairs will be necessary resulting in increased construction costs and schedule delays.
WT022	Improving the Tandem Synthetic Aperture Focusing Technique (TSAFT) for Flaw Characterization in the Inaccessible Portion of the Knuckle Region of the Double-Shell Tanks (DSTs)	Active	DST inspection at top knuckle and above, better inspection at bottom knuckle	5	Funded in FY03 for $72K. Funding requested in a Baseline Change Request (BCR) for FY04.	Tank knuckle inspections will continue with the existing version of TSAFT, but the evaluation of the knuckle region will not indicate whether anomalies, if found, are ID or OD. If the TSAFT™ fails to examine the high stress region of the DSTs, then an additional technology will have to be developed, tested, and deployed at added costs and delays. (FORCE Institute Y-Arm (extended arm) selected for examining lower knuckle cannot reach predicted location of maximum stress (at tangent point between curved portion and flat bottom).)	Jim Castleberry, 373-5011 ORP: Vic Callahan		M	DST Space Availability RPP-CR-014, CR-070A Tank Integrity DST UT-07	Double Shell Tank integrity must be maintained and space saving initiatives must be successful to avoid replanning of the TFC baseline strategy (including possible tank sequencing adjustments and potential construction of new tanks) and support accomplishment of accelerated cleanup initiatives.

[1] 1=Retrieve & Close SSTs, DSTs, and Tank Farms; 2=Provide Waste Feed Delivery to Satisfy Accelerated WTP Processing Rates; 3=Process Waste via Supplemental Treatment/Disposal; 5=Improve Mission Support & Work Management Systems

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WT026 / WT027	Tank Leak Detection, Monitoring and Mitigation (LDMM) Systems	Active	Leak detectors	2	COGEMA is funded to do work on LDMM systems. HGI is currently funded to deploy it at S-103. The interim stabilization program continues according to schedule to remove liquids from SSTs in accordance with the Consent Decree.	Provisions for LDMM have become an integral part of Tri-Party Agreement milestones addressing waste retrieval system designs. Additional significant SST leakage must be prevented to avoid reconsideration of the overall TFC baseline strategy to accommodate different retrieval methods and to limit the amount of leakage.	Warren Thompson, 372-8053 ORP: Roger Quintero, Rob Yasek, and Bob Lober	4	M	SST Retrieval Needs RPP-CR-032 OGT Design E-23 LDMM S-102 [RE23], W-211[RE07], S-112[RE03]	Failure to identify an effective means to prevent reoccurrence of primary line leak will result in negative impacts to the specific operation while a replacement is sought and negative impacts to follow on projects planning use of the HIHTL system if it is deemed unreliable. This is an ongoing risk that increases, as the SSTs get older; acceleration initiatives reduce the risk due to earlier completion of SST retrieval and closure activities.
WT032	Control of Retrieved Waste Dilution	Part Closed and Part Deferred	Faster/Cheaper retrieval from Tanks	2	Dilution control for tank farm retrieval will be done using Coriolis density meters as an operating variable and establish set points by experience. Dilution control for WTP waste feed delivery has not been addressed. EMSP Project 73827, 75896, 81964, and 81889 address diagnostics for physical properties.	Deployment of functional systems for solids content as soon as possible will minimize the cost impacts due to changes in the existing baseline for the retrieval system design. Needed to meet mission closure targets (2033).	Blaine Barton, 376-5118 ORP: Roger Quintero and James F. Thompson, Jr.	2	M	SST Retrieval Needs RPP-CR-032 DST Space Availability RPP-CR-014, CR-070A Sustained Waste Feed Delivery - RPP-CR-040	If solids content is not accurately detected, excessive amounts of water may be used to retrieve SSTs, resulting in DST storage space shortage and mission delays. Out-of-spec feed might be delivered to the WTP, resulting in process delays and increased costs
WT035-S	Moisture Flow and Contaminant Transport in Arid Conditions	Active		1	Activities will be funded next FY. October 2003 USGS meeting at Hanford regarding the postulated no-flow zone. If surface barriers prevent recharge, contaminants will not move to the groundwater. EMSP 73859 and 81908 address silica reactivity in the subsurface.	PBI-3 includes interim closure of tanks, individual tank farms and the 244-AR vault by 9/30/06. Regulators have expressed concern that the conceptual model for moisture flow and contaminant transport through the vadose zone is not understood.	Frank Anderson, 373-3971 Fred Mann, 373-3978 ORP: Phil Lamont, Bob Lober, and Rob Yasek		M	Central Plateau End States & Closure Requirements RPP-CR-041	The initial plan to optimize the timing and sequencing for disposition of excess facilities and remediation of waste sites posing the highest threat to the groundwater is due 5/30/03. If agreement on risk-based end-state strategies and closure requirements cannot be achieved, then closure of 26 tanks by 2007 is at risk.
WT044-S	Distribution of Recharge Rates	Active		1	Activities are funded in FY03 and FY04.	PBI-3 includes interim closure of tanks, individual tank farms and the 244-AR vault by 9/30/06. Regulators have expressed concern that the conceptual model for moisture flow and contaminant transport through the vadose zone is not understood.	Frank Anderson, 373-3971 Fred Mann, 373-3978 ORP: Phil Lamont, Bob Lober, and Rob Yasek		H	Central Plateau End States & Closure Requirements RPP-CR-041	The initial plan to optimize the timing and sequencing for disposition of excess facilities and remediation of waste sites posing the highest threat to the groundwater is due 5/30/03. If agreement on risk-based end-state strategies and closure requirements cannot be achieved, then closure of 26 tanks by 2007 is at risk.
WT046-S	Getter Materials in the Vadose Zone	Inactive		1	No activities funded in FY03 or FY04. POC does not recommend pursuing this at this time. However, subsurface barriers and reactive zones are part of an integral system of engineered and natural barriers that will be required to protect human health and the environment if wastes are proposed for in-place disposal. SBIR project no longer funded.	Data and information regarding the efficacy of subsurface barriers and reactive zones as leak mitigation measures in support of tank waste retrieval and closure activities is needed in the FY04 to FY06 timeframe; and for use by the Hanford Immobilized Low-Activity Tank Waste Performance Assessments, needed by FY05.	Frank Anderson, 373-3971 Fred Mann, 373-3978 ORP: Phil Lamont, Bob Lober, and Rob Yasek		M	SST Retrieval Needs RPP-CR-032 Central Plateau End States & Closure Requirements RPP-CR-041	If subsurface barriers and reactive zones are not accepted by the regulators, the capping options will have to perform better to minimize water infiltration through the wastes, thereby increasing design features and costs for construction and long-term maintenance. Failure to have demonstrated and regulatory accepted subsurface barrier and reactive zone technologies may increase the costs associated with remediation and contamination deep in the vadose zone.
WT053-S	Contaminant Mobility Beneath Tank Farms	Active		1	Activities are funded in FY03 and FY04. This is a priority for ORP, the Groundwater Protection Project, the Office of Science, and the River Corridor Project.	The mission acceleration strategy described in the HPMP and IMAP requires the RPP to overcome several regulatory obstacles: the NEPA process; the WIR Determination process; and Tank Closure permits. A NEPA ROD is scheduled to be issued in April 2004, and WIR	Frank Anderson, 373-3971 Fred Mann, 373-3978 ORP: Phil Lamont, Bob Lober, and Rob Yasek		M	Tank Closure Definition RPP-CR-039	If future NEPA Records of Decision (RODs), Tank Closure Permit decisions, and Waste Incidental to Reprocessing (WIR) determinations are not favorable to the RPP or take more time than planned, then

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					EMSP 86911, 86898, 86984, 86814, and 73758 address the subsurface beneath the tank farms.	Determination Process strategies are currently being developed.					deployment of alternative treatment technologies and tank closures could be impacted, resulting in increased costs, schedule delays, and extension of the RPP mission.
WT054	Mixer Pump Mobilization Performance Prediction (formerly Solids Yield During Mixer Pump Mobilization)	Deferred		2	Not funded. CH2M HILL staff members are tracking ongoing activities at the Savannah River Site as part of Technical Exchanges.	Good predictive tools would allow realistic, yet minimum duration, delivery schedules to be established for delivering sludge to the WTP for HLW vitrification.	Tim Oten, 376-3563 ORP: Cathy Louie		H	DST Space Availability RPP-CR-014, CR-070A Sustained Waste Feed Delivery - RPP-CR-040	If the sludge retrieval efficiency assumed in the CH2M HILL baseline (ranging from 80-95%) is not achieved, then the Ch2M HILL HLW deliveries to the WTP will take longer, or will require additional pumps to be installed and operated.
WT060	Hanford/SRS Waste Mixing Mobilization	Deferred		2	Not funded. CH2M HILL staff members are tracking ongoing activities at the Savannah River Site. Hanford and Savannah River have been cooperating to improved the current mixer pump design and identify suitable alternative technologies. This effort needs to continue, especially regarding emerging SRS mixer pump technology data.	The first waste feed delivery to the WTP will rely on mixer pumps to mobilize the waste.	Tim Oten, 376-3563 ORP: Roger Quintero and James F. Thompson, Jr.	2	H	SST Retrieval Needs RPP-CR-032 Sustained Waste Feed Delivery - RPP-CR-040 Pump Failure - Mixer/Transfer CA-01 PP011-12 TRM-32 TRM-33 W-211[RE20]	If end of pump life cannot be accurately predicted, then pump failure may occur during transfer. If pump seal leakage is significant, then more water may be added to waste and must be accommodated in transfer to WTP. A principal goal of these efforts is to manage the performance risks of the mixer pumps. If a pump fails prior to the end of its predicted lifespan and a replacement pump is not readily available, then waste transfer (from this tank) will be halted.
WT061	Reactive Barriers to Contaminant Migration	Deferred		1	No activities funded in FY03 or FY04. SBIR project no longer funded. POC does not recommend pursuing this at this time. EMSP 86807 addresses passive reactive barriers.	To support planned NEPA process for tank farm closure decisions, data is anticipated to be needed by the end of FY04. To support future low-activity PAs, data is needed by September 2005.	Julian Laurenz, 372-9301 Fred Mann, 373-3978 ORP: Phil Lamont, Bob Lober, and Rob Yasek	1	L	Central Plateau End States & Closure Requirements RPP-CR-041 Tank Closure Definition RPP-CR-039	If key radioactive elements could be trapped or immobilized in the waste matrix, disposal, closed tanks, and/or the soil column, the risk to human health and the environment could be significantly reduced.
WT062	Variable Suction Level Transfer Pump	Deferred		2	Not funded. CH2M HILL staff members are tracking ongoing activities at the Savannah River Site.	If the new generation transfer pump fails to perform as expected, then a variable suction level transfer pump will be needed in order to retrieve waste from tanks to meet retrieval requirements.	Tim Oten, 376-3563 ORP: Roger Quintero and James F. Thompson, Jr.		L	Sustained Waste Feed Delivery - RPP-CR-040	A potentially significant risk may be avoided if transfer pumps could be operated concurrently with mixer pumps to avoid the need for contingency staging space, and avoidance of out-of-spec waste transfers.
WT063	Hanford SST Saltcake Dissolution Retrieval	Active	Faster/Cheaper retrieval from Tanks	2	Selective dissolution studies and saltcake retrieval are actively supported by Supplemental Treatment/Pretreatment. High priority for universities (e.g., FIU/DIAL) to conduct modeling and experiments to improve overall understanding of saltcake dissolution.	Retrieval projects proceeding carrying risks of poor selective dissolution and reduced retrieval efficiency. Selective dissolution during retrieval can result in troublesome separations that can cause the retrieved waste to be out of tank chemistry specifications. Better prediction methods are needed to avoid large chemistry adjustment costs.	Blaine Barton, 376-5118 ORP: Billie Mauss, Jim Thompson, and Roger Quintero		H	SST Retrieval Needs RPP-CR-032 Retrieval Systems CR-064 DST Space Availability RPP-CR-014, CR-070A	If SST retrieval system pilot projects prove unsuccessful, then alternate technologies will be needed with very little time for transitioning to new or old technologies, thus causing potential delays in the SST closure project. If SST retrieval volume is greater than estimated, DST space availability becomes at risk.
WT066	Compositional Dependence of the Long-Term Performance of Glass as a Low-Activity Waste Form	Active		2	CH2M HILL and BNI are both funding activities. EM-50 funding has ceased. EMSP 73859, 81908, 81926, and 81934 addresses waste form stability and silica reactivity in the subsurface.	This work is important for consideration of supplemental waste forms. For use in the 2005 ILAW PA. This work could have a significant impact on increased waste loading. If waste treatment is accelerated as anticipated, this capability would be needed by FY06.	Fred Mann, 373-3978 ORP: Billie Mauss and Bill Hamel		L	Immobilization Waste Package Specification CR-i-03	Because of the extrapolation from short-term tests on a few glass compositions and environments, a significant amount of conservatism will occur. Without improved data, the ILAW disposal system approval process will require the use of overly conservative parameters, resulting in significant project costs..

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WT072	Automation of Tank Farm Field Processes and Wireless Communication	Active		5	SST saltcake retrieval and supplemental treatment/pretreatment projects have taken advantage of the opportunity beginning in FY03 and continuing in FY04. Sharing of the investment cost among multiple projects may allow this improvement to be implemented.	Conventional communication requires significant connection and wiring. With rapid retrievals necessary to meet schedules, the same equipment must be quickly redeployed after a retrieval is completed. Conventional instrumentation must be disconnected and new wiring connected at the new location. Adaptation of wireless communications would reduce the cost and schedule to redeploy retrieval equipment instrumentation.	Tom Moore, 373-6175; Mike Bryden, 373-4624 ORP: Mike Royack		H	SST Retrieval Needs RPP-CR-032 Sustained Waste Feed Delivery - RPP-CR-040	If tank farms continue to lack automation and wireless communication, then Tank Farm Operations will miss an opportunity for increasing efficiency that will be necessary to accommodate higher work loads during SST retrieval, waste feed delivery, and accelerated closure operations. Also, opportunities for cost savings will not be realized.
WT088	Advanced Approaches for Reducing Waste Volume Stored in DSTs	Active	DST available space	2	Preliminary boildown / fractional crystallization studies funded in FY04 by supplemental treatment/pretreatment. Further studies proposed for EM-21 Alternatives Project: low and medium curie salt. EMSP 81935 addresses ion recognition.	Process technologies or scientific advances that will create options for increasing available space in DSTs are needed to ensure optimal retrieval capabilities are available to retrieve SST wastes. Given the current schedule for SST retrieval, it is projected that additional DST space will be needed in ~2010.	Nick Kirch, 373-2380 ORP: Mike Royack		H	DST Space Availability RPP-CR-014, CR-070A SST Retrieval Needs RPP-CR-032	If DST space is not available, then retrieval of SSTs must be delayed or new DSTs must be built.
WT089	Single-Shell Tanks (SSTs) Retrieval with Minimal Water Addition	Active (other funding)	Faster/Cheaper retrieval from Tanks	2	MRS has been selected for SST retrieval with minimal water. MRS technology improvements and issue resolution are high-priority activities that are being funded in FY03 and FY04. Using Office of Science and Technology funding, AEA Technology has developed a power fluidic mixing / retrieval system which will use a limited volume of water. A full-scale prototype system will be tested at the Hanford Cold Test Facility early in FY04.	Resolution of these issues is in progress and may yet require some design changes in the MRS platform in order to ensure successful retrieval of 26 to 40 tanks within limited budgets by the end of FY06. The AEA Technology power fluidic system is considered a backup approach.	Dave Smet, 372-3537; Warren Thompson, 373-8053 ORP: Roger Quintero and James F. Thompson, Jr.	3	H	SST Retrieval Needs RPP-CR-032 Retrieval Systems CR-064	If the baseline MRS technology is unsuccessful, then retrieval schedule commitments will be missed and/or budget needs will exceed available funds. MRS employs high-pressure water to scarify or break up hard wastes, which presents a possibility of creating tank leaks or exacerbating existing leaks, thereby driving contaminants deeper into the vadose zone and possibly into the groundwater beneath the SST farms.
WT090	Chemical Behavior of Sludge Wastes	Closed		-	Focused on leaching. Not part of CH2M HILL scope. Leaching is to be done within the WTP. EMSP 73749, 81962, 81896, and 81940 address reactions and partitioning during tank processing.	Cr separation becomes important in the post-2010 timeframe.	Dan Herting, 373-2532		L	Former Risk CR-624	If Cr could be solubilized through in-tank leaching processes, then the HLW glass waste loading could be increased.
WT091	Chemical and Physical Behavior of Saltcake Wastes	Active	Pumping Slurries	2	High priority for universities (e.g., FIU/DIAL) to conduct modeling and experiments to improve overall understanding.	Retrieval projects proceeding carrying risks of line plugging and reduced retrieval efficiency. Better knowledge of plugging potential and of operational conditions that avoid plugging may permit loosening of restrictive process control requirements.	Dan Reynolds, 373-3115 ORP: Billie Mauss, Roger Quintero and James F. Thompson, Jr.	1	H	SST Retrieval Needs RPP-CR-032	If transfer and consolidation of waste solids causes the waste to behave differently, then new safety analyses and control systems may be required. Negative consequences such as precipitation within piping or processing tanks or excessive waste volume delivered to the DSTs may occur if salt cake dissolution is not better understood.
WT102	Post Retrieval Evaluation: In-Situ Characterization	Active	In-situ tank assay Remote Sampler	1	Off-riser sampling tools are funded FY03 and FY04. Sampling toolbox will be ready by FY04. EMSP 73749, 73778, 81962, 81921, 81988, 81927, 81939, 81967 and 81940 address waste characterization and chemistry during tank processing,(especially ^{99}Tc).	High ROI in terms of reduced sampling and analysis costs, and better residual tank waste inventories estimates to support tank closure decisions.	Ron Calmus, 372-3385 ORP: Bob Lober and Roger Quintero	4	H	Central Plateau End States & Closure Requirements RPP-CR-041 Tank Closure Definition RPP-CR-039 Residual Waste Volume Measurement Tools ATCD[RE24]	If the accuracy of residual waste volume measurement tools is not adequate to assess compliance, then additional tool development / deployment may be required to obtain regulatory acceptance. Current methods are expensive: boring, labor-intensive sampling, and laboratory analyses.

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WT104	Cleanable HEPA Filter	Closed		-	Further evaluation of filter failures shows that the identified technology will not be the solution.	System engineering is evaluating the filter failures and the suspected causes.	Randall Robinson, 373-1236	1	M	Radiation & Contamination CR-011 SST Retrieval Needs RPP-CR-032 Sustained Waste Feed Delivery - RPP-CR-040	If unplanned radiological exposures or releases occur while contaminated equipment is being removed, then installation of retrieval equipment and subsequent feed delivery operations may be delayed. If breather filters continue to fail at the same rate (or higher), operations will miss an opportunity for efficiency increase necessary to accomplish the increased workloads expected to meet SST retrieval, waste feed delivery and accelerated closure.
WT105	Coalescer for Tank Waste in Pits and Airborne Contamination	Deferred		5	No activities underway.	If highly contaminated pits must be accessed in the future or pits with planned workscope are more contaminated than previously thought, technology may be more safe and cost-effective than existing methods.	Dan Niebuhr, 373-4639 ORP: Chris Bosted	2	M	Radiation & Contamination CR-011	If unplanned radiological exposures or releases occur while contaminated equipment is being removed, then installation of retrieval equipment and subsequent feed delivery operations may be delayed.
WT106	Double-Shell Tank (DST) Transfer Piping Non-Destructive Examination (NDE) Tools	Active (other funding)		5	The Center for Nondestructive Evaluation at Iowa State University was awarded EM-50 funds in FY03 for NDE at Hanford.	Transfer line examinations are required to support preparation of the DST integrity assessment report by March 31, 2006, per Washington Department of Ecology Administrative Orders 00NWPKW-1250 and –1251. If transfer piping integrity inspection requirements are not specified and inspection tools are not deployed, then systems may be out of compliance.	Gary Duncan, 376-6008	3	H	DST Space Availability & Integrity RPP-CR-014, CR-070A	DST integrity must be maintained and space saving initiatives must be successful to avoid replanning of the TFC baseline strategy (including possible tank sequencing adjustments and potential construction of new tanks) and support accomplishment of accelerated cleanup initiatives.
WT107	Grab Sampling Dose Reduction	Closed		-	Field development work was completed in FY03.	This work was targeted at reducing dose exposure and simplifying the grab sample operation to meet future sampling requirements.	Roland Brown, 376-9191		L	Radiation & Contamination CR-011	If grab sampling systems are not modified, then sampling operations will miss ALARA opportunities.
WT108	In-Tank Camera and Lighting	Active		5	RFI issued in FY03 for camera equipment Will issue RFP if there is sufficient response to RFI.	Storage, retrieval and closure preparation activities currently require frequent in-tank camera observations. Process efficiencies may be missed due to insufficient lighting for in-tank operations.	Dan Niebuhr, 373-4639 ORP: Roger Quintero	3	M	SST Retrieval Needs RPP-CR-032 DST Space Availability & Integrity RPP-CR-014, CR-070A In-Tank Equipment 659	Current cameras have limitations and only one vendor has been available. If in-tank video fails to operate as required during sluicing, it will need to be replaced at added costs and delays to the project.
WT109	Radiation Survey	Inactive		2	Not funded	Technology is available.	Darin Hekkala, 373-2360 ORP: Roger Quintero	2	M	Radiation & Contamination CR-011	If radiation surveys are not improved for faster survey of large surfaces or by remote survey, then process efficiencies that would accommodate higher workloads during retrieval, WFD, and accelerated closure operations may be missed.
WT111	Remote Tank Wall Repair	Closed		-	Per the POC, vendors available to perform work if needed.	If no tank wall remote repair capability is available, then any tank failure will result in taking the tank out of service. While the probability of this is estimated as low, the consequence to mission completion is high.	Gary Duncan, 373-7606	3	H	DST Space Availability RPP-CR-014, CR-070A	DST integrity must be maintained and space saving initiatives must be successful to avoid tank sequencing adjustments and potential need for additional DSTs.
WT112	Chemical Dissolution of Water Insoluble Wastes from Single-Shell Tanks (SSTs)	Deferred	Faster/Cheaper retrieval from Tanks	2	C-106 will use oxalic acid. Wait to determine performance in C-106 before deciding priority of additional development.	Essentially all tanks contain some insoluble material, but dissolution must be compatible with carbon steel tanks.	Blaine Barton, 376-5118 ORP: Roger Quintero and James F. Thompson, Jr.		L	SST Retrieval Needs RPP-CR-032 DST Space Availability RPP-CR-014, CR-070A	If only water is used to solubilize the waste, then the lesser soluble components will be left behind and retrieval targets cannot be achieved. If enough water is used to solubilize the low-solubility wastes, then the DST space will be insufficient to maintain retrieval rates.

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WT113	Selective Chemical Species Removal	Active		3	Separation of Tc has been dropped as a priority (pending regulatory approval). Separation of Sr and I are alternatives to WTP processing. Such processing is not part of CH2M HILL scope. Monitoring Tc and I content on Tanks S112, S102, and S103 is planned by Supplemental Treatment/Pretreatment Project in FY04. EM-21 may fund selective dissolution, fractional crystallization, pretreatment studies in FY04-06.	The tanks contain several elements that cause subsequent processing difficulty and limitations. Technetium is the major contributor to ILAW glass risk assessment. Iodine causes melter offgas problems. Strontium can be complexed by organics and be difficult to separate in the WTP.	Ken Gasper, 373-1948	2	L	SST Retrieval Needs RPP-CR-032	If selected elements can be separated during tank retrieval, then subsequent processing can be less difficult and less expensive.
WT115	Technology to Support Post-Retrieval Evaluation of SSTs	Active	Non-contact surface level measurement Assay tanks	1	Activities are funded FY03 and FY04.	If a reliable technique for quantitatively measuring the residual waste volume and concentrations of mobile, long-lived contaminants of concern in the tanks is not available, then the PBI related to accelerated tank cleanup and closure and the TPA retrieval schedule may be jeopardized,. Also, the inability to characterize tank waste residuals may necessitate expensive retrieval of residuals if waste reclassification cannot be performed.	Ron Calmus, 372-3385 ORP: Bob Lober and Roger Quintero	4	H	SST Retrieval Needs RPP-CR-032 Central Plateau End States & Closure Requirements RPP-CR-041 Tank Closure Definition RPP-CR-039	If sampling redesign (e.g., in the sampling equipment) is required, then the redesign will impact schedule and require added costs.
WT116	VOC Treatment and Monitoring	Closed	Tank vapor emissions	5	Most recent documented analysis of this concern indicates that no new technology will be necessary.	CH2M HILL continues to evaluate methods to reduce and detect tank farm vapor emissions.	Markus Hughey, 373-2874 ORP: Andy Stevens		M	Radiation & Contamination CR-011 AOP Compliance C104_RE-48, 664	If a tank farm event requires the use of respiratory protection in the farm (e.g., organic vapor release), then construction, testing, and retrieval operations could be impacted, adding to cost and schedule duration.
WT123	CAMs Reliability	Active		5	Partially funded. Installing alternative vacuum pumps for CAMs. Improvements to existing electronics or finding new, more reliable CAMs is not funded.	Technology is available, but process efficiencies may be missed from more time spent fixing CAM systems. POC recommends more vendor outreach for CAM equipment.	Mark Roberts, 376-4852 ORP: Dennis Irby		H	Radiation & Contamination CR-011 AOP Compliance C104_RE-48, 664	If a tank farm event requires the use of respiratory protection in the farm (e.g., organic vapor release), then construction, testing, and retrieval operations could be impacted, adding to cost and schedule duration.
WT124	Replace Annulus Monitoring Flake Boxes with Newer Technology	Inactive		5	Not funded	Existing Flake Boxes are expensive to operate and maintain (labor intensive). Newer electronic (possibly with wireless remote reading) could be more cost effective.	Craig Jorgensen, 373-6593 ORP: Vic Callahan		L	DST Space Availability & Integrity RPP-CR-014, CR-070A Tank Integrity DST PP-011-05	Double Shell Tank integrity must be maintained and space saving initiatives must be successful to avoid replanning of the TFC baseline strategy (including possible tank sequencing adjustments and potential construction of new tanks) and support accomplishment of accelerated cleanup initiatives. If a DST primary tank fails (as indicated by a major annulus leak), then the tank will have to be pumped into another tank, resulting in a potential severe shortage of tank space and major impacts to WTP feed delivery cost and schedule.

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WT125	Interstitial Liquid Level Measurement in SSTs	Inactive	Non-contact surface level measurement	5	Currently, scans are obtained using mobile units equipped with a probe. A fixed array of sensors in the tanks is proposed that gives continuous output rather than the mobile van that only scans on a periodic basis. The fixed array would be powered with solar energy, and the measurements would be sent out with radio waves, so there is no need to run wires. MSU-DIAL has proposed, and RPP has supported the proposal for using cooperative agreement funds to investigate new concepts to address this need in FY04.	The technology for a continuous, wireless method is available. The solution will be less costly to operate, but the upfront costs may be prohibitive. Economic evaluation is required.	David Barnes, 373-3667 ORP: Andy Stevens		M	SST Integrity RPP-CR-035; CR-084	If a Single Shell Tank (SST) has significant leakage, then overall TFC baseline strategy may have to be reconsidered (including possible tank sequencing adjustments) to accommodate different retrieval methods and to limit the amount of leakage.
WT126	Line Unplugging/Plug Location	Closed for SSTs/ Deferred for DSTs	Tool box for plugged lines	2	SSTs will use HIHTL and plugging is not considered catastrophic (mitigation: replace the line). DSTs retain concerns for pipeline plugging but are not currently actively funding solutions.	If the waste viscosity is higher than predicted, then plugging may occur in the lines. If particle size exceeds 700 microns, then equipment and lines could plug. If a pipeline plugs, then the line will no longer be available to support retrieval and waste feed delivery. Significant mission delays and cost increases from system down time and either unplugging activities or line replacement will result.	Tim Oten, 376-3563 ORP: Roger Quintero		H	Sustained Waste Feed Delivery - RPP-CR-040 Line Plugging TRM-10, S-102 [RE28], TRM-14, TRM-12, C104_RE-57	If the transfer line plugs, then transfer ceases and adversely impacts schedule and the ability to support the WFD mission.
WT127	Maintenance Tracking System	Active		5	Funded in FY03. The JCS system will be Windows-based in September 2003. This will enable tracking and trending of preventative maintenance and corrective maintenance. The new Windows-based version will include tracking identifiers for pieces of equipment. The effectiveness is uncertain, since it has not been fully implemented.	Unknown until system effectiveness is proven. Without system, the TFC will be less likely to catch components before they fail.	David Braun, 373-6799 ORP: Mike Royack		L	Sustained Waste Feed Delivery - RPP-CR-040 Equipment failures C104_RE-15; PP007-02 PP007-03; PP011-11; PP013-01;PP025-03	If equipment failures occur, then tank farms will potentially be out of compliance with environmental monitoring requirements requiring alternative monitoring procedures that are more labor intensive and a delay in feed delivery could occur, along with major programmatic impacts.
WT128	Develop/Find Predictive Maintenance Tools	Closed		-	Funded in FY03. The technology is in the field. Shock pulse monitoring reports are generated quarterly. The equipment and procedures are on hand for full-scale vibration analysis and thermography.	None. Project completed.	David Braun, 373-6799	2	M	Sustained Waste Feed Delivery - RPP-CR-040	If equipment failures occur, then tank farms will potentially be out of compliance with environmental monitoring requirements requiring alternative monitoring procedures that are more labor intensive and a delay in feed delivery could occur, along with major programmatic impacts.
WT129	Spray-on Shielding	Deferred		5	Issues have been resolved for mission work currently defined. No driver to continue pursuit of alternate technologies in this area.	If highly contaminated pits must be accessed in the future or pits with planned work scope are more contaminated than previously thought, remote technology may be more safe and cost-effective than existing methods.	John W. Hobbs, 373-8676	4	M	Radiation & Contamination CR-011	If unplanned radiological exposures or releases occur while contaminated equipment is being removed, then installation of retrieval equipment and subsequent feed delivery operations may be delayed. Appropriate attention to worker safety enables sustained HLW feed delivery and accelerated SST retrieval.
WT130	Asbestos Encapsulation for Insulation Removal	Closed		-	Asbestos encapsulation was viewed as not justifying resources, since current technologies are acceptable and the scale of asbestos removal planned would not result in any measurable return on the investment that would be required.	If drivers exist in the future, alternate technology may be available, but it will not have been tested.	John W. Hobbs, 373-8676		L	Radiation & Contamination CR-011	A method that would allow facility deactivation workers to remove asbestos insulation in high-dose areas could save time and worker dose exposure and avoid the need to set up glove bags or treat the whole room as an asbestos area.
WT131	Contamination Lock-Down Surface Coating	Deferred		5	Issues have been resolved for mission work currently defined. No driver to continue pursuit of alternate technologies in this area at this time. The baseline strategy is to avoid work in highly contaminated pits.	If drivers exist in the future, alternate technology may be available, but will need to be tested/validated.	John W. Hobbs, 373-8676	3	H	Radiation & Contamination CR-011	If unplanned radiological exposures or releases occur while contaminated equipment is being removed, then installation of retrieval equipment and subsequent feed delivery operations may be delayed.

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WT132	Deactivate Inactive Systems in DST/SSTs	Closed		-	Work completed with baseline funding in FY03.	Deactivations will take place from FY03 until FY08.	Kathleen Tollefson, 373-9120		-		
WT133	Improved DST Integrity NDE Tools: Electromagnetic Acoustic Transducer (EMAT)	Active (other funding)	DST inspection at top knuckle and above	5	The Center for Nondestructive Evaluation at Iowa State University was awarded EM-50 funds in FY03 for NDE at Hanford.	Washington Administrative Code 173-303-640 (2) (c) (v) requires a physical examination or leak test as a part of an integrity assessment program. Tank integrity evaluations will be based on much smaller surface areas. If NDE tools that cover larger surfaces are not implemented, then the representativeness of the measurement may be questionable.	Jim Castleberry, 373-5011 ORP: Vic Callahan		H	DST Space Availability & Integrity RPP-CR-014, CR-070A	DST integrity must be maintained and space saving initiatives must be successful to avoid replanning of the TFC baseline strategy (including possible tank sequencing adjustments and potential construction of new tanks) and support accomplishment of accelerated cleanup initiatives.
WT134	DST Instrument Gauge Upgrades	Active		5	Baseline funding included in FY04 for AZ Farm Planning and Upgrades including Westronics Replacement, Thermocouple Repair, Actuator Valves, Electrical Load Walk Down Study, and HEPA Filter Evaluation.	The upcoming AZ Tank Farm Upgrades, and subsequent tank farm upgrades, will offer opportunities for implementing enhanced systems, as opposed to like-for-like replacements of older generation systems.	Kathleen Tollefson, 373-9120 ORP: Cathy Louie		M	DST Space Availability & Integrity RPP-CR-014, CR-070A	DST integrity must be maintained and space saving initiatives must be successful to avoid replanning of the TFC baseline strategy (including possible tank sequencing adjustments and potential construction of new tanks) and support accomplishment of accelerated cleanup initiatives.
WT135	Response to Potential Line Leak	Closed for SSTs/ Deferred for DSTs		5	CH2M HILL uses hose-in-hose transfer lines almost exclusively for SSTs and a better leak detector is not perceived as a current need. HIHTL works, is accepted and understood by Operations, and the Safety Basis covers its use.	If an existing underground transfer line begins to leak, code requires that it be repaired and equipped with secondary containment before it can be returned to service.	Warren Thompson, 372-8053	3	M	SST Retrieval Needs RPP-CR-032 Sustained Waste Feed Delivery - RPP-CR-040	If an existing underground transfer line is used and begins to leak, there would likely be a significant delay before an alternate transfer line is available. There would also be cleanup costs.
WT136	Installation of New Risers in SSTs (Single-Shell Tanks)	Inactive	Install new risers on existing SSTs	2	Not funded. Mobile Retrieval System (MRS) needs a 36-inch riser installed in T-110 during FY04 and will need other riser installations during the current contract period.	Might not be able to deploy retrieval equipment due to plugged risers or lack of large enough risers.	John Schofield, 373-2245 ORP: Roger Quintero	2	H	SST Retrieval Needs RPP-CR-032	If retrieval equipment requires larger risers than exist in some SSTs, then new, larger risers will need to be installed in those tanks, which may impose new Authorization Basis issues in dome-loading capacity due to cutting rebar.
WT137	Removal/Decontamination of In-tank Equipment	Inactive	Ancillary equipment (in tank assay)	2	Will be reconsidered when a retrieval or closure project needs improved technology.	If contaminated equipment needs to be removed or decontaminated to permit required DST upgrades for Waste Feed Delivery and to achieve SST retrieval criteria, cost-effective approaches may not be available to do the work.	Warren Thompson, 372-8053 ORP: Cathy Louie	2	L	Central Plateau End States & Closure Requirements RPP-CR-041 Availability of LLCE Equipment W-211 [RE03], 848	Construction of retrieval systems requires removal of long-length contaminated equipment (LLCE). The existing LLCE support equipment has not been maintained.
WT138	Physical Behavior of Sludge Wastes	Active	Pumping Slurries	2	An expert panel prepared a list of recommendations for piping design. An action plan has been prepared to address the recommendations.	If all of the credible potential plugging scenarios are not sufficiently mitigated, then overly conservative transfer designs must be assumed to assure that lines do not plug. If the waste chemistry or properties are different than planned, then new safety analysis and systems may be required.	Larry Julyk, 376-4608 ORP: Roger Quintero and James F. Thompson, Jr.		M	Sustained Waste Feed Delivery - RPP-CR-040 Line Plugging TRM-10, S-102 [RE28], TRM-14, TRM-12, C104_RE-57	If the transfer line plugs, then transfer ceases and adversely impacts schedule and the ability to support the WFD mission.
WT139	Best-Basis Inventory Improvement	Active		2	Findings from ORP assessment are to be addressed. An action plan has been developed to address "findings"	If the best basis inventory is significantly inaccurate, then waste feed may be out of specification and returned to the tank farm, or the tank farm will have to increase sampling to ascertain feed composition. Closure plans currently estimate that five samples will need to be taken from each tank to ascertain its contents for closure.	Jim Field, 372-3753 ORP: Cathy Louie	2	H	Sustained Waste Feed Delivery - RPP-CR-040 Central Plateau End States & Closure Requirements RPP-CR-041 BBI Characterization TRM-25	If uncertainty regarding the waste characterization data and the best basis inventory is not reduced, then waste feed to the WTP may be rejected If BBI were more accurate, fewer samples could be needed to verify closure plans.

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WT140	Post-Closure Monitoring	Active		1	LDMM and cone penetrometer work is funded in FY03 and FY04. EMSP 86759 and 87023address long term monitoring.	Substantial cost savings could result if site characterization activities could be performed without installing monitoring wells and the need to conduct full-suite lab analyses on soil samples.	Frank Anderson, 373-3971 Fred Mann, 373-3978 ORP: Bob Lober and Rob Yasek	1	L	Central Plateau End States & Closure Requirements RPP-CR-041	Current methods include costly boring, labor-intensive sampling, and lab analyses. If post-closure monitoring must be met using monitoring wells, the costs will be unacceptable.
WT141	Development and Demonstration of Bulk Vitrification Treatment Technology	Active		3	Work is funded and underway in FY03. A supplemental technology downselect will be made during the 4th quarter of FY03. If Bulk Vitrification is selected for further work, work will be funded in FY04.	If this is not funded, the ability to complete waste treatment by December 2028 would be put in jeopardy.	Dennis Hamilton, 376-2423 ORP: Billie Mauss	1	H	Availability of Supplemental LAW Treatment Capacity RPP-CR-036	If supplemental LAW treatment capability is not available (development, NEPA documentation, design, regulatory permits, and construction) in time to begin LAW treatment in 2010, then the TPA Milestone for completing tank waste treatment in 2028 is in jeopardy, and additional costs and schedule impacts will occur. Development and implementation of supplemental LAW treatment capacity will allow the RPP to complete tank waste treatment in 2028 and support completion of the Hanford cleanup mission in 2035.
WT142	Cast Stone	Active		3	Work is funded and underway in FY03. A supplemental technology downselect will be made during the 4th quarter of FY03. If cast stone is selected for further work, CH2M HILL will fund it in FY04.	If this is not funded, the ability to complete waste treatment by December 2028 would be put in jeopardy.	Kenneth Gasper, 373-1948 ORP: Billie Mauss	1	H	Availability of Supplemental LAW Treatment Capacity RPP-CR-036	If supplemental LAW treatment capability is not available (development, NEPA documentation, design, regulatory permits, and construction) in time to begin LAW treatment in 2010, then the TPA Milestone for completing tank waste treatment in 2028 is in jeopardy, and additional costs and schedule impacts will occur. Development and implementation of supplemental LAW treatment capacity will allow the RPP to complete tank waste treatment in 2028 and support completion of the Hanford cleanup mission in 2035.
WT143	Tank Waste Denitration	Deferred		3	The value of denitration depends upon whether cast stone is selected for a supplemental treatment option. A supplemental technology downselect will be made during the 4th quarter of FY03. If cast stone is selected for further work, CH2M HILL will fund it in FY04.	WT142 Containerized Cast Stone is the only supplemental treatment option that would significantly benefit from a denitration technology. The priority of denitration depends greatly on the results of the supplemental treatment downselection and the reasons. A denitration option cannot be selected to affect the selection of the preferred supplemental treatment alternative.	Michael E. Johnson, 372-3628		L	Availability of Supplemental LAW Treatment Capacity RPP-CR-036	If supplemental LAW treatment capability is not available in time to begin LAW treatment in 2010, then the TPA Milestone for completing tank waste treatment in 2028 is in jeopardy, and additional costs and schedule impacts will occur.
WT144	Fractional Crystallization	Active		3	Fractional crystallization is considered a pretreatment option for medium-curie salt treatment. Preliminary boildown/fractional crystallization studies funded in FY04 by Supplemental Treatment/Pretreatment. Further studies proposed for EM-21 Alternative Project Low and Medium Curie Salt.	Fractional crystallization, in conjunction with selective dissolution and supplemental treatment immobilization will reduce the amount of retrieved salt cake waste that must go to DSTs.	Kayle Boomer, 372-3629 ORP: Billie Mauss and James F. Thompson, Jr.		L	DST Space Availability RPP-CR-014, CR-070A SST Retrieval Needs RPP-CR-032 Alternative TRU/LLW Treatment Technologies RPP-CR-037	The sooner demands on DST space by SST retrieval can be minimized, the less the constraint on SST retrieval, helping to enable the retrieval of 26 tanks by 9/05 and 40 by 9/06.

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WT145	Qualify Steam Reforming Process for LAW Treatment	Deferred		3	Evaluation activities funded in FY03. Currently unfunded and no activities underway. A supplemental technology downselect will be made during the 1st quarter of FY04. If steam reforming is selected for further work, CH2M HILL will fund it in FY04.	If this is not pursued, the risk is still minimal if bulk vitrification (WT141) and/or cast stone (WT142) are selected for further development.	Michael E. Johnson, 372-3628 ORP: Billie Mauss		H	Availability of Supplemental LAW Treatment Capacity RPP-CR-036	If supplemental LAW treatment capability is not available (development, NEPA documentation, design, regulatory permits, and construction) in time to begin LAW treatment in 2010, then the TPA Milestone for completing tank waste treatment in 2028 is in jeopardy, and additional costs and schedule impacts will occur. Development and implementation of supplemental LAW treatment capacity will allow the RPP to complete tank waste treatment in 2028 and support completion of the Hanford cleanup mission in 2035.
WT146	Sulfate Removal	Active (other funding)		3	Included as part of EM-50 project for pretreatment of medium curie salt.	The current baseline is to vitrify all the LAW into ILAW at the WTP, but the presence of sulfate increases that vitrification volume by ~35% for the 68 SSTs.	Kayle Boomer, 372-3629 ORP: Billie Mauss, Bill Hamel, and Diane Clark		L	SST Retrieval Needs RPP-CR-032 DST Space Availability RPP-CR-014, CR-070A Availability of Supplemental LAW Treatment Capacity RPP-CR-036	If a sulfate separation technology is not developed or another treatment technology employed to process the high-sulfate waste, then significantly more glass will need to be processed through the WTP, taking more time and increasing costs.
WT147	TRU Treatment Technology	Active		3	RFI and RFP for TRU packaging were issued in FY03. Contract award pending.	Failure to develop and deploy alternative TRU and LLW tank waste treatment technologies outside the WTP would require their treatment and immobilization using the WTP vitrification systems or the supplemental LAW treatment processes. This would extend the final tank waste treatment to later than 2028 and affect the mission completion date. The IMAP states that the TRU and LLW tank wastes are to be retrieved and dispositioned by the end of 2006. A decision on the technical feasibility and likelihood of regulatory approval is planned by September 2003 so work on technology selection and development can be conducted starting in early FY04.	Rick Tedeschi, 376-6018 ORP: Rob Yasek	1	H	Alternative TRU/LLW Treatment Technologies RPP-CR-037	If field demonstrations of alternative treatment technologies, including TRU and LLW tank waste treatment, are unsuccessful (regulator disapproval, technology failure), then the TPA milestone for completing tank waste treatment is in jeopardy and additional costs and schedule delays may occur. Development and implementation of alternative LLW and TRU tank waste treatment capacity will allow the RPP to complete tank waste treatment in 2028 and support completion of the Hanford cleanup mission in 2035.
WT148	Sluicing Enhancement and Cost Reduction	Active	Faster/Cheaper retrieval from Tanks	2	Aggressive project activity funded. In order to ensure successful retrieval of 26 to 40 tanks within limited budgets by the end of FY06, alternative readily-available technologies or different implementation approaches for sluicing are needed as backups.	If enhanced sluicing cannot achieve the extent of retrieval required by the TPA, or if sluicing costs cannot be reduced as much as needed, then retrieval schedule commitments will be missed and/or budget needs will exceed available funds.	Warren Thompson, 372-8053 ORP Roger Quintero and James F. Thompson, Jr.	5	H	SST Retrieval Needs RPP-CR-032 Retrieval Systems CR-064 Sustained Waste Feed Delivery - RPP-CR-040	If SST retrieval system pilot projects prove unsuccessful, then alternate technologies will be needed with very little time for transitioning to new or old technologies, thus causing potential delays in the SST closure project. Also, this could eventually impact the WFD to WTP if a backup waste feed source is needed to meet waste feed delivery requirements.
WT149	Transport of SST Waste with Little Water	Active		2	Funded. EMSP Project 73827, 73896, 81964 address diagnostics for physical properties.	Transfer systems readily available and suitable for sludge/salts in dry and wet conditions are needed.	Warren Thompson, 372-8053 ORP: Roger Quintero and James F. Thompson, Jr.	1	H	SST Retrieval Needs RPP-CR-032	If effective transport techniques for SST wastes retrieved with minimal water addition are not implemented, then shortages of DST storage space will result in SST retrieval delays.
WT150	Characterization of Waste Inventory in Ancillary Equipment	Active	Ancillary equipment (pipelines) waste inventory	1	Minimal funding in FY03. Fieldwork will be funded in FY04. This topic has also been discussed with Florida International University for possible attention in FY04.	Presently there are no methods or tools to develop reliable estimates of waste inventory in ancillary equipment. Decision on ancillary equipment remediation as part of final tank farm closure will depend on estimated waste inventory and calculated risk consequences of residual waste in such equipment.	Frank Anderson, 373-3971 Mike Connelly, 373-3981 ORP: Bob Lober		L	Central Plateau End States & Closure Requirements RPP-CR-041 Tank Closure Definition RPP-CR-039	Lack of ability to characterize waste inventory in ancillary equipment could result in excessive conservatism in estimating inventory and performing risk assessment, leading to higher costs for retrieval and closure.

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WT151-S	Getter Materials for Tank Fill	Active		1	Activities are funded in FY03 and FY04.	If the regulators do not accept a subsurface barrier, the capping options will be rejected, thus requiring more expensive remediation methods. To support planned NEPA process for tank farm closure decisions, data is anticipated to be needed by the end of FY04. To support future low-activity PAs, data is needed by September 2005.	Julian Laurenz, 372-9301 ORP: Phil Lamont, Bob Lober, and Roger Quintero	2	M	Central Plateau End States & Closure Requirements RPP-CR-041 Tank Closure Definition RPP-CR-039	If key radioactive elements could be trapped or immobilized in the waste matrix, disposal, closed tanks, and/or the soil column, the risk to human health and the environment could be significantly reduced.
WT152	Supplemental Pretreatment Technologies	Active		3	Included as part of EM-50 project for pretreatment of medium curie salt and as support to saltcake waste retrieval from Tanks S112, S102, and S103. EMSP Projects 73803, 74019, 73748 address extractants for separation.	Allows medium curie feed from SST salt cake retrieval to be immobilized by supplemental treatment facilities before the WTP pretreatment facility is on-line, and also supplements WTP pretreatment facility when it is on-line to shorten the time to complete tank retrieval, treatment and closure.	Kayle Boomer, 372-3629 ORP: Billie Mauss	2	H	SST Retrieval Needs RPP-CR-032 DST Space Availability RPP-CR-014, CR-070A Alternative TRU/LLW Treatment Technologies RPP-CR-037	The sooner demands on DST space by SST retrieval can be minimized, the less the constraint on SST retrieval, helping to enable the retrieval of 26 tanks by 9/05 and 40 by 9/06.
WT153	Transport of Packaged and Bulk Waste	Deferred		3	Not funded. No activities underway. May pursue through technical exchanges (e.g., with Rocky Flats). Technical Challenge Sheet No. 23 made available to vendors (two responses received). Should be considered in analysis of supplemental treatment deployment.	Completing tank waste treatment may cost more if life-cycle cost of constructing and employing "traditional" transport infrastructure (transfer lines, etc.) exceeds cost of implementing alternate methods for moving certain wastes.	Stewart Mackay, 372-3634 ORP: Billie Mauss	2	M	Availability of Supplemental LAW Treatment Capacity RPP-CR-036	The sooner supplemental technologies can be deployed and operated, reduces the required throughput capacity to allow the RPP to complete tank waste treatment in 2028.
WT154	Alternative Waste Streams	Deferred		3	Not funded. No activities underway. As part of the process for finalizing and implementing the treatment baseline (particularly for supplemental LAW treatment as well as TRU and LAW treatment), CH2M HILL should undertake an effort to classify wastes according to waste characteristics that drive processing and disposal.	Completing tank waste treatment may cost more if the baseline is selected and implemented without adequate consideration of how waste characteristics (e.g., the volumes and required treatment for various types of wastes) would impact the technology selection as well as the size and configuration of the treatment facilities.	Kayle Boomer, 372-3629 ORP: Billie Mauss		M	Availability of Supplemental LAW Treatment Capacity RPP-CR-036	If supplemental LAW treatment capability is not available (development, NEPA documentation, design, regulatory permits, and construction) in time to begin LAW treatment in 2010, then the TPA Milestone for completing tank waste treatment in 2028 is in jeopardy, and additional costs and schedule impacts will occur. Development and implementation of supplemental LAW treatment capacity will allow the RPP to complete tank waste treatment in 2028 and support completion of the Hanford cleanup mission in 2035.
WT155	Alternative Glasses for Hanford	Deferred		3	Not funded. No activities underway. If, as a result of the FY03 supplemental treatment downselect, a decision is made to pursue bulk vitrification, production of alternate glasses (e.g., iron phosphate glasses) that would allow higher waste loading (and thereby reduce the volume of immobilized LAW) should be evaluated. As part of long-term plans for HLW immobilization improvements, production and qualification of high-waste-loading multi-phase glasses that would reduce the volume of immobilized HLW should be evaluated. EMSP Project 73976 addresses alternative glasses.	Completing tank waste treatment may cost more if potential improvements in waste loading are not exploited. High waste loadings achievable with iron phosphate glasses could result in shorter time to complete the Hanford mission, and significant life-cycle cost savings.	Kayle Boomer, 372-3629 ORP: Bill Hamel		L	Availability of Supplemental LAW Treatment Capacity RPP-CR-036	If supplemental LAW treatment capability is not available (development, NEPA documentation, design, regulatory permits, and construction) in time to begin LAW treatment in 2010, then the TPA Milestone for completing tank waste treatment in 2028 is in jeopardy, and additional costs and schedule impacts will occur. Development and implementation of supplemental LAW treatment capacity will allow the RPP to complete tank waste treatment in 2028 and support completion of the Hanford cleanup mission in 2035.

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WT156	Re-use of Existing Facilities	Deferred		3	Not funded. No activities underway. As the treatment baseline is finalized and implemented (particularly for supplemental LAW treatment as well as TRU and LAW treatment), opportunities for use of existing facilities should be analyzed as part of deployment planning.	Completing tank waste treatment may cost more if new facilities are constructed when existing facilities might be utilized for certain limited-scope operations such as use of the 242A evaporator / crystallizer for supplemental treatment.	Stewart Mackay, 372-3634		L	Availability of Supplemental LAW Treatment Capacity RPP-CR-036	If supplemental LAW treatment capability is not available (development, NEPA documentation, design, regulatory permits, and construction) in time to begin LAW treatment in 2010, then the TPA Milestone for completing tank waste treatment in 2028 is in jeopardy, and additional costs and schedule impacts will occur. Development and implementation of supplemental LAW treatment capacity will allow the RPP to complete tank waste treatment in 2028 and support completion of the Hanford cleanup mission in 2035.
WT157	Strategy for Long-Term Performance Testing and Comparison of Performance For Different Waste Forms	Active		3	CH2M HILL has a draft strategy under review, which will be updated after the supplemental treatment technology downselect. Funds will be spent in FY04.	Critical to CH2M HILL, especially development of new accelerated tests that can account for cast stone aging in Hanford-specific conditions (assuming that cast stone is down-selected). Extrapolating short-term tests on borosilicate glasses to long-term performance results must be modified to include other waste forms under consideration.	Fred Mann, 373-3978 ORP: Phil Lamont and Billie Mauss	1	H	Immobilization Waste Package Specification CR-i-03	The long-term performance of a final disposed waste form has a significant impact on the ability of a disposal system to maintain future exposures within acceptable limits.
WT158	Tailored Disposal Systems	Active		3	There is a limited funding in FY03. Activities will be funded in FY04 after the supplemental treatment technology downselect.	Critical to CH2M HILL. Disposal system enhancements must be identified and have demonstrated promise to be considered during the technology downselection process.	Fred Mann, 373-3978 ORP: Phil Lamont and Billie Mauss	2	H	Immobilization Waste Package Specification CR-i-03	The long-term performance of a final disposed waste form has a significant impact on the ability of a disposal system to maintain future exposures within acceptable limits. If the combined waste form/disposal system doesn't sufficiently retain contaminants of concern, then the supplemental treatment cannot be used.
WT159	Remote Pit Cleanout and Riser Preparation	Deferred		5	Hose-in-hose transfer lines with junction boxes on the surface are being used now.	If a pit or riser cannot be used because of contamination or obsolete equipment in the way, then alternative contingency plans may be expensive and time-consuming, hindering CH2M HILL's ability to achieve the aggressive schedule defined in the IMAP.	Warren Thompson, 372-8053 ORP: Mike Royack	2	M	Pit Condition RPP-CR-034 Radiation & Contamination CR-011	Knowledge about the physical condition of pits to be upgraded needs to be improved so that plans for repairs and upgrades are credible. If unplanned radiological exposures or releases occur while contaminated equipment is being removed, then installation of retrieval equipment and subsequent feed delivery operations may be delayed.

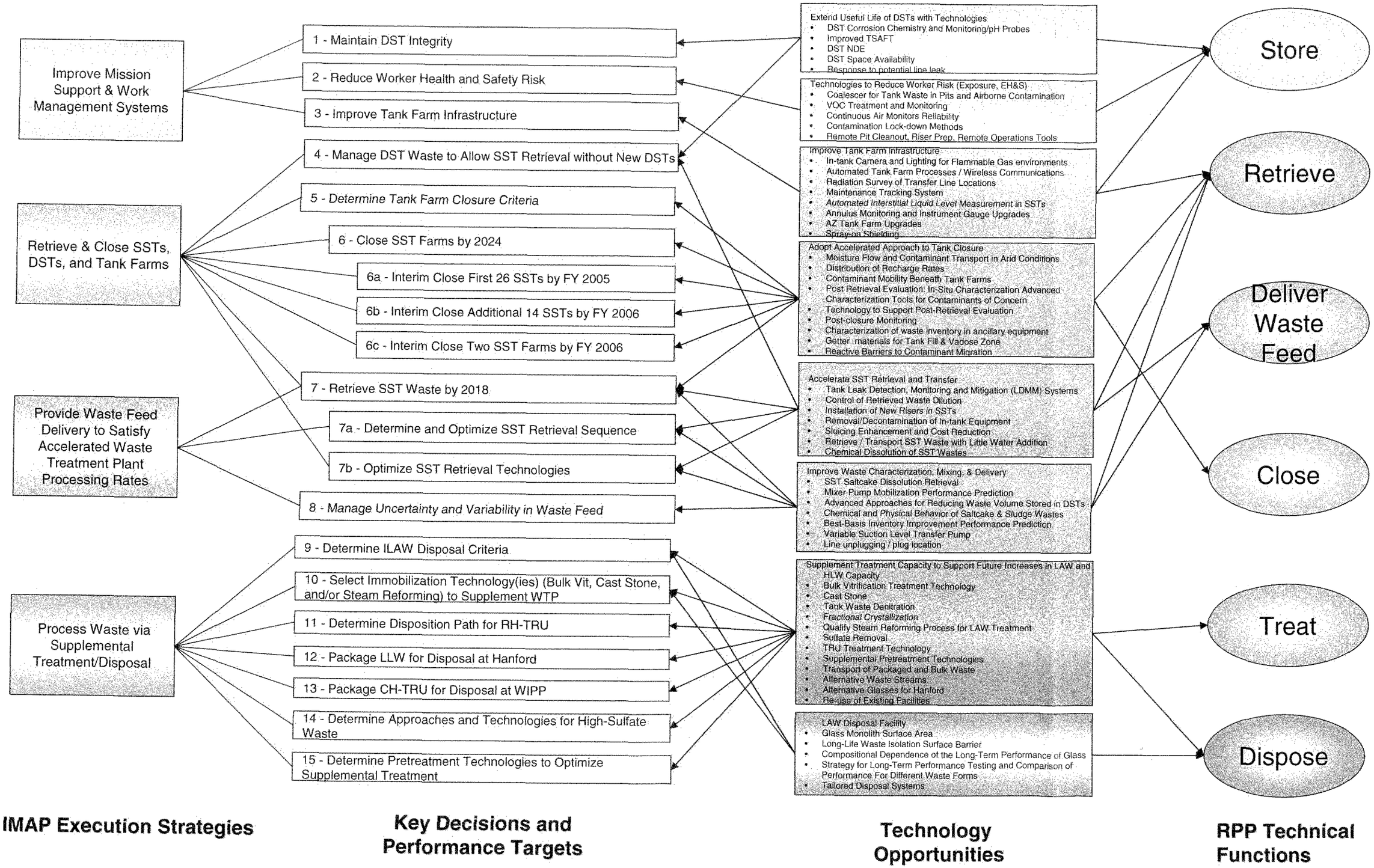

Figure 5.1. Relationship of Technology Opportunities to Key Decisions / Performance Targets, IMAP Strategies, and RPP Functions

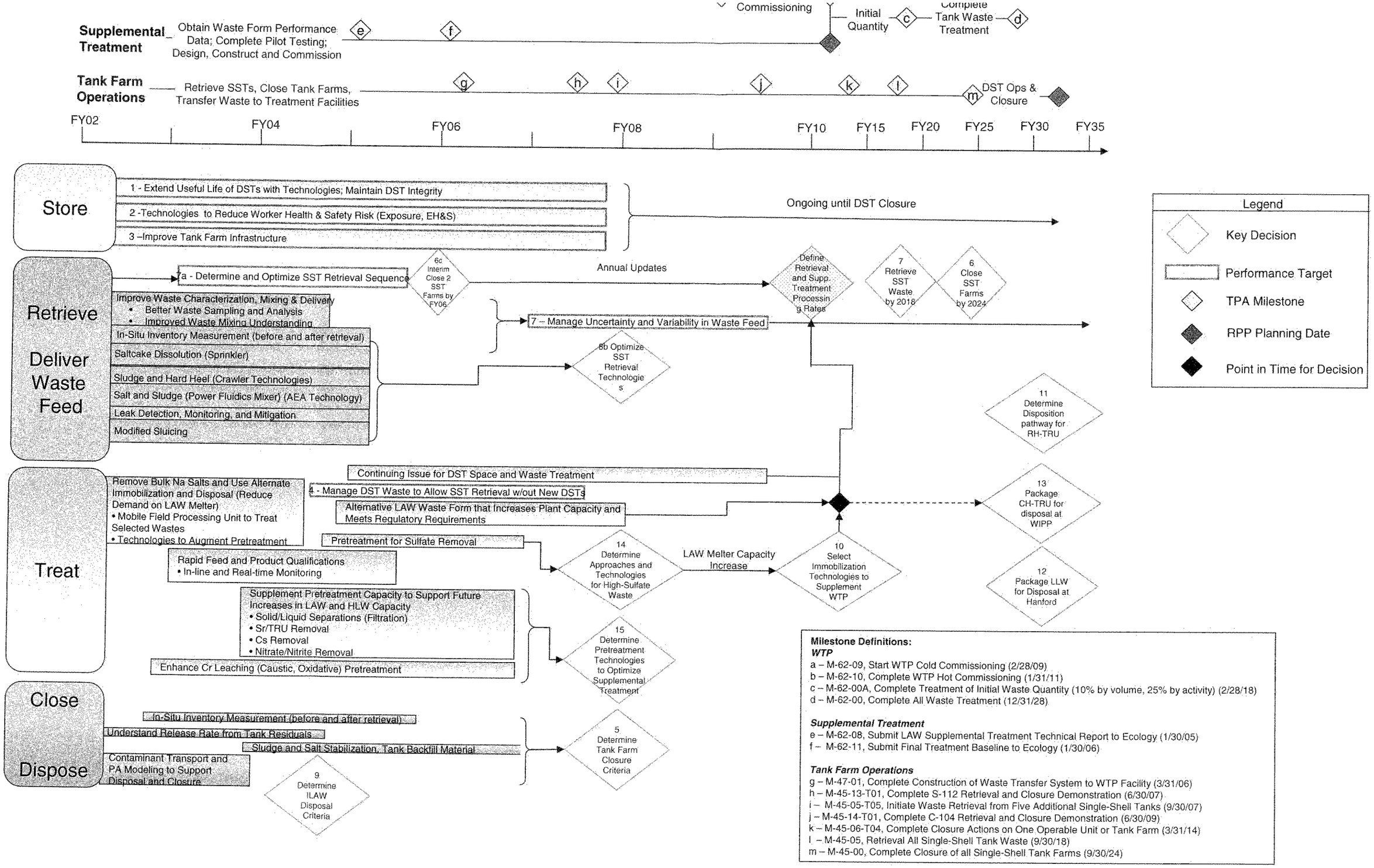

Figure 5.2. Roadmap schedule for Key Decisions/ Performance Targets and Technology Opportunities

6.0 Technology Gap Analysis

This section provides an analysis of technology gaps that could adversely impact successful completion of the IMAP execution strategies. The technology gap analysis identifies key areas where investment may be needed, but where no CH2M HILL technology investment is being made or planned. It uses the technology opportunity disposition, data crosswalk and roadmapping efforts to provide information on the slate of technologies being funded and the role technology opportunities play in helping CH2M HILL achieve its mission acceleration goals.

As shown in Figure 6.1, technology gaps were identified based on a review of the Technology Opportunity Statements to determine those: 1) for which a disposition path has not been identified, and 2) that, if not addressed, are most likely to have a significant adverse impact on CH2M HILL's ability to successfully implement the IMAP execution strategies. Technology Opportunity Statements for which a disposition path exists include those that are funded (either by CH2M HILL or some other organization such as EM-50 or EMSP), or that will be addressed through Technical Exchanges with other sites. Another factor that was considered in identifying the technology gaps was whether a technology opportunity has been closed (and therefore unfunded) based on a "proceed at risk" strategy when significant technical risk still exists.

As noted in Section 4.0, the Technology Opportunity Statements are characterized as either active, inactive, deferred, or closed. Those that were designated as being inactive (i.e., work scope that must be conducted now, but no related activities are funded) are obvious candidates for consideration as possible technology gaps. There were five of these possible gaps:

- WT109 Radiation Survey
- WT124 Replace Annulus Monitoring Flake Boxes with Newer Technology
- WT125 Interstitial Liquid Level Measurement in SSTs
- WT136 Installation of New Risers in SSTs
- WT137 Removal/Decontamination of In-Tank Equipment
- WT046-S Getter Materials in the Vadose Zone

In this section, the technology gaps are discussed in the following contexts:

- 6.1 – Technology Gaps Related to PBIs and RPP Critical Risks
- 6.2 - Technology Gaps Related to Tough Technical Problems

Furthermore, other potential technology gaps identified in the data crosswalking and roadmpaping exercises are discussed in Section 6.3, and include DST Integrity, Worker Risk, Infrastructure Improvement, and Integration Opportunities.

6.1 Technology Gaps Related to PBIs and RPP Critical Risks

CH2M HILL's performance will be evaluated by ORP based on the four performance-based incentives (PBIs) for FY 2003 through FY 2006 shown in Table 6.1.

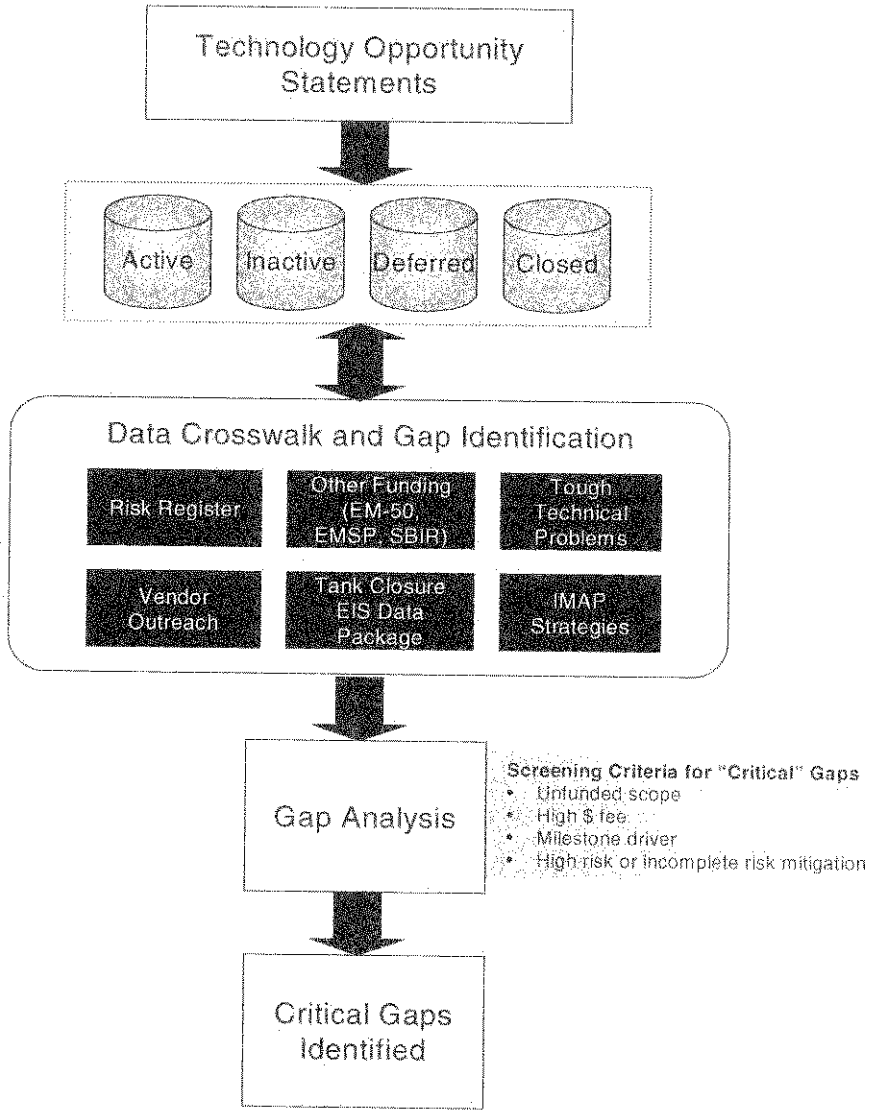

Figure 6-1 Technology Gap Identification Process

Table 6-1 CH2M HILL PBIs for FY 2003 Through FY 2006

PBI Number	PBI Title	Performance Fee Available
PBI-1	Store	$3 million
PBI-2	Waste Treatment Plant Production Support (Feed Delivery and Product Receipt)	$30 million
PBI-3	Single-Shell Tank (SST) Retrieval and Closure	$32 million
PBI-4	Supplemental Waste Treatment and Disposal	$7 million

Clearly, the bulk of CH2M HILL's performance fee is tied to SST retrieval and closure and WTP support (feed delivery and product receipt). Thus, any technology gaps in these areas would have the greatest impact on CH2M HILL.

In addition to the PBIs, the RPP Critical Risk List is another key driver for CH2M HILL performance. Technology Risks, Technical Risks, and New Critical Risks from the RPP Critical Risk List were combined for the purposes of this categorization and binning of technology gaps into the following 10 critical risk categories for use in the data crosswalk and analysis:

- SST Retrieval Needs RPP-CR-032
- Sustained Waste Feed Delivery - RPP-CR-040
- Supplemental LAW Treatment - RPP-CR-036 and Alternative TRU/LLW Treatment Technologies - RPP-CR-037
- SST Integrity - RPP-CR-035
- DST Space Availability and Integrity - RPP-CR-014 / CR-070A
- Pit Conditions - RPP-CR-034
- Regulatory Decisions (Closure Definition) - RPP-CR-039 and Central Plateau End States - RPP-CR-041
- WTP Executable Schedule (Close-coupled EPC) – RPP-CR-042
- Yucca Mountain, NV, Availability to Accept IHLW - RPP-CR-038
- LERF/ETF Facilities Handling WTP Effluents – RPP-CR-033

Comparison of these critical risks with the PBIs in Table 6.1 shows that ORP has incentivized CH2M HILL to address most of the top critical risks, with the exception of DST space availability and DST integrity (see Section 6.3.1). Relationships between the five potential technology gaps (the five inactive Technology Opportunity Statements that are not currently being pursued) and the PBIs and critical risks are described below. They are listed in a loosely constructed priority order of greatest perceived impact to CH2M HILL from both a risk perspective and performance fee perspective. The first three are considered of sufficient probable impact to warrant a closer examination of the technology opportunity from a corporate perspective to accomplish the PBIs and mitigate the critical risks rather than a single project acting as the lead for the opportunity.

Installation of New Risers in SSTs (WT136). Risers penetrating the tank domes provide access to the tanks. Existing risers may not be large enough in diameter to accommodate retrieval equipment. The Mobile Retrieval System (MRS) needs a 36-inch riser installed in T-110 during FY04 and will need other riser installations before FY06. CH2M HILL might not be able to deploy planned retrieval equipment due to lack of large enough risers or plugged risers. However, Hanford has installed risers in the past (about 20 years ago), so there is a baseline that works, but it is more difficult to implement (and, therefore, more expensive) than is suitable for

multiple rapid deployments. This Technology Opportunity Statement is for a better, faster, and cheaper technique. It may be an opportunity to accelerate the schedule and reduce costs, but its inattention does not jeopardize the mission. This technology opportunity was also highlighted as one of CH2M HILL's Tough Technical Problems (see Section 6.2).

Removal/Decontamination of In-Tank Equipment (WT137). Current techniques to remove, decontaminate, and dispose of equipment removed from tank risers are costly and slow. Cost savings for the total retrieval and closure life cycle may be millions of dollars, but are still considered relatively small compared to the cost of the overall retrieval and closure mission. In the current structure, however, no single project can afford to invest in a new and better approach. Nevertheless, in consideration of the current contract and the PBIs, it is a low priority.

Replace Annulus Flake Boxes with New Technology (WT124). Existing flake boxes, which are backup to ENRAFs, are expensive to operate and are labor-intensive. Operating cost savings may be realized with new technology. The current technology is, nevertheless, satisfactory and the cost savings would probably be low. In consideration of the current contract and the PBIs, this is a very low priority.

Radiation Survey (WT109). Better and faster methods to conduct radiation surveys along transfer lines and in contamination areas would reduce worker exposure and cost. This is a cost-saving technology opportunity, but the overall cost savings are small (~$100K/yr up to $1M/yr). In consideration of the current contract and the PBIs, it is a very low priority.

Getter Materials in the Vadose Zone (WT046-S) can reduce the cost of final closure by retarding the movement of contaminants from the tank. It is one tool in a suite of tools to provide overall protection from contaminants leaving the tank region and entering the environment. The overall degree of protection is provided by extent of retrieval, stabilizing agents added into the tank, stabilizing agents added to the vadose zone, and protective caps to prevent water from infiltrating the tank. This is a long-term issue and the need for getter materials in the vadose zone has not been established. In consideration of the current contract and the PBIs, it is a very low priority.

6.2 Technology Gaps Related to Tough Technical Problems

Table 6.2 links the tough technical problems that were identified by CH2M HILL management in May 2003 to the FY03 Technology Opportunity Statements. The tough technical problems that are shaded blue are the ones for which the related Technology Opportunity Statements are not funded (i.e., closed, inactive, or deferred). The tough technical problems with "NA" shown in several columns are those for which no Technology Opportunity Statement was ever formulated.

The list of tough technical problems was originally generated in preparation for a meeting between CH2M HILL management and PNNL Energy Science and Technology Directorate (ESTD) management to investigate whether PNNL might have capabilities to support CH2M HILL that weren't being fully utilized. After the meeting, PNNL responded to the tough technical problems that were presented. The original list contained 25 problems, but subsequent comparisons led to several of the problems being combined, so the total dropped to 20, as shown in Table 6.2.

Comparison of the 20 problems with the Technology Opportunity Statements revealed that most (13) of the problems were covered. Several of the problems are quite broad and are addressed by multiple Technology Opportunities. Seven of the problems are not covered by Technology

Opportunity Statements. PNNL's response to the total list of Tough Technical Problems indicated that solutions to three of the problems were either already available through off-the-shelf technology or could be readily engineered from currently available technology. These were:

Problem # 4 – Inspecting Tank Risers
Problem # 9 – Pump with Remote Adjustable/Locatable Suction
Problem # 19 – Remote Video Vehicle

Four Tough Technical Problems remain that are not represented in the Technology Opportunity Statements:

Problem # 6—Simple Exhausters
Problem # 13—In-Process Sampler for HIHTL
Problem # 15—Straight-Through Pipe Connector
Problem # 20—Turnkey Modular Pump Pit Systems

Two of these problems, "In-Process Sampler for HIHTL" and "Straight-Through Pipe Connector" have been presented to AEA Technologies as topics for their earmarked technology development activities.

One of the technology gaps identified from analyzing the Technology Opportunity Statements is present on the list of Tough Technical Problems. Installation of New Risers in SSTs is highlighted as an important gap that could delay accomplishing the retrieval PBI and is called out specifically as a Tough Technical Problem.

Table 6-2 Links Between Technology Opportunity Statements and Tough Technical Problems

Tough Technical Problem #	Tough Technical Problem Description	Technology Opportunity Number	Technology Opportunity Title	Technology Opportunity Status
1	Faster/Cheaper retrieval from Tanks	WT032	Control of Retrieved Waste Dilution	Part Closed and Part Deferred
1	Faster/Cheaper retrieval from Tanks	WT063	Hanford SST Saltcake Dissolution Retrieval	Active
1	Faster/Cheaper retrieval from Tanks	WT089	SST Retrieval with Minimal Water Addition	Closed
1	Faster/Cheaper retrieval from Tanks	WT112	Chemical Dissolution of Water Insoluble Wastes from SSTs	Deferred
1	Faster/Cheaper retrieval from Tanks	WT148	Sluicing Enhancement and Cost Reduction	Active
2	DST available space	WT088	Advanced Approaches for Reducing Waste Volume Stored in DSTs	Active
3	Pumping Slurries	WT091	Chemical and Physical Behavior of Saltcake Wastes	Active
3	Pumping Slurries	WT138	Physical Behavior of Sludge Wastes	Active

Tough Technical Problem #	Tough Technical Problem Description	Technology Opportunity Number	Technology Opportunity Title	Technology Opportunity Status
4	Inspecting Tank Risers	NA	NA	PNNL replied that this is currently available technology, no need for development.
5	Install new risers on existing SSTs	WT136	Installation of New Risers in SSTs	Inactive
6	Simple Exhausters	NA	NA	NA
7	Non-contact surface level measurement	WT125	Interstitial Liquid Level Measurement in SSTs	Inactive
7	Non-contact surface level measurement	WT115	Technology to Support Post-Retrieval Evaluation of SSTs	Active
8	Tool box for plugged lines	WT126	Line Unplugging/Plug Location	Closed for SSTs/Deferred for DSTs
9	Pump with remote adjustable/locatable suction	NA	NA	PNNL replied that this is currently available technology, no need for development, engineer and build
10	Ancillary equipment (pipelines) waste inventory	WT150	Characterization of Waste Inventory in ancillary equipment	Active
11	Ancillary equipment (in tank assay)	WT137	Removal/Decontamination of In-tank Equipment	Inactive
12	In-situ tank assay	WT102	Post Retrieval Evaluation: In-Situ Characterization	Active
13	In-process sampler for HIHTL	WT009	Representative Sampling to Support Retrieval and Transfer of DST Waste to WTP for Treatment and Disposal	Closed Funding to address this problem as part of salt cake retrieval and pretreatment is actively being pursued for FY04.
14	Remote Sampler	WT102	Post Retrieval Evaluation: In-Situ Characterization	Active
15	New straight through pipe connector	NA	NA	NA
16	DST inspection at top knuckle and above	WT133	Improved DST Integrity NDE Tools: Electromagnetic Acoustic Transducer (EMAT)	Active
16	DST inspection at top knuckle and above, better inspection at bottom knuckle	WT022	Improving the Tandem Synthetic Aperture Focusing Technique (TSAFT) for Flaw Characterization in the Inaccessible Portion of the Knuckle Region of the DSTs	Active
17	Leak detectors	WT026 / WT027	Tank Leak Detection, Monitoring and Mitigation (LDMM) Systems	Active
18	Tank vapor emissions	WT116	VOC Treatment and Monitoring	Closed
19	Remote video vehicle	NA	NA	PNNL replied that this is currently available technology.

Tough Technical Problem #	Tough Technical Problem Description	Technology Opportunity Number	Technology Opportunity Title	Technology Opportunity Status
20	Turn key module pump pit systems	NA	NA	NA

6.3 Other Potential Technology Gaps

6.3.1 DST Integrity Technologies

Improving DST integrity will reduce tank failure risk, which is essential to raising allowable DST waste levels and assuring DST space availability (RPP-CR-014, CR-070A). While technology and funding for DSTs have been identified, careful consideration should be given to whether the activities that are funded are adequate. Funded Technology Opportunity Statements related to DST maintenance and inspection include: DST Corrosion Chemistry and Monitoring/pH Probes (WT004/WT079S), Improving the TSAFT for Flaw Characterization in the Inaccessible Portion of the Knuckle Region of DSTs (WT022), DST Transfer Piping NDE Tools (WT106), Improved DST NDE Tools (WT133), DST Instrument Gauge Upgrades (WT134), and Advanced Approaches for Reducing Waste Volume Stored in DSTs (WT088). The two Technology Opportunity Statements described below, in particular, should be more carefully evaluated.

DST Corrosion Monitoring/pH Probes (WT004/WT079S). Corrosion probes were installed in Tanks AN-104, AN-105, and AN-107 and data is being collected, but additional data interpretation work may be necessary to confirm the meaning of the data and assess the potential impact to DST integrity. For probes installed in sludge and supernatant, the electrochemical noise (EN) data from all systems successfully indicate rates of uniform corrosion. For probes installed in the vapor space, work is needed to correlate the data collected to cracking, pitting, and thinning in a vapor environment. Also, discrete EN transients indicative of pit initiation or other electrochemical events have occasionally been recorded on some channels. These occasional transients may be the result of pit initiation or bubble formation in the sludge near the electrodes. Funding was allocated in FY03 and funding has been requested for FY04 to interpret the data collected from the probes in the vapor space. CH2M HILL is also funding a study to correlate the ammonia concentration in the dome space with corrosion probe and testing results to determine the extent of pitting. In the first quarter of FY04, an expert panel will assess the feasibility of raising the waste levels in the DSTs. A major concern is how much NDE inspection and testing is needed statistically to certify a DST for the mechanical stresses associated with raising the waste levels. The issue that will be addressed for the corrosion probe is how raising the waste level will affect the validity of corrosion probe data. The expert panel assessment will provide additional insights on the importance of the corrosion probe for assuring DST space availability.

Improved DST NDE Tools (WT133). The accelerated schedule has added a requirement to inspect the upper regions of the DSTs so that allowable waste levels can be raised during storage. This requirement can be addressed by using NDE technology (WT133) to inspect the upper regions of the DSTs in order to increase the level of waste stored. The Iowa State University Center for Nondestructive Evaluation (the integrator and technical expert) and Sonic Sensors (the system supplier) have funding reinstated from FY02 by EM-50 to demonstrate the Electro-Magnetic Acoustic Transducer (EMAT) for possible application on the DSTs as a rapid screening tool. While EM-50 funding is in place for FY03, there is no

budget planned for FY04. Initial estimates were that the accessible areas of a DST primary liner could be inspected in about a week (including setup and calibration) using EMAT. Based on the results of this scan, identified areas meeting as-yet-undefined criteria could receive detailed P-scan evaluations. EMAT and the associated DST Transfer Piping NDE Tools (WT106) address improved technologies for assuring DST integrity.

6.3.2 Technologies to Reduce Worker Risk

A number of Technology Opportunity Statements relating to reducing worker health and safety risk are closed or deferred. Worker safety is part of CH2M HILL's conduct of operations, but these technology improvements reduce the longer-term costs of assuring worker safety. While worker safety does not tie to critical risks or PBIs, adequate attention to worker safety enables sustained HLW feed delivery and accelerated SST retrieval. The consequences of deferring worker safety improvements should be carefully evaluated. Spray On Shielding (WT129), Improve Pit Remote Operation Tools (WT021), and Contamination Lock-Down and Surface Coating Issues (WT131) have been sufficiently resolved for mission work currently defined because the strategy is to avoid work in highly contaminated tank farm pits. Asbestos encapsulation was viewed as not justifying resources, as current technologies are acceptable, and the scale of asbestos removal planned would not result in any measurable return on the potential investment required. Cleanable HEPA Filters (WT104) was closed, but filter failures still occur.

Improve Pit Remote Operation Tools (WT021) supports characterization of pits, which would help resolve the Pit Condition risk (RPP-CR-034). Improve Pit Remote Operation Tools (WT021) provides funding for the "Pit Viper" technology that was deployed in FY02 in support of the C-104 retrieval project. Since this deployment, the Pit Viper end effectors and control system have been enhanced to support a broad range of tank farm pit activities.

6.3.3 Tank Farm Infrastructure Improvement

Remote Tank Wall Repair (WT111) is closed because vendors specializing in oil or chemical tank repair could be engaged to develop a Hanford solution and repair a leak within a year of occurrence. While the probability of needing this technology is low, the potential consequence of a tank leak is high. As time goes on, the likelihood for significant leaks will increase due to the advanced age of SSTs and the need to retrieve the waste using water. Technology investment in this area may have a significant payback in the future.

6.3.4 Technology Integration Opportunities

Technical Points of Contact for several inactive Technology Opportunity Statements have indicated that they would like to seek vendor solutions. Information on vendor technologies for Continuous Air Monitors Reliability (WT123) and Radiation Surveys (WT109) would be useful to Tank Farm staff, although funding is not available.

While Cleanable HEPA Filters (WT104) has been closed, systems engineering is further evaluating the filter failures and the suspected causes. The findings of this analysis may be amenable to vendor solutions or further research and technology development.

In the area of Technical Exchanges, the Savannah River Site has expressed an interest the EMAT technology and might be interested in observing its demonstration. If the corrosion probe is determined to be important to DST integrity or DST space availability, SRS uses a

different type of probe, which could measure constituents that help determine corrosion on a real-time basis. These are potential areas for Technical Exchanges with SRS.

EMSP has funded several HLW and subsurface contamination projects that could lead to solutions for tank farm closure and ILAW disposal. For example, Reactive Barriers to Contamination Migration (WT061) might benefit from the results of EMSP project 86807, Long-Term Stewardship of Mixed Wastes: Passive Reactive Barriers for Simultaneous In Situ Remediation of Chlorinated Solvent, Heavy Metal, and Radionuclide Contaminants. Post-Closure Monitoring (WT140) would benefit from EMSP project 86759, Radionuclide Sensors for Water Monitoring. These linkages are further defined in Appendix D.

6.4 Conclusions

The Roadmapping exercise provided positive indications of progress in consolidated RPP integration and planning against the accelerated mission. No critical gaps in technology were uncovered in the current analysis. There is one "gap" that could be considered of sufficient probable impact to warrant a closer examination of the technology opportunity from a corporate perspective to accomplish the PBIs and mitigate the critical risks rather than a single project acting as the lead for the opportunity.

Installation of New Risers in SSTs (WT136). Risers penetrating the tank domes provide access to the tanks. Existing risers may not be large enough in diameter to accommodate retrieval equipment. The Mobile Retrieval System (MRS) needs a 36-inch riser installed in T-110 during FY04 and will need other riser installations before FY06. CH2M HILL might not be able to deploy planned retrieval equipment due to lack of large enough risers or plugged risers. However, Hanford has installed risers in the past (about 20 years ago), so there is a baseline that works, but it is more difficult to implement (and, therefore, more expensive) than is suitable for multiple rapid deployments. This Technology Opportunity Statement is for a better, faster, and cheaper technique. It may be an opportunity to accelerate the schedule and reduce costs, but its inattention does not jeopardize the mission. This technology opportunity was also highlighted as one of CH2M HILL's Tough Technical Problems (see Section 6.2). The current CH2M HILL position is that adequate capability to address this technical challenge is now commercially available and therefore this Technology Opportunity Statement is inactive.

Continued diligence in technical outreach, via Technical Exchanges, may be important to DST integrity or DST space availability, and EMSP has funded several HLW and subsurface contamination projects that could lead to solutions for tank farm closure and ILAW disposal.

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Appendix A

Technology Opportunity Statements

(Organized numerically by their Technology Opportunity Number[WT-XXX])

FY03 Technology Opportunity Number*	Technology Opportunity Statement Title
WT004 /WT079-S	Double-Shell Tank (DST) Corrosion Chemistry and Monitoring/pH Probes
WT009	Representative Sampling to Support Retrieval and Transfer of DST Waste to WTP for Treatment and Disposal
WT016	Glass Monolith Surface Area
WT017	Long-Life Waste Isolation Surface Barrier
WT021	Improve Pit Remote Operation Tools
WT022	Improving the Tandem Synthetic Aperture Focusing Technique (TSAFT) for Flaw Characterization in the Inaccessible Portion of the Knuckle Region of the Double-Shell Tanks (DSTs)
WT026 /WT027	Tank Leak Detection, Monitoring and Mitigation (LDMM) Systems
WT032	Control of Retrieved Waste Dilution
WT035-S	Moisture Flow and Contaminant Transport in Arid Conditions
WT044-S	Distribution of Recharge Rates
WT046-S	Getter Materials in the Vadose Zone
WT053-S	Contaminant Mobility Beneath Tank Farms
WT054	Mixer Pump Mobilization Performance Prediction (formerly Solids Yield During Mixer Pump Mobilization)
WT060	Hanford/SRS Waste Mixing Mobilization
WT061	Reactive Barriers to Contaminant Migration
WT062	Variable Suction Level Transfer Pump
WT063	Hanford SST Saltcake Dissolution Retrieval
WT066	Compositional Dependence of the Long-Term Performance of Glass as a Low-Activity Waste Form
WT072	Automation of Tank Farm Field Processes and Wireless Communication
WT088	Advanced Approaches for Reducing Waste Volume Stored in DSTs
WT089	Single-Shell Tanks (SSTs) Retrieval with Minimal Water Addition
WT090	Chemical Behavior of Sludge Wastes
WT091	Chemical and Physical Behavior of Saltcake Wastes
WT102	Post-Retrieval Evaluation: In-Situ Characterization
WT104	Cleanable HEPA Filter
WT105	Coalescer for Tank Waste in Pits and Airborne Contamination
WT106	Double-Shell Tank (DST) Transfer Piping Non-Destructive Examination (NDE) Tools
WT107	Grab Sampling Dose Reduction
WT108	In-Tank Camera and Lighting
WT109	Radiation Survey
WT111	Remote Tank Wall Repair

* Also known as "Assigned Tracking Number".

FY03 Technology Opportunity Number*	Technology Opportunity Statement Title
WT112	Chemical Dissolution of Water Insoluble Wastes from Single-Shell Tanks (SSTs)
WT113	Selective Species Removal
WT115	Technology to Support Post-Retrieval Evaluation of SSTs
WT116	VOC Treatment and Monitoring
WT123	CAMs Reliability
WT124	Replace Annulus Monitoring Flake Boxes with Newer Technology
WT125	Interstitial Liquid Level Measurement in SSTs
WT126	Line Unplugging/Plug Location
WT127	Maintenance Tracking System
WT128	Develop/Find Predictive Maintenance Tools
WT129	Spray-on Shielding
WT130	Asbestos Encapsulation for Insulation Removal
WT131	Contamination Lock-Down Surface Coating
WT132	Deactivate Inactive Systems in DST/SSTs
WT133	Improved DST Integrity NDE Tools: Electromagnetic Acoustic Transducer (EMAT)
WT134	AZ Tank Farm Upgrades
WT135	Response to Potential Line Leak
WT136	Installation of New Risers in SSTs (Single-Shell Tanks)
WT137	Removal/Decontamination of In-Tank Equipment
WT138	Physical Behavior of Sludge Wastes
WT139	Best-Basis Inventory Improvement
WT140	Post-Closure Monitoring
WT141	Development and Demonstration of Bulk Vitrification Treatment Technology
WT142	Cast Stone
WT143	Tank Waste Denitration
WT144	Fractional Crystallization
WT145	Qualify Steam Reforming Process for LAW Treatment
WT146	Sulfate Removal
WT147	TRU Treatment Technology
WT148	Sluicing Enhancement and Cost Reduction
WT149	Transport of SST Waste with Little Water
WT150	Characterization of Waste Inventory in Ancillary Equipment
WT151-S	Getter Materials for Tank Fill

FY03 Technology Opportunity Number*	Technology Opportunity Statement Title
WT152	Supplemental Pretreatment Technologies
WT153	Transport of Packaged and Bulk Waste
WT154	Alternative Waste Streams
WT155	Alternative Glasses for Hanford
WT156	Re-Use of Existing Facilities
WT157	Strategy for Long-Term Performance Testing and Comparison of Performance For Different Waste Forms
WT158	Tailored Disposal Systems
WT159	Remote Pit Cleanout and Riser Preparation

Office of River Protection
Technology Opportunity Statement

General Reference Information	**ACTIVE**
2*	***Assigned Tracking Number:*** WT004 and WT079-S
1*	***Title:*** Double-Shell Tank (DST) Corrosion Chemistry and Monitoring/pH Probes
3*	***Summary:*** Corrosion control of high-level waste DSTs is currently provided by concentration limits on hydroxide, nitrite, and nitrate, which requires expensive waste sampling and inhibitor additions. Concentration limits may be too conservative or inadequate to cover future tank operations. Electrochemical noise probes have been deployed in five DSTs, and 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. Expected benefits are safer operation and reduced risk of primary tank failure and avoidance of unnecessary chemical additions. In addition, a pH probe (Lanthanum-Fluoride) has been identified that is suitable for the Hanford high ionic strength wastes, and needs to be deployed in the DSTs to continuously monitor the changing chemistry conditions that lead to a lowering of pH below the required range.
38new	***Principal Contact:*** Gary P. Duncan, CH2M HILL, 509-376-6008, Fax: 509-372-0065, gary_p_duncan@rl.gov
Technology Opportunity Description	
8A*	***Project:*** ☐ Safe Storage – Operations and Maintenance X Safe Storage – Life Extension ☐ Waste Retrieval and Transfer – Waste Inventory Properties ☐ Waste Retrieval and Transfer – Equipment ☐ Closure ☐ Disposal
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW03 Work Breakdown Structure (WBS) No.: 5.7.2
12A	***Problem Description:*** Corrosion monitoring of double-shell tanks (DSTs) is currently provided by process knowledge and tank sampling. Tanks found to be within chemistry specification limits are considered to be not at risk for excessive corrosion damage. However, maintaining DST wastes within chemistry limits has been problematic. Tank samples are infrequent and their analysis difficult and expensive. Waste streams that are exempt from the corrosion control specifications complicate process knowledge. In-tank, real-time measurement of the corrosive characteristics of the tank wastes is needed to improve control of corrosion processes. Available technology for corrosion monitoring has progressed to a point where it is now feasible to monitor and control corrosion by on-line monitoring of the corrosion process and direct addition of corrosion inhibitors. Progress toward meeting this need has been made through the deployment of electrochemical noise probes in five Hanford tanks. These probes have generated data that improve insight to the extent and type of corrosion processes occurring as chemistry in the tank waste is adjusted. Additional work is needed to validate the conclusions and interpretation of data and to upgrade probe design for extended life. Recent ultrasonic examinations of DSTs indicated corrosion near the waterline in the form of pits

(e.g., 101-AY, 102-AN). Such waterline corrosion is a result of a lack of adequate hydroxide concentration near the waste surface due to a reaction between carbon dioxide in the dome space air and hydroxide in the waste. The decrease in hydroxide concentration translates to a decrease in the pH of the waste near the waterline. It has been well known that at pH values less than 10, the carbon steel wall of the DSTs is prone to pitting attack. A decrease in pH could also occur underneath the waste surface in the supernatant and the sludge due to consumption of hydroxide by organics. Therefore, knowledge of pH of the waste is extremely beneficial in mitigating corrosion of the tank wall and extends its life. Probes to measure pH instantaneously in various environments are routinely used in the process industry. Probes with glass electrodes are usually limited for use in solutions with low ionic strength. A pH probe (Lanthanum-Fluoride) has been identified that is suitable for the Hanford high ionic strength wastes, and needs to be deployed in the DSTs to continuously monitor the changing chemistry conditions that lead to a lowering of pH below the required range. This is a corrosion control issue and will affect all of the dilute waste storage tanks at Hanford, and may ultimately impact all 28 DSTs.

Recent years ultrasonic examination of DSTs has gathered a growing body of evidence of material behavior under actual tank operating conditions. In some cases, these data appear inconsistent with the laboratory data that formed the basis for the waste chemistry specifications. The waste in double-shell tank (DST) 241-AN-107 had been outside corrosion chemistry control limits for several years. However, limited UT examination performed in 1998 indicated the tank to be corroding at a very low rate with no observable pitting or stress corrosion cracking (SCC). The UT results were supported by the more recent examination of corrosion probe coupons removed from tank 241-AN-107 after approximately 4 years of exposure to tank waste. The coupon analysis indicated very little general corrosion in tank waste with no observable pitting and SCC. This suggests that the current DST waste chemistry limits may be conservative.

The laboratory database for the corrosion control chemistry specifications is 20 years old and was formulated on waste chemistries no longer produced at Hanford.

Chemical changes occur in the waste over time to deplete corrosion inhibiting chemicals (hydroxide and nitrite). An understanding of these depletion reactions is needed to develop empirical equations and depletion models that can be used to predict the changing chemistry of DST wastes. These equations and models will serve as tools to ensure timely corrective actions will be taken to keep the tank wastes within the corrosion control chemistry limits. New laboratory studies need to be conducted to better characterize the conditions of the future waste tank operations and the changing waste chemistry conditions of the present tank wastes.

The potential benefits of better understanding corrosion chemistry and of a corrosion monitoring system include:

1. Safer operation and reduced risk of primary tank failure, due to more timely identification and resolution of corrosivity conditions. Corrosion will be monitored directly, versus monitoring chemical species. Assumptions about tank waste homogeneity and accuracy of the corrosion chemistry specification will be reduced or removed.

2. Avoidance of unnecessary chemical additions, which have impacts beyond the cost of the addition operation itself: corrosion inhibitor additions increase significantly the amount of sodium that will require immobilization and disposal.

9A	***Priority:*** X HIGH Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction ☐ MEDIUM Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction ☐ LOW Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation		
9B	***Priority***		
	Schedule Impact	☒ HIGH Needed to meet PBIs ☐ MED Needed to meet mission targets (2033 closure) ☐ LOW Can improve mission targets or no schedule impact	
	Cost Savings	☐ HIGH >$1B total life-cycle savings ☒ MED >$100M but <$1B total life-cycle savings ☐ LOW <$100M total life-cycle savings	
	Implementation Cost/Schedule	☒ HIGH <$10M and <2 yrs. ☐ MED >$10M and <2 yrs or <$10M and > 2 yrs. ☐ LOW >$10M and > 2yrs. or significant technical risk	
	Baseline Risk Reduction	☒ HIGH The baseline technical solution has not been proven at large scale or on actual radioactive waste. ☐ MED The baseline technical solution has been demonstrated at large scale but not implemented in radioactive operations. ☐ LOW The baseline technical solution has been implemented at Hanford.	
Cost Information			
17A*	***Current Baseline Cost:*** $		
17B	***Estimated Cost Impact:*** $		
18*	***Cost Impact Explanation:*** A core sample costs $750K, a grab sample costs $150K, and a caustic addition costs $170K. A corrosion probe costs $150K to install and operate for 3 years, plus $40-50K for data analysis. Lifecycle: $0.2M/probe to install, $0.1M/probe to operate and maintain Of the $2M scope still needed on this subject, only the monitoring of installed probes is funded in FY03. Potential cost avoidances are: cost of building new tanks in case of DST failure ($435M in 1993 dollars for 6 tanks) and cost of vitrification of additional sodium from conservative caustic additions (not quantified).		
Risk Information			
37 new	***Risk Identifier:*** ☒ CR- 070A ☐ New ***Risk Statement:*** If DST corrosion control continues to be based on samples and concentration limits only (as opposed to use of corrosion and pH probes), then Tank Farm Operations will miss an opportunity of efficiency increase and cost savings that will be necessary to achieve aggressive SST retrieval, Waste Feed Delivery, and Accelerated Closure schedules. If a DST fails before the end of the RPP mission, then a tank space shortfall may occur (Technical Risk List) DST Space Availability (RPP-CR-014, CR-070A). Double Shell Tank integrity must be		

	maintained and space saving initiatives must be successful to avoid replanning of the TFC baseline strategy (including possible tank sequencing adjustments and potential construction of new tanks) and support accomplishment of accelerated cleanup initiatives.
12B	***Risk Narrative:*** The RONDE system, recently deployed by CH2M HILL for the DST Integrity Program, could also be utilized to start the inspection process of upper region of the DSTs.
Schedule Information	
21	***Regulatory Drivers:*** *Washington Administrative Code* 173-303-640(2)(c)(iii) requires consideration of existing corrosion protection when performing tank system integrity assessments. HNF-SD-WM-OCD-015, *Tank Farm Waste Transfer Compatibility Program*, describes decision rules relating to waste transfers into and within the DST system. The document defines a means of consistently applying safety, operational regulatory and programmatic criteria and specifies considerations necessary to assess waste transfers. 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. Administrative Orders 00NWPKW-1250 and –1251, issued by the Washington State Department of Ecology, require incorporation of corrosion probe data into the DST System Integrity Assessment Report, due March 2006 (Section 12).
22*	***Milestones:*** (Draft) TPA Milestone M-48-14 requires completion of the DST System Integrity Assessment Report (including consideration of corrosion probe data) by March 31, 2006.
28*	***Earliest Date Required:*** *FY03*
29*	***Latest Date Required:*** *FY05*
13B	***Schedule Explanation:*** TIP No.:T03-01-300, "On-Line Monitoring for Waste Tank Corrosion Control," 6/30/2003
30	***Technology Insertion Point:*** ☐ New x Existing Code: T03-01-300 Official Date: 6/30/2003
Additional Points of Contact (POC)	
34	***Contractor End User POCs:*** G. P. (Gary) Duncan, CH2M HILL, 509- 376-6008, F/509-372-0065, gary_p_duncan@rl.gov
35	***DOE End User POCs:*** Vic Callahan, (509) 373-9880, Victor_L_Callahan@rl.gov
36*	***Other Contacts:*** Mo Anatatmula, CH2M HILL, 509-373-0785, Fax: 509-372-1608, Ramamoham_P_Anantatumla@rl.gov, Mark Roberts, CH2M HILL, 509-376-4825, Fax: 509-373-9889

Office of River Protection
Technology Opportunity Statement

General Reference Information	**CLOSED**
2*	***Assigned Tracking Number:*** WT009
1*	***Title:*** Representative Sampling to Support Retrieval and Transfer of DST Waste to WTP for Treatment and Disposal
3*	***Summary:*** A concept for taking a representative sample and associated rapid analysis of feeds is needed for waste being staged for cross site transfer or DST waste being mixed and staged for transfer from the TFC to the WTP. The need for an in-process Hose-in-Hose Transfer Line (HIHTL) was identified as a tough technical problem (#15) in FY03 Note: Evaluation of clamshell sampler and off-riser sampler completed in FY03.
38new	***Principal Contact:*** Roland Brown
Technology Opportunity Description	
8A*	***Project:*** ☐ Safe Storage – Operations and Maintenance ☐ Safe Storage – Life Extension ☐ Waste Retrieval and Transfer – Waste Inventory Properties X Waste Retrieval and Transfer – Equipment ☐ Closure ☐ Disposal
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-WT04 (primary); ORP-WT03 secondary Work Breakdown Structure (WBS) No.: 5.8.2 (primary); 5.7.1 (secondary)
12A	***Problem Description:*** A representative, and preferably also rapid, sampling system has to be developed and demonstrated so that supernate and HLW slurry feeds being sent to the WTP can be staged successfully to meet the required schedule and data quality objectives with a minimum impact on tank space and within guidelines for worker safety and ALARA considerations. Current grab samplers consisting of "bottle-on-a-string" are used for slurry/supernate sampling. This system of sampling may produce cross contamination with material from higher elevations above the desired sample depth as it is withdrawn from the tank. Although this cross contamination is proportional, it could skew the sample results. High level waste sampling will be either grab sampling or core sampling. Neither of these methods can be performed during active mixing system operation, therefore allowing time for in-tank stratification to be re-established before the sampling can be performed. Grab sampling is a manual operation performed through an existing riser using a portable "glove bag" for containment control that has potential for personal contamination and exposure. With the Hanford Site's existing capabilities it takes weeks or even months to sample and analyze a tank. The AZ-101 pump tests showed that HLW can rapidly settle (3-ft per hour) after mixer pumps are shutdown. The rapid settling will impact waste content during a transfer operation, possibly requiring mixing while transferring. In addition, sampling while mixing, which cannot be done with base-line grab or core truck methods, will be required to assure that a representative sample is available for validation of a waste batch prior to transfer. Independent evaluation of design criteria for an alternative system (RPP-7170) confirmed the need for a robust design that can sample while the mixer pumps are operating in HLW feed tanks. 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 the Tank Farm Contractor (TFC) provides feeds to support efficient operation of the WTP and with a minimum use of tank space. Representative sampling involving potentially non-homogeneous waste feed is definitely needed.. Long sample and analysis times will cause operations to tie up tanks until analytical results are available to determine how the waste should be staged. Quicker sample/analytical responses will provide more flexibility to the tank system. Staging of waste for cross-site transfer will become a critical feature of timely staging of privatization feed as waste from the 200 W Area is utilized. In FY 2000, the number of feed tanks were expanded from two to over 12 for LAW and HLW feeds. A mobile sampling system that could be moved between feed tanks would be capable of providing verification samples and flexible to accommodate any changes in the feed schedule. The activity is awaiting revision of the sampling and analysis requirements which will be based upon the Regulatory DQO for WTP waste feed acceptance, which is in process of preparation/approval (October 2002).
9A*	***Priority:*** ☐ HIGH Large cost benefit, short-term implementation needed to achieve benefits, easy to implement, high risk reduction. ☐ MEDIUM Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction. X LOW Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation.
9B	***Priority***

	Schedule Impact	☐ HIGH Needed to meet PBIs ☐ MED Needed to meet mission targets (2033 closure) ☐ LOW Can improve mission targets or no schedule impact
	Cost Savings	☐ HIGH >$1B total life-cycle savings ☐ MED >$100M but <$1B total life-cycle savings ☐ LOW <$100M total life-cycle savings
	Implementation Cost/Schedule	☐ HIGH <$10M and <2 yrs. ☐ MED >$10M and <2 yrs or <$10M and > 2 yrs. ☐ LOW >$10M and > 2yrs. or significant technical risk
	Baseline Risk Reduction	☐ HIGH The baseline technical solution has not be proven at large scale or on actual radioactive waste. ☐ MED The baseline technical solution has been demonstrated at large scale but not implemented in radioactive operations. ☐ LOW The baseline technical solution has been implemented at Hanford.

Cost Information	
17A*	***Current Baseline Cost:*** $50-100K per grab sample; $500-750K per core sample; $500-750K per RCRA analysis
17B	***Estimated Cost Impact:*** $10,000,000
18*	***Cost Impact Explanation:*** Setup time for sampling would be reduced and less personnel exposure will result in a cost reduction from current levels. A significant cost savings associated with the manpower to both take and analyze the samples would be achieved if an on-line instrument were developed. The cost of taking and analyzing samples currently is on the order of $400K to $500K per sample. In the future as more tanks are being retrieved, more cross-site

	transfers will need to be made with less elapsed staging time to avoid the need for additional cross site transfer lines and additional staging tanks.
Risk Information	
37 new	***Risk Identifier:*** ☐ CR- [e.g., CR-047] ☒ New ***Risk Statement:*** If TF characterization is inadequate, and feed does not meet WTP feed specs, then out-of-spec waste may be sent back to Tank Farms and delays may occur in providing needed feed to the WTP. If the waste viscosity is higher than predicted, then plugging may occur in the lines. If the particle size exceeds 700 microns, then equipment and lines could plug. If more samples must be taken and analyzed, then key resources (sampling crews and analytical lab personnel and equipment) may become a bottle-neck and more radiation exposure will be received by staff handling the samples. If additional sampling for tank-to-tank transfer is required, then additional costs will be incurred and there may be delays.
12B	***Risk Narrative:*** See item #37 above.
Schedule Information	
21	***Regulatory Drivers:*** Regulatory DQO for Waste Feed Delivery and TPA milestones for WTP start up, and milestones for completing immobilization of all retrieved waste by 2028.
22*	***Milestones:*** First sludge feed will be delivered to WTP in 2007 to support WTP Hot Commissioning.
28*	***Earliest Date Required:*** *If the WTP HLW vitrification is accelerated, then this capability could be required by January 2006.*
29*	***Latest Date Required:*** *The need becomes more significant when the WTP HLW sludge processing moves to full scale, perhaps in 2009.*
13B	***Schedule Explanation:*** See items #22, 28, and 29.
30	***Technology Insertion Point:*** ☐ New ☒ Existing Code: T01-01-108 Official Date: 12/31/2002 "Deployment Decision for Selecting Technology for RPP Representative Sampling of Phase 1 Privatization Feed Staging Tanks," (obsolete title)
Additional Points of Contact (POC)	
34	***Contractor End User POCs:*** Roland Brown, CH2M HILL (509) 373-5694; Roland_G_Brown@rl.gov
35	***DOE End User POCs:*** James F. Thompson, Jr, Office of River Protection, (509) 373-9757, James_f_jr_thompson@rl.gov
36*	***Other Contacts:*** Gorge Stanton, CH2M HILL, 509-373-5590, Fax: 509-373-6101, George_A_Jr_Stanton@rl.gov

Office of River Protection
Technology Opportunity Statement

General Reference Information	**ACTIVE**
2*	***Assigned Tracking Number:*** WT016
1*	***Title:*** Estimate long-term contaminant release potential from Glass Monolith Surface Area
3*	***Summary:*** A method is needed to estimate the surface area of vitrified low-activity waste (LAW) in order to estimate the total contaminant release from glasses for thousands of years. The contaminant release rate, affected by cracks in the glasses, is proportional to the surface area reachable by moving moisture. Much research has been directed toward the intrinsic rate, but little research has been directed toward the change of surface area with time. If assumptions of surface area are uncertain, then the performance assessments cannot easily be defended. This work is also important for alternate waste forms such as the supplemental technologies for immobilized LAW: bulk vitrification and containerized grout. Vendors awarded contracts in response to FY03 Requests for Proposals may supply this information.
38new	**Principal Contact:** F.M. (Fred) Mann, CH2M HILL, 509-373-3978, Fax: 509-373-3974, Frederick_m_mann@rl.gov
Technology Opportunity Description	
8A*	***Project:*** ☐ Safe Storage – Operations and Maintenance ☐ Safe Storage – Life Extension ☐ Waste Retrieval and Transfer – Waste Inventory Properties ☐ Waste Retrieval and Transfer – Equipment ☐ Closure X Disposal
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW13 Work Breakdown Structure (WBS) No.: 5.9.4
12A	***Problem Description:*** The total contaminant release rate from a glass waste form depends not only the intrinsic release rate but also the effective surface area over which that intrinsic release rate is applicable. Technologies are needed to measure the effective surface area (i.e. the total wetted area, including internal cracks, of the glass monolith) as well as the ability to project this quantity as a function of time. This need is described in Section 9.3.2 of the Office of River Protection Preliminary Integrated Technology Plan, DOE-ORP-2001-17, Rev 0.
9a*	***Priority:*** ☐ HIGH Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction X MEDIUM Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction ☐ LOW Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation

9b*	**Priorities**		
	Schedule Impact	☐ HIGH x MED ☐ LOW	Needed to meet PBIs Needed to meet mission targets (2033 closure) Can improve mission targets or no schedule impact
	Cost Savings	☐ HIGH ☐ MED x LOW	>$1B total life-cycle savings >$100M but <$1B total life-cycle savings <$100M total life-cycle savings
	Implementation Cost/Schedule	☐ HIGH x MED ☐ LOW	<$10M and <2 yrs. >$10M and <2 yrs or <$10M and > 2 yrs. >$10M and > 2yrs. or significant technical risk
	Baseline Risk Reduction	☐ HIGH x MED ☐ LOW	The baseline technical solution has not been proven at large scale or on actual radioactive waste. The baseline technical solution has been demonstrated at large scale, but not implemented in radioactive operations. The baseline technical solution has been implemented at Hanford.
Cost Information			
17A*	***Current Baseline Cost:*** Conservative extrapolations from 1980's waste forms.		
17B	***Estimated Cost Impact:*** Less bounding assumptions will allow higher waste loadings, which will accelerate schedule and reduce costs (~10^8 to ~10^9 dollars); Lower design requirements for the ILAW disposal facility (exceed 10^8 dollars)		
18*	***Cost Impact Explanation:*** A better understanding of long-term release might allow DOE to relax requirements for the short-term testing now required under the outsourcing contract. Possible cost savings could be in the hundreds of millions of dollars.		
Risk Information			
37 new	***Risk Identifier:*** ☐ CR-_____ [e.g., CR-047] ☐ New ***Risk Statement:*** If assumption of surface area are uncertain, then the performance assessments cannot easily be defended		
12B	***Risk Narrative:*** 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.		
Schedule Information			
21	***Regulatory Drivers:*** DOE Order 435.1 requires that waste acceptance criteria address chemical and structural stability of waste packages. The same order requires an assessment of long-term public health and safety. Contaminant release rates are an important input to this assessment. Long-term waste form testing is a requirement of the Hanford Site Waste Disposal Authorization Statement issued by EM-1. This effort will also support Washington State permitting requirements under WAC 173-303. PBI-2 requires completing construction of facility for 880 IHLW containers by 9/30/06. Complete construction of an ILAW disposal facility (13,000 to 15,000 containers) by 9/30/06.		
22*	***Milestones:*** Data Packages for 2005 ILAW PA		

28*	***Earliest Date Required:*** FY 2001
29*	***Latest Date Required:*** If waste tank waste treatment were accelerated, then this capability would be needed by 2006.
13B	***Schedule Explanation:*** A standard method for determining waste form release rate and supporting data is needed to prepare the ILAW product specifications for Phase II of the RPP/ORP outsourcing beginning in approximately 2006.
30	***Technology Insertion Point:*** ☐ New ☐ Existing Code: _____ Official Date: _____ Technology Insertion Point(s): 2005 ILAW PA Data Package
Additional Points of Contact (POC)	
34	***Contractor End User POCs:*** F.M. (Fred) Mann, CH2M HILL, 509-373-3978, Fax: 509-373-3974, Frederick_m_mann@rl.gov
35	***DOE End User POCs:*** P.E. (Philip) LaMont, DOE-RL/ORP, (509) 376-6117, Fax: (509) 373-0628, philip_e_lamont@rl.gov;
36*	***Other Contacts:*** Greg Parsons, CH2M HILL, (509) 371-3783, Fax: (509) 371-3510, greg_l_parsons@rl.gov K.A. (Ken) Gasper, CH2M HILL, 509-373-1948, F/509-373-9093, kenneth_a_ken_gasper@rl.gov

Office of River Protection
Technology Opportunity Statement

General Reference Information	**ACTIVE**
2*	***Assigned Tracking Number:*** WT017
1*	***Title:*** Long-Life Waste Isolation Surface Barrier
3*	***Summary:*** Long-term studies of surface barriers for Hanford waste sites inside the tank farms are needed to generate requirements and regulatory acceptance for the design, selection, validation, and monitoring results. The Hanford Surface Barrier has high performance, but it is too expensive for large surface areas to be covered.
38new	***Principal Contact:*** F.M. (Fred) Mann, CH2M HILL, 509-373-3978, Fax: 509-373-3974, Frederick_m_mann@rl.gov
Technology Opportunity Description	
8A*	***Project:*** ☐ Safe Storage – Operations and Maintenance ☐ Safe Storage – Life Extension ☐ Waste Retrieval and Transfer – Waste Inventory Properties ☐ Waste Retrieval and Transfer – Equipment ☐ Closure ☒ Disposal
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW04 (primary), ORP-TW13 (secondary) Work Breakdown Structure (WBS) No.: 5.8.5 (primary), 5.9.4 (secondary)
12A	***Problem Description:*** The 200 Area remediation includes a combination of removal and leave-in-place with in situ treatment and/or barrier placement strategies. Sites within areas that will be used for waste management and other industrial uses or sites where capping provides better, more cost-effective protection of human health and the environment are the main candidates for surface barriers. Failure to establish an acceptable long-life surface barrier could result in excavation requirements that would be cost prohibitive. Currently 99% of the high-level waste contained in the 177 tanks in the Hanford Site tank farms is planned to be retrieved. After further remediation, the tank farms are planned to be closed (including the use of a surface barrier). The retrieved waste will be separated into two streams, each of which is planned to be vitrified. The high-level waste will be stored at the Hanford Site until it is sent to a geological repository. The ILAW will be disposed onsite. Current closure plans include a surface barrier to limit infiltration. In FY 1997, Bechtel Hanford, Inc., and Pacific Northwest National Laboratory completed 3 years worth of field performance testing and monitoring for the Hanford Prototype Barrier as part of a treatability test. Additional but limited field performance testing and monitoring continues. The purpose of this treatability test was to demonstrate the effectiveness of construction techniques and barrier performance. Data from this test could also be used to demonstrate acceptability of less robust barriers for use at the Hanford Site. Data collected during these 4 years showed that the barrier worked as designed, but an acceptable methodology for extrapolating short-term data into long-term performance is still required. The areas that are currently planned to be completed within the Environmental Restoration (ER) Project to finalize the treatability testing are as follows:

	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 ensure 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 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 and warning systems will need to be addressed. Areas that are presently not funded that require further study prior to deployment of barriers at waste sites include the following: 1. Develop a model for extrapolating short-term data to address long-term performance that is acceptable to the DOE and regulators 2. Evaluate alternative materials and reduced thicknesses including alternatives to fluid-applied asphalt and the use of geoclay to allow a graded approach to barrier application 3. Analyze the edge effect of side slopes that use coarse materials such as gravel or large rocks for slope stability increase infiltration in those areas. This needs to be analyzed to determine if this is a significant issue that requires design changes 4. Evaluate long-term monitoring techniques, including a long-term, easy-to-use, soil moisture measurement device to monitor the cap performance. These techniques would ideally be non-intrusive with minimal potential for creating a preferential pathway circumventing the barrier integrity. NRC (NRC 2001) cited this as the major S&T need for the Hanford Site, and this is the top priority of core projects of the Hanford Groundwater / Vadose Zone Integration Project. However, due to the long-term nature of this need, and the other Hanford projects contributing to aspects of this need, the priority for further internal near-term funding this task from a tank closure perspective is currently set at a low priority This need is described in Section 10.3.11of the Office of River Protection Preliminary Integrated Technology Plan, DOE-ORP-2001-17, Rev 0.
9a*	***Priority:*** ☐ HIGH Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction ☐ MEDIUM Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction ☒ LOW Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation (Low Priority for Tank Closure Technology Opportunity)

9b*	**Priorities**		
	Schedule Impact	☐ HIGH x MED ☐ LOW	Needed to meet PBIs Needed to meet mission targets (2033 closure) Can improve mission targets or no schedule impact
	Cost Savings	x HIGH ☐ MED ☐ LOW	>$1B total life-cycle savings >$100M but <$1B total life-cycle savings <$100M total life-cycle savings
	Implementation Cost/Schedule	☐ HIGH x MED ☐ LOW	<$10M and <2 yrs. >$10M and <2 yrs or <$10M and > 2 yrs. >$10M and > 2yrs. or significant technical risk
	Baseline Risk Reduction	x HIGH ☐ MED ☐ LOW	The baseline technical solution has not been proven at large scale or on actual radioactive waste. The baseline technical solution has been demonstrated at large scale but not implemented in radioactive operations. The baseline technical solution has been implemented .
Cost Information			
17A*	***Current Baseline Cost:*** $		
17B	***Estimated Cost Impact:*** Improvements in specifications and implementation experience should save ~10^8 dollars; value would quadruple for Hanford Site		
18*	***Cost Impact Explanation:*** Barriers are a significant part of the baseline strategy for many sites in the 200 Area. Improvements in design would establish confidence in long-term performance and would greatly affect both waste management and environmental restoration budgets. National OST funding may be provided for F&R development. There are existing technologies and cheaper technologies are being tested.		
Risk Information			
37 new	***Risk Identifier:*** ☐ CR- [e.g., CR-047] ☒ New ***Risk Statement:*** If a subsurface barrier is not accepted by the regulators, the capping options will be rejected, thus requiring more expensive remediation methods.		
12B	***Risk Narrative:*** Reliance on existing testing programs to assess barrier performance. Potential for capping options to be rejected, thus requiring more expensive remediation methods. The requirements-setting documents may need to use conservative values or the facility design may be more expensive than necessary. In particular, more material than necessary may be used from an area of significant cultural value or the DOE may be forced to import suitable materials from a considerable distance. The RMM database should be queried for further risk information as it develops.		
Schedule Information			
21	***Regulatory Drivers:*** *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA), RCRA, and *Model Toxic Control Act* (MTCA) provide requirements for environmental remediation. DOE Order 435.1 (Radioactive Waste Management) provides requirements for radioactive waste. The length of time required to move contaminants from the disposal facility to groundwater is proportional to the amount of infiltration allowed through by the surface barrier. Given DOE's definition of the time of compliance as not more than 1,000 years, the design life of the surface barrier becomes an element in a defense in depth philosophy for waste disposal system design.		

22*	***Milestones:*** 2008 Closure of 200 Area Sites; 2024 closure of all SST farms; 2028 Closure of all tank farms
28*	***Earliest Date Required:*** 2001
29*	***Latest Date Required:*** 2010–If waste tank closure is accelerated, then this capability would be needed by FY2006.
13B	***Schedule Explanation:*** PBI-3 includes interim closure of M-45 high risk SSTs (S-112, S-102, C-104), C-106, 4 low risk/volume tanks, additional HLW tanks (>fee over and above 19), individual tank farms (> fee over and above 2), and 244-AR vault by 9/30/2006. This will be implemented beyond the CH2M HILL contract period.
30	***Technology Insertion Point:*** ☐ New ☒ Existing Code: _____ Official Date: _____ A cover has undergone short-term testing at the 200-BP-1 site at Hanford using environmental restoration funds. However, the funds are being greatly reduced and are scheduled to be eliminated. **Technology Insertion Point(s):** TIP 0001 (RL-ER-01); TIP 0002 (RL-ER02); TIP 0003 (RL-ER03)
Additional Points of Contact (POC)	
34	***Contractor End User POCs:*** Ron Calmus, CH2M HILL, (509) 372-3385; F/509-372-2862; ronald_b_calmus@rl.gov
35	***DOE End User POCs:*** P.E. (Phil) LaMont, DOE-ORP, 509-376-6117; F/509-372-1350, philip_e_lamont@rl.gov R.W. (Bob) Lober, DOE-ORP, 509-373-7949, F/509-373-1313, robert_w_lober@rl.gov Rob Yasek, DOE-ORP, 509-372-1270, Fax: 509-373-9140, Robert_M_Yasek@rl.gov
36*	***Other Contacts:*** K.A. (Ken) Gasper, CH2M HILL, 509-373-1948, F/509-373-9093, kenneth_a_ken_gasper@rl.gov

Office of River Protection
Technology Opportunity Statement

General Reference Information	**DEFERRED**
2*	***Assigned Tracking Number:*** WT021
1*	***Title:*** Improve Pit Remote Operation Tools
3*	***Summary:*** Current methods for working in high dose rate pits are labor intensive, costly, and result in a high worker dose. A commercial off the shelf remote arm and deployment platform was procured during FY01. The system (named "Pit Viper") was deployed in FY02 in support of the C-104 retrieval project. The deployment showed the need to enhance Pit Viper end effectors and control system to support a broader range of tank farm pits and activities. Study underway is identifying the specific type of pits, users, and specific job activities requiring remote equipment to meet future tank farm goals and commitments. PNNL Robotics is enhancing the control system. Note: The work was deferred in FY03. Issues have been resolved for mission work currently defined. The baseline is to avoid work in highly contaminated pits as much as possible. If highly contaminated pits must be accessed in the future or pits with planned work scope are more contaminated than previously thought, remote technology may be more safe and cost-effective than existing methods.
38new	***Principal Contact:*** John W. Hobbs, CH2M HILL, (509) 372-8676, John_Hobbs@rl.gov
Technology Opportunity Description	
8A*	***Project:*** ☐ Safe Storage – Operations and Maintenance ☐ Safe Storage – Life Extension ☐ Waste Retrieval and Transfer – Waste Inventory Properties X Waste Retrieval and Transfer – Equipment ☐ Closure ☐ Disposal
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW03 Work Breakdown Structure (WBS) No.: 5.7.1
12A	***Problem Description:*** A significant number of pit entries will be required to modify, upgrade, and or install equipment to support waste retrieval and transfer operations at Hanford. Current methods for working in pits rely on pole tools, mirrors, and other extended reach hand tools to perform pit activities. These methods are labor intensive, costly, and result in a high worker dose. During FY00 remote technologies and deployment configurations were evaluated for Hanford tank farm pits. A procurement specification was developed and a commercial off the shelf remote arm and deployment platform was procured during FY01. The first deployment of the system occurred in FY02, in support of C-104 retrieval preparation. A lessons-learned document was issued, that provided recommendations for improvements and development of end effectors and tooling configurations adapted to future uses. A review of potential future uses and their expected cost benefit is underway. A path forward needs to be developed to support funding decisions.
9A*	***Priority:*** X HIGH Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction ☐ MEDIUM Moderate cost benefit, near term implementation needed to achieve benefits,

		moderately easy to implement, moderate risk reduction ☐ LOW Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation	
9B	***Priority***		
	Schedule Impact	☐ HIGH ☐ MED ☒ LOW	Needed to meet PBIs Needed to meet mission targets (2033 closure) Can improve mission targets or no schedule impact
	Cost Savings	☐ HIGH ☒ MED ☐ LOW	>$1B total life-cycle savings >$100M but <$1B total life-cycle savings <$100M total life-cycle savings
	Implementation Cost/Schedule	☐ HIGH ☐ MED ☒ LOW	<$10M and <2 yrs. >$10M and <2 yrs or <$10M and > 2 yrs. >$10M and > 2yrs. or significant technical risk
	Baseline Risk Reduction	☐ HIGH The baseline technical solution has not be proven at large scale or on actual radioactive waste. ☐ MED The baseline technical solution has been demonstrated at large scale but not implemented in radioactive operations. ☒ LOW The baseline technical solution has been implemented at Hanford.	
Cost Information			
17A*	***Current Baseline Cost:*** $TBD Concerned Projects being identified		
17B	***Estimated Cost Impact:*** $TBD Path forward to be defined		
18*	***Cost Impact Explanation:*** Budget cost for Special Protective Coating for the 24 pits remaining in W-314 scope is estimated at about $1M. However, the actual cost could be significantly higher in case some of the pits have higher radiation doses than assumed. The potential cost avoidance is about $5M.		
Risk Information			
37 new	***Risk Identifier:*** ☒ RPP-CR-032 and RPP-CR-034 ☐ New ***Risk Statement:*** If the tank and pits are not acceptable for use, then design and construction activities will be impacted. If the pits cannot be cleaned to acceptable worker dose levels, then there may be cost increases and schedule delays. If pits (SY, S-12A, S-A, and S-C) are not acceptable for use, then design and construction activities will be impacted. If the pits to be upgraded are in worse physical condition than assumed, then additional repairs will be necessary resulting in increased construction costs and schedule delays. If high dose rate pits cannot be sufficiently decontaminated, then time-consuming and high worker exposure remote pit operations with pole tools will be necessary. Tank Farm Upgrades to support SST Retrieval and Waste Feed Delivery would then suffer cost increases and schedule delays.		
12B	***Risk Narrative:*** An example of pit activity is protective coating application by Project W-314: if pit conditions require extensive surface preparation, the cost of pit upgrades (especially SPC application) could far exceed baseline estimates. This is "high" risk for W-314. As a reference, Project W-320 encountered 40R dose rates in the C-106 pump pit. Decontamination operations		

	were only able to reduce exposure to 20R at cost of ~ 5 months and ~ $2M.
Schedule Information	
21	***Regulatory Drivers:*** The W-314 upgrades are driven by the TPA M-43 milestones
22*	***Milestones:*** TPA M-43 milestones
28*	***Earliest Date Required:*** *FY03 for W-314*
29*	***Latest Date Required:*** *FY05 for W-314, beyond for W-211, W-521 and SST retrieval Projects*
13B	***Schedule Explanation:*** Tank Farm pit Evaluation being developed by Technology Integration PNNL staff will identify potential technology needs and insertion points. No specific candidates have been identified. W-314 Pit Upgrades in SY, AW and AP are scheduled during the period FY03 to FY05. The W-314 upgrades are driven by the TPA M-43 milestones.
30	***Technology Insertion Point:*** ☐ New ☐ Existing Code: _____ Official Date: _____
Additional Points of Contact (POC)	
34	***Contractor End User POCs:*** John W. Hobbs, CH2M HILL, (509) 372-8676, John_Hobbs@rl.gov
35	***DOE End User POCs:*** *[name, organization, telephone, fax, email]*
36*	***Other Contacts:*** John Bailey, CH2M HILL Tel(509) 372-0045 Fax (509)372-2403 john_w_bailey@rl.gov ;Dan Baide, CH2M HILL Tel(509) 376-3274 Fax (509)373-6101 daniel_g_dan_baide@rl.gov

Office of River Protection
Technology Opportunity Statement

General Reference Information	**ACTIVE**
2*	***Assigned Tracking Number:*** WT022
1*	***Title:*** Improving the Tandem Synthetic Aperture Focusing Technique (TSAFT) for Double-Shell Tank (DST) Knuckle Flaw Characterization
3*	***Summary:*** NDE ultrasonic testing tools currently used cannot access the high stressed tank k knuckle region. The TSAFT technology, which is based on propagation of ultrasonic energy is planned for deployment in early FY03 for tank knuckle NDE. The technique deployed can only be deployed down a 24 inch riser limiting its access to the tank, can only detect and size cracks parallel to the transducer beam, and can't identify if the crack is on the inside or the outside of the primary tank, which may lead to overly pessimistic conclusions. Enhanced capabilities could be developed based on work being conducted by PNNL for SR. This Technical Opportunity Statement addresses Tough Technical Problem # 18: Need for DST tank integrity inspection higher up in the tank than CH2M HILL has done previously, as CH2M HILL plans to fill the DSTs to the curvature leading into the dome. The RONDE system, recently deployed by CH2M HILL for the DST Integrity Program, could be utilized to start the inspection process of the DSTs. While it may need to be modified for use in the upper reaches of the annulus, the technology should be applicable for inspection of the upper regions of the primary liner. POC is Jim Honeyman. This Technical Opportunity Statement addresses Tough Technical Problem #23: Potential improvements for ultrasonic testing of DST knuckles, POC is Doug Larsen.
38new	***Principal Contact:*** Jim Castleberry, (509) 373-5011, Jim_l_castleberry@rl.gov
Technology Opportunity Description	
8A*	***Project:*** ☐ Safe Storage – Operations and Maintenance X Safe Storage – Life Extension ☐ Waste Retrieval and Transfer – Waste Inventory Properties ☐ Waste Retrieval and Transfer – Equipment ☐ Closure ☐ Disposal
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW03 Work Breakdown Structure (WBS) No.: 5.7.2
12A	***Problem Description:*** Compliance to Washington Administrative Code (WAC) 173-303-640 requires life cycle integrity assessments, including non-destructive evaluation (NDE) of 6 DSTs on a portion of the tank wall, bottom knuckle, and bottom. Washington Administrative Order 00NWPKW-1250/1251 provides additional examination requirements for knuckle examinations. Additional DSTs will be selected for NDE based upon examination results. NDE equipment must be deployed to fulfill this requirement. Fracture mechanics analysis indicates that the knuckle region of the DST that rests on the concrete foundation is the highest-stressed region of the tanks. This high-stressed region is not accessible using current ultrasonic technology. The TSAFT technology, which is based on propagation of ultrasonic energy is planned for deployment in early FY03 for tank knuckle NDE. The technique deployed can only be deployed down a 24 inch riser limiting its access to the tank, can only detect and size cracks parallel to the

	transducer beam, and can't identify if the crack is on the inside or the outside of the primary tank, which may lead to overly pessimistic conclusions. Enhanced capabilities could be developed based on work being conducted by PNNL for SR.
9* old	***Priority:*** ☐ HIGH Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction X MEDIUM Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction ☐ LOW Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation
9*	***Priority***

Schedule Impact	☐ HIGH ☒ MED ☐ LOW	Needed to meet PBIs Needed to meet mission targets (2033 closure) Can improve mission targets or no schedule impact
Cost Savings	☐ HIGH ☐ MED ☒ LOW	>$1B total life-cycle savings >$100M but <$1B total life-cycle savings <$100M total life-cycle savings
Implementation Cost/Schedule	☒ HIGH ☐ MED ☐ LOW	<$10M and <2 yrs. >$10M and <2 yrs or <$10M and > 2 yrs. >$10M and > 2yrs. or significant technical risk
Baseline Risk Reduction	☐ HIGH ☒ MED ☐ LOW	The baseline technical solution has not been proven at large scale or on actual radioactive waste. The baseline technical solution has been demonstrated at large scale but not implemented in radioactive operations. The baseline technical solution has been implemented at Hanford.

Cost Information	
17A*	***Current Baseline Cost:*** $ Equipment replacement dollars for UT crawlers will be used in FY04 to fund an enhanced TSAFT. The enhanced TSAFT will put transducers further down the tank knuckle curvature area and use a different frequency transducer to give better image and data.
17B	***Estimated Cost Impact:*** $TBD
18*	***Cost Impact Explanation:*** $0.6M to improve the flaw detection capability and develop next generation tool.
Risk Information	
37 new	***Risk Identifier:*** ☒ CR-070A [e.g., CR-047] ☒ New ***Risk Statement:*** If the TSAFT technology is not enhanced, then DST knuckle NDE may lead to falsely alarming measurements and result in unnecessary costs. If the TSAFTTM fails to examine the high stress region of the DSTs, then an additional technology will have to be developed, tested, and deployed at added costs and delays. (FORCE Institute Y-Arm (extended arm) selected for examining lower knuckle cannot reach predicted location of maximum stress (at tangent point between curved portion and flat bottom).) DST Space Availability (RPP-CR-014, CR-070A). DST integrity and space saving initiatives must be successful to avoid replanning of the TFC baseline strategy (including possible tank sequencing adjustments and potential construction of new tanks) and support accomplishment of accelerated cleanup initiatives.

12B	***Risk Narrative:*** *[further explanation, if warranted]*
Schedule Information	
21	***Regulatory Drivers:*** Completion of the physical examinations of the DSTs is required by WAC commitment and as a prerequisite for obtaining Resource Conservation and Recovery Act (RCRA) Part B permit status for continued operation of the DST system. Washington Administrative Code 173-303-640(2)(c)(v) requires a physical examination or leak test as a part of an integrity assessment program. Washington Administrative Order 00NWPKW-1250/1251 requires examination of knuckle areas by FY 2005.
22*	***Milestones:*** TPA and WAC for FY2005
28*	***Earliest Date Required:*** *[month, year]*
29*	***Latest Date Required:*** *[month, year]*
13B	***Schedule Explanation:*** Deployment of first generation TSAFT planned in early FY03
30	***Technology Insertion Point:*** ☐ New ☐ Existing Code: Official Date:
Additional Points of Contact (POC)	
34	***Contractor End User POCs:*** Jim Castleberry, (509) 373-5011, jim_l_castleberry@rl.gov; Gary, CH2M HILL (509) 376-6008, F (509) 372-0065, gary_p_duncan@rl.gov; C.E. (Chris) Jensen, CH2M HILL, (509) 373-5058, chris_e_jensen@rl.gov; Wes Bryan CH2M HILL (509) 373-9740, F (509) 372-0065, wes_bryan@rl.gov
35	***DOE End User POCs:*** Vic Callahan, (509) 373-9880, victor_l_callahan@rl.gov
36*	***Other Contacts:*** Jim Honeyman, CH2M HILL, (509) 376-740; james_o_jim_honeyman@rl.gov; Doug Larsen, CH2M HILL, (509) 373-5995, douglas_c_larsen@rl.gov

Office of River Protection
Technology Opportunity Statement

General Reference Information	**ACTIVE**
2*	***Assigned Tracking Number:*** WT026 / WT027
1*	***Title:*** Tank Leak Detection, Monitoring and Mitigation (LDMM) Systems
3*	***Summary:*** Leak detection methods must be able to detect and quantify (monitor) tank waste leakage into the vadose zone immediately surrounding the SST's in a timely and cost effective manner. Cost effective, risk reducing leak mitigation efforts and tools may also be considered for use. This technology opportunity statement is also supported by other, more specific, need statements that address the development and demonstration of leak mitigation technologies such as "getter materials" to reduce contaminant mobility. Technology Opportunity Statement WT046S, and "reactive barriers to contaminant migration" Technology Opportunity Statement WT061. Leak detectors were identified as a tough technical problem (#19) in FY03. Currently saltcake waste retrievals from Tanks S-112 and S-102 will rely on the present LDMM technique, which uses material balance information. Ecology seeks best available LDMM technology to be deployed for retrieval later in FY04 of Tanks S-103 and S-106.
38new	***Principal Contact:*** Warren Thompson, 372-8053
Technology Opportunity Description	
8A*	***Project:*** ☐ Safe Storage – Operations and Maintenance ☐ Safe Storage – Life Extension X Waste Retrieval and Transfer – Waste Inventory Properties X Waste Retrieval and Transfer – Equipment ☐ Closure ☐ Disposal
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW04 Work Breakdown Structure (WBS) No.: 5.08.05 Retrieval/Closure Program
12A	***Problem Description:*** Improvements are needed in both in-tank and ex-tank leak detection methods for use while wastes are being retrieved and transferred from potentially leaking SSTs. Currently, mass balance calculations based on static liquid levels have a potential error factor equal to four- to eight-thousand gallons while dynamic mass balance methods for salt tanks can have uncertainties as large as one hundred thousand gallons and a stable static liquid surface is not available during the bulk of salt retrieval by modified sluicing. Furthermore, leaks must carry gamma-emitting waste to within one half to one meter of existing dry wells before they can be detected with high-resolution spectral gamma systems. Neutron moisture detectors require the plume to come within 150 cm of the dry wells. Given the limits of present leak detection systems, more accurate mass balance determinations are needed. Both in-tank and ex-tank leak detection systems that improve on the capabilities of the current baseline approach are needed. The objective is to detect a minimum quantity of liquid escaping the containment of a waste tank in real time and monitor the amount lost so that appropriate mitigation measures can be implemented. The tank farm areas are congested with underground utilities and pipelines, so instrumentation deployed deep in the ground must take into consideration the difficulty, expense and schedule impact of placing sensing probes. There are relatively few access ports (tank risers)

available for deployment of sensors inside a tank. Leak detection technologies capable of utilizing the existing infrastructure of steel-cased dry wells are desirable. Six to eight drywells are located around each 75-ft diameter Single Shell Tank.

The site geology, although relatively uniform, contains lenses of silt and gravel that can affect the subsurface migration of tank waste leaks. Furthermore, geologic anomalies (e.g., clastic dikes) can exist further complicating the subsurface migration of tank waste leaks.

While dry wells extend around the immediate periphery of most SST's to depths ranging from 80 to 130 feet, there are no operating well structures that allow detection directly beneath the tanks to allowing detection of potential leaks moving vertically from the center of the tank. Possible solutions are tracer, electrical, electromagnetic, seismic, radar, and other techniques capable of leak detection throughout the volume of soil surrounding a tank to enable early, reliable, and accurate leak detection. It is desirable for leak detection technologies to have a 95% probability of detection with no more than a 5% probability of false alarms. It is also desirable for leak detection technologies to be capable of using the existing infrastructure of steel-cased dry wells to minimize deployment costs. Better in-tank leak detection methods are also important and could include spectral gamma detection techniques, pressure transducer technology, and other methods.

Mitigating systems that improve on the capabilities of the current baseline approach could be considered. The objective is to prevent, curb, or eliminate the possibility or extent of liquid waste leakage from underground storage tanks into the surrounding soils. If cost-benefit, risk-reduction, and alternatives evaluations of new in-tank and ex-tank mitigating technologies determine that deployment, implementation, and operation is feasible, then further evaluation should be pursued. Such evaluations may include bench- and field-scale demonstrations and testing. Example concepts that could be evaluated include retrieval methods and operating strategies that minimize the potential for leakage, leak point and potential leak point location, seek-and-seal devices and methods, administrative approaches that maximize the use and coordination of currently available tools and methods including such things as sheet pile barriers, close-coupled grout injection barriers, dry-air containment barriers, auxiliary pumping schemes, reactive zones/barriers, "stop-leak" formulations, waste mining strategies, and other approaches.

In FY02 a down-select process was used where 8 technologies were evaluated on their moisture detection performance and their ability to be deployed on an underground single-shell tank. This let to Electrical Resistance Tomography (ERT) and High Resolution Resistivity (HRR) methods being selected for further testing.

Following this down-select, a 110 day leak testing was completed at the Hanford 105A mock tank cold test site in FY 2002-03 within the ERT and HRR methods. Data were obtained for several electrode arrangements, including long vertical electrodes, vertical electrodes arrays, and surface electrodes. Data were recorded for all methods during the 110 day test which included 13 injection leak cycles. A statistically based assessment was completed of the ERT and HRR methods tested in the 110 day 105A mock tank tests in FY 2002-03. The assessment was based on the EPA statistical methods for assessing tank leak methods. The assessment provides a leak detection performance level based on a 95% probability of detection with a 5% false alarm probability.

An HRR based method is currently being readied for a deployment test and an injection leak test on an SST during waste retrieval campaign in FY2004 on Tank S-103. The HRR method was

	chosen based on a number of performance attributes that include sensitivity, ability to sense the whole volume under an SST, ability to provide 2-dimensional data to localize the leak point, and the ability to use existing tank infrastructure (drywells) as electrodes. A deployment test will evaluate compatibility with the waste retrieval system and the injection leak test will confirm leak detection performance.
9A*	***Priority:*** ☐ HIGH Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction X MEDIUM Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction ☐ LOW Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation
9B	***Priority***

Schedule Impact	☐ HIGH ☐ MED ☐ LOW	Needed to meet PBIs Needed to meet mission targets (2033 closure) Can improve mission targets or no schedule impact
Cost Savings	☐ HIGH ☐ MED ☐ LOW	>$1B total life-cycle savings >$100M but <$1B total life-cycle savings <$100M total life-cycle savings
Implementation Cost/Schedule	☐ HIGH ☐ MED ☐ LOW	<$10M and <2 yrs. >$10M and <2 yrs or <$10M and > 2 yrs. >$10M and > 2yrs. or significant technical risk
Baseline Risk Reduction	☐ HIGH ☐ MED ☐ LOW	The baseline technical solution has not be proven at large scale or on actual radioactive waste. The baseline technical solution has been demonstrated at large scale but not implemented in radioactive operations. The baseline technical solution has been implemented at Hanford.

Cost Information	
17A*	***Current Baseline Cost:*** $ 1,000,000
17B	***Estimated Cost Impact:*** $ None
18*	***Cost Impact Explanation:*** The working assumption is that no new LDMM technology will be required for the next four years for scheduled retrieval of non-leaking tanks, and vacuum retrieval of leaking 200 series tanks. The cost is based on using drywell logging services for four years plus some additional level measuring equipment. This is predicated on regulator approval to proceed with tank waste retrieval on this basis. Baseline cost estimate is based on retrieval of 40 tanks in the next four years. Limited LDMM testing may be needed to address tank retrieval in the post 2006 time frame.
Risk Information	
37 new	***Risk Identifier:*** ☐ CR- [e.g., CR-047] ☐ New ***Risk Statement:*** If improved LDMM capabilities are not available, then it is assumed that existing LDMM methods will be approved by the regulators for use with modified sluicing. OGT Design. Failure to identify an effective means to prevent reoccurrence of primary line leak will result in negative impacts to the specific operation while a replacement is sought and negative impacts to follow on projects planning use of the HIHTL system if it is deemed

	unreliable. LDMM S-102 [RE23], W-211[RE07], S-112[RE03]. If regulators or DOE require unplanned ex-tank LDMM Systems be deployed, then the cost and schedule will be impacted.
12B	***Risk Narrative:*** The Washington State Department of Ecology (Ecology) has been very pro-active with the leak detection, monitoring, and mitigation (LDMM) that is currently being planned for testing on Hanford's Tank S-103. Ecology has identified a number of objectives that an LDMM system must provide if it is to be used for tank leak detection. Ecology has rejected the baseline gamma and neutron moisture monitoring methods as being adequate to monitor for tank leaks during waste retrievals of tank that contain "several thousands of gallons of fluid:" ▪ The leak detection system should be capable of detecting relatively small leaks (2,000 gallons or less) with a 95% probability of detection and a minimum 5% probability of positive false alarm. ▪ Leaks are to be detected in a timely manner, i.e., within 24 hours of the escape of liquids from containment. ▪ Leak volumes and leak rates must be reasonably calculated to the extent possible, in a timely manner. ▪ Data can be rapidly reduced to provide results allowing for timely retrieval/closure action decisions by site owners/operators and regulators. ▪ LDM should interrogate the entire environment surrounding an SST (not simply selected sample points) and should have the potential to assess impacts from a leak within the operating system. ▪ LDM should track lateral and vertical movement of any leak within the above criteria. ▪ Leak detection methods should be based on best available technology applicable to the tank waste type and retrieval method.
Schedule Information	
21	***Regulatory Drivers:*** It is planned with Ecology concurrence that initial retrievals of C-106, S-112 and S-102 will utilize existing LDMM methods. A demonstration of the HRR will be carried out as part of S-103 retrieval.
22*	***Milestones:*** T04-03-100, T04-01-341, T04-03-341,T04-04-110, T04-04-120, M-45 Series of TPA milestones (These milestones are expected to be renegotiated to accept currently available LDMM methods)
28*	***Earliest Date Required:*** *9/30/03*
29*	***Latest Date Required:*** *9/30/06*
13B	***Schedule Explanation:*** The early date supports application in an early retrieval project if a cost-effective improvement is selected for use. The late date supports the beginning of retrieval of large leaking SSTs if cost effective methods are identified. This need supports currently negotiated Tri-Party Agreement milestones for development and deployment of waste tank leak detection, monitoring, and mitigation (LDMM) techniques and for completing leak detection, monitoring, and mitigation (LDMM) system design by May 2003 (Assumed to be renegotiated)
30	***Technology Insertion Point:*** ☐ New ☐ Existing Code: Official Date: 1. Annual progress report on the development of waste tank LDMM activities in support of TPA milestone M-45-08, 9/30/02 (required 9/30/2000 and thereafter). (Assumed to be removed by negotiation) 2. Any new LDMM technologies could be applied to any of the 40 tanks scheduled to be retrieved after 9/30/2003. This includes S-112. C-201. C-202. C-203. C-204 that are scheduled to

	begin at the last quarter of 2003 and the first quarter of FY2004. T-110 is the first large leaker to be retrieved with the MRS, scheduled for 2005. Additional leakers will be retrieved after 2006. 3. Performance Based Incentive PBI-3 identifies S-112, S-102, and C-104 retrieval and interim closure in accordance with M-45 milestones. (Assumed to be renegotiated to accept current LDMM methods)
Additional Points of Contact (POC)	
34	***Contractor End User POCs:*** Warren Thompson, CH2M HILL, (509) 372-8053 warren_t_thompson@rl.gov
35	***DOE End User POCs:*** Roger Quintero, (509) 373-0421, roger_a_quintero@rl.gov Rob Yasek, (509) 372-1270, Robert_M_Yasek@rl.gov Bob Lober, (509) 373-7949, Robert_w_lober@rl.gov
36*	***Other Contacts:*** Fred Reich, COGEMA Engineering, 509-373-0598, Fax: 509-372-2825, Frederick_R_Fred_Reich@rl.gov Moses N. Jarayssi, CH2M HILL, 509-372-9242, Fax: 509-373-9093 K.A. (Ken) Gasper, CH2M HILL, 509-373-1948, FAX: 509-373-9093, kenneth_a_ken_gasper@rl.gov

Office of River Protection
Technology Opportunity Statement

General Reference Information	**PART CLOSED AND PART DEFERRED**
2*	***Assigned Tracking Number:*** WT032
1*	***Title*:** Control of Retrieved Waste Dilution
3*	***Summary***: Solids content in retrieved and transferred slurries from Hanford tanks needs to be controlled for several reasons: • Solid contents in transferred slurries needs to be limited to prevent line plugging • Storage tank space in Double-Shell Tanks (DSTs) is limited; the addition of excessive amounts of water during retrieval of Single-Shell Tanks (SSTs) waste into DSTs would require additional evaporator campaigns, and therefore delay subsequent SST retrievals • The Waste Treatment Plant will receive waste from Double-Shell Tanks, with specific solid concentration requirements. Low-activity waste must be delivered with no greater than 2 wt% solids (dry basis). High-level waste must be delivered at between 10 and 200 grams solids per liter, which equates to a lower limit of approximately 1-wt% solids. Various methods will be used to retrieve and transfer slurries from SSTs and DSTs: • Sluicing (in SSTs) for dissolution or suspension • Vacuum retrieval with air/water addition into intermediate tank, then transfer pump • Mixer pump and transfer pump (in DSTs) Depending on the retrieval method used, solids concentration will be intrinsically controlled by the retrieval method, or will require measurement as part of a process control system. Instruments previously used or planned for retrieval systems include: • Volume flow meter (measures volumetric flow rate) • Coriolis effect mass flow meter (measures mass flow rate and density) • Ultrasonic densitometer (measures slurry density) • Fluid and solid monitor (measures slurry density and solids concentration) Combined measurements of volume flow and mass flow, or the measurement of density allow a calculation of solids concentrations as long as the liquid density is known. This calculation was used in the previous retrieval of SST C-106 by sluicing, where the liquid density was measured on a sample prior to the retrieval, and only limited (or known) changes in density occurred because the sluicing fluid was the tank supernate. However, this will not be the case in future retrievals, and an independent measurement of the liquid density might be necessary. Dual Coriolis effect mass flow meters would potentially meet this need, but they require the use of a filter on a derived stream, and create a plugging risk. Coriolis flow meters are being incorporated into designs for salt cake and sludge retrieval from SSTs. Although measurement of suspended solids is not quantitatively possible the measurement provides a process indicator relative to susceptibility to plugging. Operations expects to empirically establish a set point(s) that provides protection from plugging without excessive water addition. This approach satisfies the need for retrieval and transfer within the tank farm. Transfers to WTP, however, have quantitative specifications and the operating set points from a single

	Coriolis meter cannot be used to validate that waste delivered to WTP is within specifications. Readily available instruments that would allow on-line measurement of solids concentration are needed to support delivery of waste feed to the WTP.
38new	***Principal Contact:*** W. Blaine Barton, CH2M HILL, 509-376-5118, F/509-373-4641, w_b_blaine_barton@rl.gov
Technology Opportunity Description	
8A*	***Project:*** ☐ Safe Storage – Operations and Maintenance ☐ Safe Storage – Life Extension ☐ Waste Retrieval and Transfer – Waste Inventory Properties X Waste Retrieval and Transfer – Equipment ☐ Closure ☐ Disposal ☐ Supplemental Treatment
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW04 Work Breakdown Structure (WBS) No.: 5.8.2
12A	***Problem Description:*** See Summary
9*	***Priorities:***

Schedule Impact	☐ HIGH X MED ☐ LOW	Needed to meet PBIs Needed to meet mission targets (2033 closure) no schedule impact or can improve mission targets (<2033 closure).
Cost Savings	☐ HIGH ☐ MED X LOW	>$1B total life-cycle savings >$100M but <$1B total life-cycle savings <$100M total life-cycle savings
Implementation Cost/Schedule	☐ HIGH ☐ MED X LOW	<$10M and <2 yrs. >$10M and <2 yrs or <$10M and > 2 yrs. >$10M and > 2yrs. or significant technical risk
Baseline Risk Reduction	X HIGH ☐ MED ☐ LOW	The baseline technical solution has not been proven at large scale or on actual radioactive waste. The baseline technical solution has been demonstrated at large scale but not implemented in radioactive operations. The baseline technical solution has been implemented at Hanford.

Cost Information	
17A*	***Current Baseline Cost:*** $
17B	***Estimated Cost Impact:*** $
18*	***Cost Impact Explanation:*** Deployment of in-situ solids concentration instrumentation could provide cost savings by avoiding the use of excessive amounts of water to retrieve SSTs and delivery of waste feed outside specification requirements to WTP.
Risk Information	
37	***Risk Identifier:*** ☐ CR- [e.g., CR-047] ☐ New

new	***Risk Statement:*** If solids content is not accurately detected, excessive amounts of water may be used to retrieve SSTs, resulting in DST storage space shortage and mission delays, or out of spec feed might be delivered to the WTP resulting in process delays and increased cost.
12B	***Risk Narrative:***
Schedule Information	
21	***Regulatory Drivers:*** N/A
22*	***Milestones:***
28*	***Earliest Date Required:*** FY 2002
29*	***Latest Date Required:*** September 2010
13B	***Schedule Explanation:*** Deployment of functional systems for solids content as soon as possible will minimize the cost impacts due to changes in the existing baseline the retrieval system design.
30	***Technology Insertion Point:*** ☐ New ☐ Existing Code: _____ Official Date: _____
Additional Points of Contact (POC)	
34	***Contractor End User POCs:*** W. Blaine Barton, CH2M HILL, 509-376-5118, F/509-373-4641, w_b_blaine_barton@rl.gov Dan Reynolds, CH2M HILL, 373-3115, daniel_a_reynolds@rl.gov
35	***DOE End User POCs:*** Roger Quintero, DOE-ORP, 509-373-0421, Fax: 509-373-1313, roger_a_quintero@rl.gov; James F. Thompson, Jr, Office of River Protection, (509) 373-9757, james_f_jr_thompson@rl.gov
36*	***Other Contacts:*** K.A. (Ken) Gasper, CH2M HILL, 509-373-1948, FAX: 509-373-9093, kenneth_a_ken_gasper@rl.gov

Office of River Protection
Technology Opportunity Statement

General Reference Information	**ACTIVE**
2*	***Assigned Tracking Number:*** WT035-S
1*	***Title:*** Moisture Flow and Contaminant Transport in Arid Conditions
3*	***Summary:*** Tested theories and equations are needed for performance assessments to predict moisture movement and contaminant transport beneath the tank farms and RPP facilities. The Hanford underground conditions are very low moisture, so that water flows are more often horizontal than vertical. Better methods and data will improve the quality of risk assessments; and demonstrate that fluid flow through porous media is the correct model.
38new	***Principal Contact:*** Fred Mann, CH2M HILL, 509-373-3978, Fax: 509-373-3974, frederick_m_mann@rl.gov; Frank Anderson, CH2M HILL, 509-373-3971, Fax: 509-373-3974, frank_j_anderson@rl.gov
Technology Opportunity Description	
8A*	***Project:*** ☐ Safe Storage – Operations and Maintenance ☐ Safe Storage – Life Extension ☐ Waste Retrieval and Transfer – Waste Inventory Properties ☐ Waste Retrieval and Transfer – Equipment ☒ Closure ☒ Disposal
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW04 (primary), ORP-TW13 (secondary) Work Breakdown Structure (WBS) No.: 5.8.5 (primary), 5.9.4 (secondary)
12A	***Problem 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 database from which an understanding can be developed. The movement of water in both liquid and vapor phases is of interest because of the high salt content of many DOE waste types and forms. On degradation, waste containing high salt contents may raise the salt content of soil moisture in the liquid phase, causing soil vapor to be drawn to the waste. However, the formation of secondary minerals could consume soil water, and thus a limited supply of soil water could decrease the release process. The physics of multiphase water flow and the tradeoffs between vapor phase flow and waters of reaction must be better understood to quantify the potential releases from waste forms. 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. This need is described in Section 10.3.7 of the Office of River Protection Preliminary Integrated Technology Plan, DOE-ORP-2001-17, Rev 0.
9a*	***Priority:*** ☐ HIGH Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction ☒ MEDIUM Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction ☐ LOW Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation
9b*	**Priorities**

Schedule Impact	☐ HIGH ☐ MED x LOW	Needed to meet PBIs Needed to meet mission targets (2033 closure) Can improve mission targets or no schedule impact
Cost Savings	x HIGH ☐ MED ☐ LOW	>$1B total life-cycle savings >$100M but <$1B total life-cycle savings <$100M total life-cycle savings
Implementation Cost/Schedule	☐ HIGH x MED ☐ LOW	<$10M and <2 yrs. >$10M and <2 yrs or <$10M and > 2 yrs. >$10M and > 2yrs. or significant technical risk
Baseline Risk Reduction	x HIGH ☐ MED ☐ LOW	The baseline technical solution has not been proven at large scale or on actual radioactive waste. The baseline technical solution has been demonstrated at large scale, but not implemented in radioactive operations. The baseline technical solution has been implemented at Hanford.

Cost Information	
17A*	***Current Baseline Cost:*** Laboratory measurements of hydraulic and chemical properties.
17B	***Estimated Cost Impact:*** Lessen retrieval/closure requirements (~10^8 to 10^9 dollars); Less bounding assumptions on ILAW will allow higher waste loadings, which will accelerate schedule and reduce costs (~10^8 to 10^9 dollars); Lower design requirements for the ILAW disposal facility (exceed 10^8 dollars)
18*	***Cost Impact Explanation:*** 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.
Risk Information	
37 new	***Risk Identifier:*** ☐ CR- [e.g., CR-047] ☒ New ***Risk Statement:*** If methods and data result in an incorrect estimate of environmental impact, it will be impossible to assure the public that the DOE can predict the impact of leaving (1) waste in the tanks and their associated subsurface contamination in place and (2) leaving immobilized

	waste in onsite ILAW disposal facilities.
12B	***Risk Narrative:*** Conservative methods and data will be used in the performance assessments, likely requiring more stringent contaminant release specifications in the waste product request for proposal and requiring more expensive disposal facilities. The RMM database should be queried for further risk information.
Schedule Information	
21	***Regulatory Drivers:*** Performance assessments are required by DOE Order 435.1 as well as RCRA and CERCLA. Composite analyses, which also require knowledge of recharge, are also required under the new DOE order. The Washington State Department of Ecology and the Environmental Protection Agency have expressed concern that the Hanford Site does not understand the conceptual model for moisture flow and contaminant transport through the vadose zone.
22*	***Milestones:*** Data Packages for 2005 ILAW PA (2004); Tank Farm RFI Report (2007); 200 Area RFI reports (through 2008)
28*	***Earliest Date Required:*** ASAP
29*	***Latest Date Required:*** If the tank closure is accelerated, then this capability could be required by FY2006.
13B	***Schedule Explanation:*** For use during the maintenance phase of Hanford Immobilized Low-Activity Tank Waste Performance Assessments, such data and testing are needed by 2005. Information for tank farm assessments and for 200 Area Remediation sites is needed in a similar time frame. PBI-3 includes interim closure of M-45 high-risk SSTs (S-112, S-102, C-104), C-106, 4 low-risk/volume tanks, additional HLW tanks (>fee over and above 19), individual tank farms (> fee over and above 2), and 244-AR vault by 9/30/2006.
30	***Technology Insertion Point:*** ☐ New ☒ Existing Code: _____ Official Date: _____ Technology Insertion Point(s): TIP 0001 (RL-ER01), TIP 0002 (RL-ER02), TIP 0003 (RL-ER03)
Additional Points of Contact (POC)	
34	***Contractor End User POCs:*** Ron Calmus, CH2M HILL, (509) 372-3385; F/509-372-2862; ronald_b_calmus@rl.gov
35	***DOE End User POCs:*** P.E. (Phil) LaMont, DOE-ORP, 509-376-6117; F/509-372-1350, philip_e_lamont@rl.gov R.W. (Bob) Lober, DOE-ORP, 509-373-7949, F/509-373-1313, robert_w_lober@rl.gov Rob Yasek, DOE-ORP, 509-372-1270, Fax: 509-373-9140, robert_m_yasek@rl.gov
36*	***Other Contacts:*** K.A. (Ken) Gasper, CH2M HILL, 509-3731-1948, F/509-373-9093, kenneth_a_ken_gasper@rl.gov

Office of River Protection
Technology Opportunity Statement

General Reference Information			**ACTIVE**
2*	***Assigned Tracking Number:*** WT044-S		
1*	***Title*:** Distribution of Recharge Rates		
3*	***Summary:*** Fundamental data is needed to improve confidence in estimating recharge rates as a function of time and space for use in impact assessments under realistic conditions. Hanford Site impacts assessments (e.g. Hanford Immobilized Low-Activity Tank Waste Performance Assessment and Retrieval Performance Evaluation) have shown significant dependence of impacts on recharge rate. Such conclusions are reinforced by Hanford Site work for the Nuclear Regulatory Commission on the importance of surface barriers. While short-term measurements of natural recharge rates are known at local scales, sound estimates must cover many acres and time periods of thousands of years.		
38new	***Principal Contact:*** Fred Mann, CH2M HILL, 509-373-3978, Fax: 509-373-3974, frederick_m_mann@rl.gov; Frank Anderson, CH2M HILL, 509-373-3971, Fax: 509-373-3974, frank_j_anderson@rl.gov		
Technology Opportunity Description			
8A*	***Project:*** ☐ Safe Storage – Operations and Maintenance ☐ Safe Storage – Life Extension ☐ Waste Retrieval and Transfer – Waste Inventory Properties ☐ Waste Retrieval and Transfer – Equipment ☒ Closure ☐ Disposal		
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW04 (primary), ORP-TW13 (secondary) Work Breakdown Structure (WBS) No.: 5.8.5 (primary), 5.9.4 (secondary)		
12A	***Problem Description:***		
9a*	***Priority:*** ☒ HIGH Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction *(High Priority as a Science Opportunity)* ☐ MEDIUM Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction ☐ LOW Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation		
9b	**Priorities**		
	Schedule Impact	☐ HIGH ☐ MED x LOW	Needed to meet PBIs Needed to meet mission targets (2033 closure) Can improve mission targets or no schedule impact
	Cost Savings	x HIGH ☐ MED ☐ LOW	>$1B total life-cycle savings >$100M but <$1B total life-cycle savings <$100M total life-cycle savings
	Implementation Cost/Schedule	☐ HIGH x MED ☐ LOW	<$10M and <2 yrs. >$10M and <2 yrs or <$10M and > 2 yrs. >$10M and > 2yrs. or significant technical risk

	Baseline Risk Reduction	x HIGH ☐ MED ☐ LOW	The baseline technical solution has not been proven at large scale or on actual radioactive waste. The baseline technical solution has been demonstrated at large scale, but not implemented in radioactive operations. The baseline technical solution has been implemented at Hanford.
Cost Information			
17A*	***Current Baseline Cost:*** Indeterminate. Point estimates of recharge and laboratory measurements of hydraulic properties on small cores.		
17B	***Estimated Cost Impact:*** Lessen retrieval/closure requirements (~10^8 to 10^9 dollars); Less bounding assumptions on ILAW will allow higher waste loadings, which will accelerate schedule and reduce costs (~10^8 to ~10^9 dollars); Lower design requirements for the ILAW disposal facility (exceed 10^8 dollars)		
18*	***Cost Impact Explanation:*** Less conservative values for hydraulic properties and recharge rates in and around disposal and tank farm facilities will allow less stringent release contaminant specifications as well as less stringent requirements for waste disposal facility design.		
Risk Information			
37 new	***Risk Identifier:*** ☐ CR- [e.g., CR-047] ☒ New ***Risk Statement:*** If methods and data result in an incorrect estimate of environmental impact, it will be impossible to assure the public that the DOE can predict the impact of (1) leaving waste in the tanks and associated subsurface contamination in place and (2) leaving immobilized waste in onsite ILAW disposal facilities.		
12B	***Risk Narrative:*** Conservative methods and data will be used in impact assessments, likely requiring more stringent contaminant release specifications in the waste product request for proposal and requiring more expensive disposal facilities. The RMM database should be queried for further risk information as it becomes available.		
Schedule Information			
21	***Regulatory Drivers:*** Impact analyses are required under AEA, CRCLA, NEPA, and RCRA regulations.		
22*	***Milestones:*** Data Packages for 2005 ILAW PA (2004); Tank Farm RFI Report (2007); 200 Area RFI reports (through 2008)		
28*	***Earliest Date Required:*** FY 2001		
29*	***Latest Date Required:*** September 2008		
13B	***Schedule Explanation:*** Impact assessments are presently being done on the Hanford Site and will be maintained until site closure. Closure assessments are expected to occur until at least post 2020. PBI-3 requires interim closure of M-45 milestone (S-112, S-102, C-104), C-106, 4 low risk/volume, and additional high risk SSTs, individual tank farms, and 244-AR vault by 9/30/2006.		

30	***Technology Insertion Point:*** ☐ New ☒ Existing Code: _____ Official Date: _____
Additional Points of Contact (POC)	
34	***Contractor End User POCs:*** Ron Calmus, CH2M HILL, (509) 372-3385; F/509-372-2862; ronald_b_calmus@rl.gov
35	***DOE End User POCs:*** P.E. (Phil) LaMont, DOE/ORP, 509-376-6117; F/509-372-1350, philip_e_lamont@rl.gov R.W. (Bob) Lober, DOE/ORP, 509-373-7949; F/509-373-1313; robert_w_lober@rl.gov Rob Yasek, DOE-ORP, 509-372-1270, Fax: 509-373-9140, robert_m_yasek@rl.gov
36*	***Other Contacts:*** K.A. (Ken) Gasper, CH2M HILL, 509-373-1948, FAX: 509-373-9093, kenneth_a_ken_gasper@rl.gov

Office of River Protection
Technology Opportunity Statement

General Reference Information	**INACTIVE**
2*	***Assigned Tracking Number:*** WT046-S
1*	***Title:*** Getter Materials in the Vadose Zone
3*	***Summary:*** Fundamental data is needed to improve understanding of the performance of getter materials added to wastes, tank fill materials, and subsurface barriers and reactive zones that will reduce the release rate and mobility of contaminants in the vadose zone. Understanding how important contaminants interact with the soil for Hanford oxidizing conditions will help develop getter materials that retard the transport of those contaminants in the Hanford environment. For example, Sandia National Lab developed in situ formation of hydroxyapatite, which may be used in Hanford soils as a proof-of-concept for sequestering technetium and uranium. Success has also been achieved through the application of hydrogen sulfide gas in the subsurface to reduce the mobility of chromium and other contaminants. Subsurface barriers and reactive zones provide a mechanism for addressing retrieval of wastes from tanks known or suspected to be leaking. Successful subsurface barriers and reactive zones can limit the migration of contamination leaked during tank waste retrieval operations or existing contamination from past tank leaks, and expand opportunities for retrieval methods that may otherwise be prohibited due to concerns over uncontrolled leakage during retrieval.
38new	***Principal Contact:*** Fred Mann, CH2M HILL, 509-373-3978, Fax: 509-373-3974, frederick_m_mann@rl.gov; Frank Anderson, CH2M HILL, 509-373-3971, Fax: 509-373-3974, frank_j_anderson@rl.gov
Technology Opportunity Description	
8A*	***Project:*** ☐ Safe Storage – Operations and Maintenance ☐ Safe Storage – Life Extension ☒ Waste Retrieval and Transfer – Waste Inventory Properties ☒ Waste Retrieval and Transfer – Equipment ☒ Closure ☒ Disposal
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW04 (primary), ORP-TW13 (secondary) Work Breakdown Structure (WBS) No.: 5.8.5 (primary), 5.9.4 (secondary)
12A	***Problem Description:*** Many negatively charged elements and compounds (e.g. TcO_4^-, Se^-) are poorly sorbed on most materials under basic (pH > 7) conditions. Some negatively charged materials (e.g. I^-) do sorb on Hanford soils under basic conditions while compounds such as pertechnetate are extremely mobile in the environment and long-lived. Based on risk assessments, technetium-99 represents roughly 96% of the risk to groundwater due to its mobility and longevity. An understanding of how important contaminants interact with the soil will aid the development of appropriate materials to retard the transport of those contaminants. If low-cost getter materials can be developed for use in waste disposal, then requirements on waste forms can be reduced, potentially saving hundreds of millions of dollars in the Hanford Immobilized Waste Disposal Program. Successful demonstration of getter materials can also provide an option to retrieving or otherwise remediating contaminated soils deep in the vadose zone as a result of past tank leaks. The Savannah River Site uses FeS to trap technetium, and many disposal sites use concrete to trap uranium. The Pacific Northwest National Laboratory has successfully deployed hydrogen sulfide gas in the subsurface to reduce the mobility of chromium contamination at the White Sands missile range in New

	Mexico. The success of this deployment led to hydrogen sulfide gas remediation being selected by the Environmental Protection Agency as the presumptive remedy for the White Sands missile range chromium contaminated waste sites. There is a related science need for getter materials/stabilizers for tank fill to immobilize residual waste contamination. This science need also supports Technology Opportunity, "Reactive Barriers to Contaminant Migration" (WT061) because sequestering agents deployed as a permeable flow-through barrier would prevent the migration of contaminants beneath the tank farms and facilities. Enabling technologies include methods for subsurface deployment of reactive barriers and subsequent verification of placement and performance with respect to reduction in contaminant mobility. This need is described in Section 10.3.4 of the Office of River Protection Preliminary Integrated Technology Plan, DOE-ORP-2001-17, Rev 0.
9a*	***Priority:*** ☐ HIGH Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction ☒ MEDIUM Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction *(Medium Priority for Science Opportunity)* ☐ LOW Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation
9b	***Priorities***

Schedule Impact	☐ HIGH ☐ MED x LOW	Needed to meet PBIs Needed to meet mission targets (2033 closure) Can improve mission targets or no schedule impact
Cost Savings	☐ HIGH ☐ MED x LOW	>$1B total life-cycle savings >$100M but <$1B total life-cycle savings <$100M total life-cycle savings
Implementation Cost/Schedule	☐ HIGH ☐ MED x LOW	<$10M and <2 yrs. >$10M and <2 yrs or <$10M and > 2 yrs. >$10M and > 2yrs. or significant technical risk
Baseline Risk Reduction	x HIGH ☐ MED ☐ LOW	The baseline technical solution has not been proven at large scale or on actual radioactive waste. The baseline technical solution has been demonstrated at large scale but not implemented in radioactive operations. The baseline technical solution has been implemented at Hanford.

Cost Information

17A*	***Current Baseline Cost:*** Indeterminate. The current strategy for closure of Hanford double- and single-shell tanks does not include the use of sequestering agents in the vadose zone. Although use of sequestering agents has been proposed for use in support of Environmental Restoration activities on the Hanford site and elsewhere throughout the United States, the technology has not been deployed at Hanford.
17B	***Estimated Cost Impact:*** Lessen retrieval/closure requirements (~10^8 to 10^9 dollars); Less bounding assumptions on ILAW will allow higher waste loadings, which will accelerate schedule and reduce costs (~10^8 to ~10^9 dollars); Lower design requirements for the ILAW disposal facility (exceed 10^8 dollars). More cost effective alternative to immobilizing contamination deep in the vadose zone where retrieval will be cost prohibitive. Support cost effective retrieval of wastes from tanks known or suspected to be

	leaking by providing a leak mitigation measure.
18*	***Cost Impact Explanation:*** The cost savings could be significant. With regard to the disposal facility, the cost savings resulting from lowering the design requirements could exceed several hundred million dollars. The cost saving associated with deployment of the getter material in the soil could approach several hundred million dollars depending on the inventory and distribution of contamination resulting from past and anticipated future leaks. Cost savings associated with deployment of getter materials in tank fill materials could be in the tens to hundreds of millions of dollars if more rigorous tank retrieval requirements or tank closure approaches can be avoided by taking advantage of getter materials in reducing release rate. The availability of demonstrated and regulatory accepted subsurface barrier technology could allow the use of more robust tank waste retrieval methods employing greater volumes of liquids if the subsurface barriers are close-coupled to the tanks and provide options for waste retrieval from tanks known or suspected to have leaked or are of questionable leak integrity.
Risk Information	
37 new	***Risk Identifier:*** ☐ CR- [e.g., CR-047] ☒ New ***Risk Statement:*** If subsurface barriers and reactive zones are not accepted by the regulators, the capping options will have to perform better to minimize water infiltration through the wastes, thereby increasing design features and costs for construction and long-term maintenance. Failure to have demonstrated and regulatory accepted subsurface barrier and reactive zone technologies may increase the costs associated with remediation of contamination deep in the vadose zone. Subsurface barriers and reactive zones are part of an integral system of engineered and natural barriers that will be required to protect human health and the environment if wastes are proposed for in-place disposal.
12B	***Risk Narrative:*** Conservative methods and data will be used in the performance assessment, likely requiri more stringent contaminant release specifications in the waste product request for proposal and requiring more expensive disposal facilities. More rigorous and expensive retrieval and closure methods may be required to achieve performance requirements. The RMM database should be queried for further risk information.
Schedule Information	
21	***Regulatory Drivers:*** Performance assessments are required by DOE Order 435.1 and RCRA and CERCLA regulations. Applicable regulatory requirements under RCRA and CERCLA require that contamination in the vadose zone be remediated in a manner protective of human health and the environment. The Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement) requires investigation, demonstration, and deployment of leak detection, monitoring, and mitigation methods in support of tank waste retrieval and closure activities. Subsurface barriers and reactive zones are one form of leak mitigation measures.
22*	***Milestones:*** M-45 Series of Tri-Party Agreement milestones addressing SST retrieval and closure demonstration activities (2003 through 2028). Data Packages for 2005 ILAW PA (2004); Tank Farm RFI Report (2007); 200 Area RFI reports (through 2008)
28*	***Earliest Date Required:*** January 2004
29*	***Latest Date Required:*** December 2007
13B	***Schedule Explanation:*** Data and information regarding the efficacy of subsurface barriers and reactive zones as leak mitigation measures in support of tank waste retrieval and closure activities is needed in the FY 2004 to FY 2006 time frame. For use during the maintenance phase of Hanford Immobilized Low-Activity Tank Waste Performance Assessments, such data and testing are needed by 2005 PBI-3 includes interim closure of M-45 high risk SSTs (S-112, S-102, C-104), C-106, 4 low risk/volume tanks, additional HLW tanks (>fee over and above 19), individual tank farms (> fee over and above 2), and 244-AR vault bv 9/30/2006. Interim retrieval and closure milestones for SSTs are also contained in

	the M-45 Series of TPA milestones.
30	***Technology Insertion Point:*** ☐ New ☐ Existing Code: Official Date:
Additional Points of Contact (POC)	
34	***Contractor End User POCs:*** Ron Calmus, CH2M HILL, (509) 372-3385; F/509-372-2862; ronald_b_calmus@rl.gov
35	***DOE End User POCs:*** P.E. (Phil) LaMont, DOE-ORP, 509-376-6117; F/509-372-1350, philip_e_lamont@rl.gov R.W. (Bob) Lober, DOE-ORP, 509-373-7949; F/509-373-1313; robert_w_lober@rl.gov
36*	***Other Contacts:*** K.A. (Ken) Gasper, CH2M HILL, 509-373-1948, F/509-373-39093, kenneth_a_ken_gasper@rl.gov

Office of River Protection
Technology Opportunity Statement

General Reference Information	**ACTIVE**
2*	***Assigned Tracking Number:*** WT053-S
1*	***Title:*** Contaminant Mobility Beneath Tank Farms
3*	***Summary:*** Quantifying and understanding 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 tank farms and RPP facilities will allow evaluation of the potential mobility of contaminants under all "leave or retrieve" options. While significant progress has been made on this topic (and the high cesium mobility is better understood), the current understanding of the mobility of contaminants from SST leaks and major soil column transuranic disposal sites is not fully adequate to support cleanup, closure, and performance assessment-related decisions. However, significant progress has been made on this topic and the high cesium mobility is now understood. The Co mobility can be increased by complexants and the U mobility is being studied.
38new	***Principal Contact:*** F.M. (Fred) Mann, CH2M HILL, 509-373-3978, Fax: 509-373-3974, frederick_m_mann@rl.gov; Frank Anderson, CH2M HILL, 509-373-3971, Fax: 509-373-3974, frank_j_anderson@rl.gov
Technology Opportunity Description	
8A*	***Project:*** ☐ Safe Storage – Operations and Maintenance ☐ Safe Storage – Life Extension ☐ Waste Retrieval and Transfer – Waste Inventory Properties ☐ Waste Retrieval and Transfer – Equipment ☒ Closure ☐ Disposal
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW04 (primary), ORP-TW13 (secondary) Work Breakdown Structure (WBS) No.: 5.8.5 (primary), 5.9.4 (secondary)
12A	***Problem Description:*** Spectral gamma logging of drywells around underground single-shell tanks (SSTs) has provided valuable data on penetration of gamma-emitting contaminants from tank leaks into the soil beneath tanks. Knowledge of the inventory and distribution of contaminants from past tank leaks, and mechanisms that have controlled their movement, will be important in assessing risk implications from past leaks and potential future leaks during retrieval, and making decisions on whether or what remediation efforts may be needed for closing tank farms, or for taking interim corrective actions prior to tank farm closure. This science need also supports Technology Opportunity, "Reactive Barriers to Contaminant Migration" (WT061) because sequestering deployed as a permeable flow-through barrier would prevent the migration of contaminants beneath the tank farms and facilities. This need is described in Section 10.3.8 of the Office of River Protection Preliminary Integrated Technology Plan, DOE-ORP-2001-17, Rev 0.
9a*	***Priority:*** ☐ HIGH Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction

	☒ MEDIUM Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction ☐ LOW Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation		
9b*	***Priorities***		
	Schedule Impact	☐ HIGH ☐ MED x LOW	Needed to meet PBIs Needed to meet mission targets (2033 closure) Can improve mission targets or no schedule impact
	Cost Savings	x HIGH ☐ MED ☐ LOW	>$1B total life-cycle savings >$100M but <$1B total life-cycle savings <$100M total life-cycle savings
	Implementation Cost/Schedule	☐ HIGH x MED ☐ LOW	<$10M and <2 yrs. >$10M and <2 yrs or <$10M and > 2 yrs. >$10M and > 2yrs. or significant technical risk
	Baseline Risk Reduction	x HIGH ☐ MED ☐ LOW	The baseline technical solution has not been proven at large scale or on actual radioactive waste. The baseline technical solution has been demonstrated at large scale, but not implemented in radioactive operations. The baseline technical solution has been implemented at Hanford.
Cost Information			
17A*	***Current Baseline Cost:*** $100,000,000		
17B	***Estimated Cost Impact:*** Lessen retrieval/closure requirements (~10^8 to 10^9 dollars) Lower design requirements for the ILAW disposal facility (exceed 10^8 dollars)		
18*	***Cost Impact Explanation:*** Remediation of contaminated soil, if required as part of interim corrective measures or tank farm closure, could cost in the hundreds of millions of dollars. Improved understanding of transport mechanisms and long-term risk implications will ensure technical defensibility of such decisions		
Risk Information			
37 new	***Risk Identifier:*** ☐ CR-_____ [e.g., CR-047] ☒ New ***Risk Statement:*** If methods and data result in an incorrect estimate of environmental impact, it will be difficult to assure the public that the DOE can predict the impact of leaving (1) waste in the tanks and their associated subsurface contamination in place and (2) leaving immobilized waste in onsite ILAW disposal facilities.		
12B	***Risk Narrative:*** Cleanup decisions will lack technical defensibility. The RMM database should be queried for further risk information as information becomes available.		
Schedule Information			
21	***Regulatory Drivers:*** Single-shell tanks are RCRA TSD units, regulated under WAC 173-303. Tri-Party Agreement milestones adopted under Change Control Form M-45-98-03 require investigation of the SST waste management areas under a RFI/CMS process. Additional Tri-Party Agreement milestones under the M-45 series require retrieval of waste and closure of tank farms in a manner that protects public health and the environment. The Record of Decision for the RPP EIS requires a NEPA process for making decisions on tank farm closure, once a sufficient understanding of vadose zone conditions and processes is attained		

22*	***Milestones:*** Data Packages for 2005 ILAW PA (2004); Tank Farm RFI Report (2007); 200 Area RFI reports (through 2008)
28*	***Earliest Date Required:*** FY 2001
29*	***Latest Date Required:*** September 2008
13B	***Schedule Explanation:*** Over the period FY 1999 through FY 2007 subsurface investigations and laboratory analyses are taking place in the SST waste management areas under RCRA assessment as part of a Phase 1 RFI/CMS process addressed in the Tri-Party Agreement. In the first half of FY 2004, an RFI Report is scheduled to be prepared that will summarize results of site-specific investigations, and provide recommendations on additional investigations that may need to be performed to support decisions on controlling existing subsurface contamination, retrieving waste from tanks, and closing tank farms. Improved understanding of transport and fixation/binding mechanisms in this time frame will support recommendations on what additional investigations, if any, may need to be conducted. PBI-3 includes interim closure of M-45 high risk SSTs (S-112, S-102, C-104), C-106, 4 low risk/volume tanks, additional HLW tanks (>fee over and above 19), individual tank farms (> fee over and above 2), and 244-AR vault by 9/30/2006.
30	***Technology Insertion Point:*** ☐ New ☐ Existing Code: Official Date:
Additional Points of Contact (POC)	
34	***Contractor End User POCs:*** Ron Calmus, CH2M HILL, (509) 372-3385; F/509-372-2862; ronald_b_calmus@rl.gov
35	***DOE End User POCs:*** P.E. (Phil) LaMont, DOE-ORP, 509-376-6117; F/509-372-1350, philip_e_lamont@rl.gov R.W. (Bob) Lober, DOE-ORP, 509-373-7949; F/509-373-1313; robert_w_lober@rl.gov Rob Yasek, DOE-ORP, 509-372-1270, Fax: 509-373-9140, robert_m_yasek@rl.gov
36*	***Other Contacts:*** K.A. (Ken) Gasper, CH2M HILL, 509-373-1948, F/509-373-9093, kenneth_a_ken_gasper@rl.gov

Office of River Protection
Technology Opportunity Statement

General Reference Information	**DEFERRED**
2*	***Assigned Tracking Number:*** WT054
1*	***Title:*** Mixer Mobilization Pump Performance Prediction (formerly Solids Yield During Mixer Pump Mobilization)
3*	***Summary:*** This need focuses on tools for predicting performance of mixer pumps to be deployed in DSTs based upon waste properties, design parameters, and overall system configuration.
38new	***Principal Contact:*** Tim Oten, CH2M HILL, 509-376-3563, Fax: 509-372-3106, timothy_c_oten@rl.gov
Technology Opportunity Description	
8A*	***Project:*** ☐ Safe Storage – Operations and Maintenance ☐ Safe Storage – Life Extension X Waste Retrieval and Transfer – Waste Inventory Properties X Waste Retrieval and Transfer – Equipment ☐ Closure ☐ Disposal
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW04 Work Breakdown Structure (WBS) No.: 5.8.2
12A	***Problem Description:*** The basic need is to be able to predict the performance of mixer-pumps planned for deployment in DSTs at Hanford, based on physical properties of the waste, the mixer pump design parameters, and the overall configuration of the system (such as sludge depth, supernate depth, vertical and horizontal location of mixer pump discharge nozzles). This need was previously focused on accurate measurement of shear strength because of the perceived importance of shear strength to the ECR of a mixer pump. However, all of PNNL's mixer pump test data were recently correlated with three dimensionless parameters (Letter Report by Shekarriz et al. April 1998) with the following result: ECR is much more sensitive to nozzle velocity ($U_o^{0.75}$) than to shear strength ($1/\tau_s^{0.17}$). Shear strength appears to be less important than the characteristics of the jet. In full-scale mixer pumps, pumped slurry exits through a very short nozzle that may not create a well-developed jet, while small-scale mobilization tests used a nozzle that created a well-developed jet. It isn't clear if the current mixer pump design produces jets that are analogous to the small-scale tests, and consequently, the validity of using the correlations to predict full-scale performance is in question. Recent computational fluid dynamic modeling completed for tank AZ-102 (PNNL-13275) predicts that only 50% of the sludge present in that tank will be mobilized by operating two, 300-hp mixer pumps according to current baseline plans. This is significantly less than the currently planned retrieval efficiency of 80% (HNF-SD-WM-SP-012, Rev. 2, p. 4-2). The 80% retrieval efficiency is based on the best available ECR correlation. In FY 2000, a process test of the two, 300-hp mixer pumps in AZ-101 (RPP-6548 Rev 1) found that 95-100% of the waste was mobilized, however, an accurate unbiased estimate of the amount

	of waste suspended (and therefore the retrieval efficiency) could not be accurately determined. The planned retrieval efficiency for AZ-101 was 90%. "Based on grab sample analysis, augmented with estimates of solid concentration for regions of the tank where grab sample data were not available, the weight percent of sludge suspended by operation of two mixer pumps at maximum speed is 41 percent. Additional calculations using data from both grab samples and the gamma probe estimate that approximately 38 percent of the sludge was suspended. The remaining 59 to 62 percent of the mass either was partially suspended or pushed along the bottom of the tank. A higher concentration of solids in grab samples near the bottom of the tank, and a sharp increase in the gamma-probe reading due to radionuclides in the solid phase, suggests that the solids do not become uniformly suspended throughout the tank but some portions of the solids are suspended at a much smaller height relative to the overall height of the waste. Interpretation of the data was complicated by the fast settling nature of the sludge, the difference between the shutoff time of the two mixer pumps at the end of the test, and the fact that no grab samples or instrument readings (other than temperature) could be taken under the conditions of interest – while both mixer pumps were running. An accurate, unbiased estimate of the amount of sludge actually suspended could not be determined."
9a*	***Priority:*** X HIGH Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction ☐ MEDIUM Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction ☐ LOW Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation
9b	***Prioirity***

Schedule Impact	☐ HIGH ☐ MED ☐ LOW	Needed to meet PBIs Needed to meet mission targets (2033 closure) no schedule impact or can improve mission targets (<2033 closure).
Cost Savings	☐ HIGH ☐ MED ☐ LOW	>$1B total life-cycle savings >$100M but <$1B total life-cycle savings <$100M total life-cycle savings
Implementation Cost/Schedule	☐ HIGH ☐ MED ☐ LOW	<$10M and <2 yrs. >$10M and <2 yrs or <$10M and > 2 yrs. >$10M and > 2yrs. or significant technical risk
Baseline Risk Reduction	☐ HIGH ☐ MED ☐ LOW	The baseline technical solution has not been proven at large scale or on actual radioactive waste. The baseline technical solution has been demonstrated at large scale but not implemented in radioactive operations. The baseline technical solution has been implemented at Hanford.

Cost Information	
17A*	***Current Baseline Cost:***
17B	***Estimated Cost Impact:*** $ Up to $100M in cost avoidance
18*	***Cost Impact Explanation:*** Good predictive tools will allow realistic, yet minimum duration, delivery schedules to be established for delivering sludge for HLW vitrification to the WTP

	This is a risk (potential loss x probability) mitigating activity. The size of the potential loss is large if the retrieval efficiencies of the high-level waste tanks are significantly less than planned. The potential loss could be as large as the $100M in capital costs associated with the retrieval system projects if major rework is required plus the schedule and financial impacts of delaying high-level waste vitrification at the Waste Treatment Plan. On the other hand, some moderate cost savings may be realized if there is design conservatism that can be reduced for future pump installations
Risk Information	
37 new	***Risk Identifier:*** ☐ CR-_____ [e.g., CR-047] ☐ New ***Risk Statement:*** If the sludge retrieval efficiency assumed in the CH2M HILL baseline (ranging from 80-95%) is not achieved, then the CH2M HILL HLW deliveries to the WTP will take longer, or will require additional pumps to be installed and operated
12B	***Risk Narrative:*** *[further explanation, if warranted]*
Schedule Information	
21	***Regulatory Drivers:*** N/A
22*	***Milestones:*** This activity supports the objective of treating 10% of the Hanford tank waste by mass and 25% by curies by 2018.
28*	***Earliest Date Required:*** FY 2002
29*	***Latest Date Required:*** September 2005
13B	***Schedule Explanation:*** This needs to be resolved so it can influence design updates to the high-level waste tanks. Key dates for the various high-level waste tanks are as follows: **Tank** **Start of Design** **Start of Construction** Early results (i.e., a validated model) will allow for better management of the programmatic risks with respect to the quantity of HLW feed that can be delivered to the Waste Treatment Plant.
30	***Technology Insertion Point:*** ☐ New ☐ Existing Code: Official Date: After initial AZ-101 and AZ-102 transfers occur, functions and requirements for AN-102 and later tanks can be modified. (Timeframe: early 2008) Correlations derived from small-scale mobilization testing and a computational fluid dynamic model (TEMPEST), neither of which has been compared to full-scale tests. **Technology Insertion Point(s):** N/A
Additional Points of Contact (POC)	
34	***Contractor End User POCs:***
35	***DOE End User POCs:*** Cathy Louie, DOE-ORP, 509-376-6834, Fax: 509-373-0628, catherine_s_louie@rl.gov
36*	***Other Contacts:*** K.A. (Ken) Gasper, CH2M HILL, 509-373-1948, F/509-373-9093, kenneth_a_ken_gasper@rl.gov

Office of River Protection
Technology Opportunity Statement

General Reference Information			DEFERRED
2*	***Assigned Tracking Number:*** WT060		
1*	***Title:*** Hanford/SRS Waste Mixing Mobilization		
3*	***Summary:*** This need considers supplementary pumping to assist sludge retrieval, or cost effective replacements for one or two of the mixer pumps. Pulsatile Flow Mixer Technology is a low liquid alternative to past practice sluicing and a way to either replace or augment baseline mixer pump waste mobilization for selected wastes/tanks (e.g. saltcake or saltcake/sludge tanks).		
38new	***Principal Contact:*** Tim Oten, CH2M HILL, 509-376-3563, Fax: 509-372-3106, timothy_c_oten@rl.gov		
Technology Opportunity Description			
8A*	***Project:*** ☐ Safe Storage – Operations and Maintenance ☐ Safe Storage – Life Extension X Waste Retrieval and Transfer – Waste Inventory Properties X Waste Retrieval and Transfer – Equipment ☐ Closure ☐ Disposal		
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW04 Work Breakdown Structure (WBS) No.: 5.8.2		
12A	***Problem Description:***		
9a*	***Priority:*** X HIGH Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction ☐ MEDIUM Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction ☐ LOW Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation		
9b	***Priority***		
	Schedule Impact	☐ HIGH ☐ MED ☐ LOW	Needed to meet PBIs Needed to meet mission targets (2033 closure) no schedule impact or can improve mission targets (<2033 closure).
	Cost Savings	☐ HIGH ☐ MED ☐ LOW	>$1B total life-cycle savings >$100M but <$1B total life-cycle savings <$100M total life-cycle savings
	Implementation Cost/Schedule	☐ HIGH ☐ MED ☐ LOW	<$10M and <2 yrs. >$10M and <2 yrs or <$10M and > 2 yrs. >$10M and > 2yrs. or significant technical risk

	Baseline Risk Reduction	☐ HIGH ☐ MED ☐ LOW	The baseline technical solution has not been proven at large scale or on actual radioactive waste. The baseline technical solution has been demonstrated at large scale but not implemented in radioactive operations. The baseline technical solution has been implemented at Hanford.
Cost Information			
17A*	***Current Baseline Cost:*** $20,000,000		
17B	***Estimated Cost Impact:*** $		
18*	***Cost Impact Explanation:*** If a cost effective mixer alternative is available for one or both of planned 300hp mixer pumps for some of the tanks, there could be significant cost savings. For some tanks, use of one or more pulsatile mixer flow pumps lower cost approach could replace one or both of the baseline 300hp mixer pumps. For other tanks, this technology could augment the two 300 hp mixer pumps to ensure more complete mobilization and retrieval. The baseline cost for the current mixer pumps is $500K per pump. The advanced design mixer pump is expected to cost $625K per pump in production quantities. (There are actually even larger costs connected to infrastructure upgrades and support systems required by the mixer pumps; a fair comparison with an alternative technology needs to account for these costs). Therefore, any alternative technology must be cost competitive with this mixer pump to be used. Two mixer pumps are generally planned for deployment in Hanford DSTs, with a total of 50 pumps currently planned (not all DSTs will receive mixer pumps). Over the life of the RPP program about 216 of the baseline pumps will be needed. If the advanced design mixer pump replaces the baseline pump, that quantity drops to about 86 pumps. Therefore, the current baseline will spend $108M for the baseline pump or $53.8M for the Advanced Design Mixer Pump. These costs are embedded in already authorized capital projects totaling over $500 million. To be cost effective alternatives must reduce this overall cost.		
Risk Information			
37 new	***Risk Identifier:*** ☐ CR- [e.g., CR-047] ☐ New ***Risk Statement:*** If end of pump life can not be accurately predicted, then pump failure may occur during transfer (492). If pump seal leakage is significant, then more water may be added to waste and must be accommodated in transfer to WTP. For any of the SST or DST tank retrievals and transfers, if utilizing pulsatile mixer/transfer equipment results in a more cost effective way of achieving mixing and mobilization of waste for retrieval and transfer, then savings can be beneficially used to complete the RPP mission.		
12B	***Risk Narrative:*** One of the principal goals of this effort is to manage the performance risks of the mixer pumps. Pumps have been extensively tested with simulants both in scale and full size. Full-scale in-situ experience at Hanford is so far limited to the AZ-101 mixer pump test recently completed. While the results of the test are encouraging they do not constitute a comprehensive performance demonstration, as this specific tank is not a representative and challenging case (low sludge shear strength, small amount of sludge, etc…). There is also some risk that the Hanford waste will behave significantly differently than the simulants, and so the mixer pump performance may be different than predicted. Hanford and Savannah River have been cooperating with TFA to both improve the current mixer pump design and identify suitable alternative technologies. This effort needs to continue (especially regarding emerging SRS mixer pump technology data).		
Schedule Information			

21	***Regulatory Drivers:*** A failure to deliver required quantities of feed to the WTP will delay treatment, and may impact the ability to meet the RPP program commitments.
22*	***Milestones:*** Waste feed delivery milestones (2005 and onwards)
28*	***Earliest Date Required:*** TBD
29*	***Latest Date Required:*** TBD
13B	***Schedule Explanation:*** The first waste feed delivery to the waste treatment facility will rely on mixer pumps to mobilize the waste. Two pumps were installed in 101-AZ by project W-151 to run process tests. Project W-151 has procured a spare pump. Project W-211 has procured two pumps for installation in other DSTs. Alternatives to mixer pump technology that are more cost effective can only be considered if they are developed before the W-211 project has more mixer pumps fabricated, which will and continue each year for several years. Opportunity for cost savings by considering alternates to two 300 hp mixer pumps occurs for AN (after AN-101) and AW tanks; currently $20M/tank; cost savings opportunities exist in those functions and requirements in 2004 time frame.
30	***Technology Insertion Point:*** ☐ New ☐ Existing Code: Official Date: The current baseline technology is the use of "Project W-211 style" mixer pumps. While pulsatile mixer pump technology was at first planned for S-102 SST retrieval, it may be better planned for the second full scale retrieval defined in M-45 milestones or for later retrievals. DST mixing and transfer F&Rs for the next group of tanks are scheduled for FY2004.
Additional Points of Contact (POC)	
34	***Contractor End User POCs:*** Tim Oten, CH2M HILL, 509-376-3563, Fax: 509-372-3106, timothy_c_oten@rl.gov
35	***DOE End User POCs:*** Roger Quintero, DOE-ORP, 509-373-0421, Fax: 509-373-1313, roger_a_quintero@rl.gov
36*	***Other Contacts:*** K.A. (Ken) Gasper, CH2M HILL, 509-373-1948, F/509-373-9093, kenneth_a_ken_gasper@rl.gov

Office of River Protection
Technology Opportunity Statement

General Reference Information	**DEFERRED**
2*	***Assigned Tracking Number:*** WT061
1*	***Title:*** Reactive Barriers to Prevent Contaminant Migration
3*	***Summary:*** Sequestering agents deployed as a permeable flow-through (reactive) barrier would prevent the migration of contaminants beneath the tank farms and RPP facilities. Recent efforts as part of the Immobilized Waste Program and by the TFA have identified some potentially useful materials, but implementation problems must be solved for these materials to have practical, and cost effective application in field use.
38new	***Principal Contact:*** F.M. (Fred) Mann, CH2M HILL, 509-373-3978, Fax: 509-373-3974, frederick_m_mann@rl.gov; Julian Laurenz, CH2M HILL, 509-372-9301, Fax: 509-372-9292, julian_e_laurenz@rl.gov
Technology Opportunity Description	
8A*	***Project:*** ☐ Safe Storage – Operations and Maintenance ☐ Safe Storage – Life Extension ☒ Waste Retrieval and Transfer – Waste Inventory Properties ☒ Waste Retrieval and Transfer – Equipment ☒ Closure ☒ Disposal
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW04 (primary), ORP-TW13 (secondary) Work Breakdown Structure (WBS) No.: 5.8.5 (primary), 5.9.4 (secondary)
12A	***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 Pacific Northwest National Laboratory and Sandia National Laboratories) suggests magnetite, bone char, and hydrotalcite to be most effective for attenuating technetium. Similarly, hydrotalcite and iron-oxyhydroxides are candidates for attenuating uranium and selenium. Recent efforts as part of the Immobilized Waste Program and by the Tank Focus Area champion have identified some potentially useful materials. Implementation problems must be solved, however, before such agents could have practical, and cost-effective, application in the field. This technology opportunity supports the Hanford tanks science opportunities RL-WT046 (A&B) Getter Materials (outside the tank and for tank fill). If low-cost getter materials can be developed for use in waste disposal, then requirements on waste forms can be reduced, potentially saving hundreds of millions of dollars in the Hanford Immobilized Waste Disposal Program. The need for sequestering agent technology development has also been identified in the ILAW program logic, and was evaluated as an option in Appendix F of the "Retrieval Performance Evaluation Methodology for the AX Tank Farm" (DOE/RL-98-72). A similar Technology Opportunity has been identified by the Retrieval Projects as Tank Leak

	Detection, Monitoring and Mitigation (LDMM) Systems (WT026/027). This need is described in Section 10.3.5 of the Office of River Protection Preliminary Integrated Technology Plan, DOE-ORP-2001-17, Rev 0.
9a*	***Priority:*** ☐ HIGH Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction ☐ MEDIUM Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction ☒ LOW Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation (Low Priority as a Technology Opportunity; outside the Contract period)
9b*	**Priorities**

Schedule Impact	☐ HIGH ☐ MED x LOW	Needed to meet PBIs Needed to meet mission targets (2033 closure) Can improve mission targets or no schedule impact
Cost Savings	☐ HIGH ☐ MED x LOW	>$1B total life-cycle savings >$100M but <$1B total life-cycle savings <$100M total life-cycle savings
Implementation Cost/Schedule	☐ HIGH ☐ MED x LOW	<$10M and <2 yrs. >$10M and <2 yrs or <$10M and > 2 yrs. >$10M and > 2yrs. or significant technical risk
Baseline Risk Reduction	x HIGH ☐ MED ☐ LOW	The baseline technical solution has not been proven at large scale or on actual radioactive waste. The baseline technical solution has been demonstrated at large scale, but not implemented in radioactive operations. The baseline technical solution has been implemented at Hanford.

Cost Information	
17A*	***Current Baseline Cost:*** 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.
17B	***Estimated Cost Impact:*** Lessen retrieval/closure requirements (~10^8 to 10^9 dollars); Lower design requirements for the ILAW disposal facility (exceed 10^8 dollars)
18*	***Cost Impact Explanation:*** The cost savings could be significant. With regard to the disposal facility, the cost savings resulting from lowering the design requirements could exceed several hundred million dollars. The cost saving associated with deployment of the getter material in the soil could approach several hundred million dollars depending on the inventory and distribution of contamination resulting from past and anticipated future leaks (if contaminated soils would otherwise have to be removed to meet long term performance requirements for closed tank farms). The cost savings associated with placement of getter materials in tank fill materials as part of closure could approach several hundred million dollars, if higher levels of tank waste removal, or tank removal, would otherwise be required to meet long term performance requirements for closed tank farms.
Risk Information	

37 new	***Risk Identifier:*** ☐ CR- [e.g., CR-047] ☒ New ***Risk Statement:*** If key radioactive elements could be trapped or immobilized in the waste matrix, disposal facility, closed tanks, and/or the soil column, the risk to human health and the environment could be significantly reduced.
12B	***Risk Narrative:*** 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.
Schedule Information	
21	***Regulatory Drivers:*** Performance assessments are required by DOE Order 435.1.
22*	***Milestones:*** Data Packages for 2005 ILAW PA (2004); Tank Farm RFI Report (2007); 200 Area RFI reports (through 2008)
28*	***Earliest Date Required:*** FY 2001
29*	***Latest Date Required:*** September 2008
13B	***Schedule Explanation:*** To support future low-activity performance assessments, data is needed by September 2005. The results from the performance assessment will be used during the design of the waste package or disposal facility. To support the planned National Environmental Policy Act (NEPA) process for tank farm closure decisions, data is anticipated to be needed by the end of FY 2004. To support the remediation of other 200 area sites, information is needed by 2005. PBI-3 includes interim closure of M-45 high risk SSTs (S-112, S-102, C-104), C-106, 4 low risk/volume tanks, additional HLW tanks (>fee over and above 19), individual tank farms (> fee over and above 2), and 244-AR vault by 9/30/2006.
30	***Technology Insertion Point:*** ☐ New ☐ Existing Code: Official Date: **Technology Insertion Point(s):** TIP 0001 (RL-ER01), TIP 0002 (RL-ER02), TIP 0003 (RL-ER03)
Additional Points of Contact (POC)	
34	***Contractor End User POCs:*** Ron Calmus, CH2M HILL, (509) 372-3385; F/509-372-2862; ronald_b_calmus@rl.gov
35	***DOE End User POCs:*** P.E. (Phil) LaMont, DOE-ORP, 509-376-6117; F/509-372-1350, philip_e_lamont@rl.gov R.W. (Bob) Lober, DOE-ORP, 509-373-7949; F/509-373-1313; robert_w_lober@rl.gov
36*	***Other Contacts:*** K.A. (Ken) Gasper, CH2M HILL, 509-373-1948, F/509-373-9093, kenneth_a_ken_gasper@rl.gov

Office of River Protection
Technology Opportunity Statement

General Reference Information	**DEFERRED**
2*	***Assigned Tracking Number:*** WT062
1*	***Title:*** Variable Suction Level Transfer Pump
3*	***Summary:*** A transfer pump that can draw waste from preselected levels from the surface down to within 10 inches (or less) of the bottom and can operate while the mixer pumps are running is needed.
38new	***Principal Contact:*** Tim Oten, CH2M HILL, 509-376-3563, Fax: 509-372-3106, timothy_c_oten@rl.gov
Technology Opportunity Description	
8A*	***Project:*** ☐ Safe Storage – Operations and Maintenance ☐ Safe Storage – Life Extension X Waste Retrieval and Transfer – Waste Inventory Properties X Waste Retrieval and Transfer – Equipment ☐ Closure ☐ Disposal
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW04 Work Breakdown Structure (WBS) No.: 5.8.2
12A	***Problem Description:*** The current design does not allow for simultaneous operations of the variable suction level transfer pump while the mixer pumps are operating. Only fixed suction level transfer pumps can be operated simultaneously with mixer pumps. The current baseline equips sludge tanks (HLW feed to the treatment plant) with fixed suction level transfer pumps, in order to allow solids suspension by mixer pump during transfers. However, some HLW tanks will need decanting capabilities for both the baseline process, and risk mitigation-type activities, such as contingency staging space for LAW feed. The current design equips the salt tanks (LAW feed to the treatment plant) with variable suction level transfer pumps, in order to enable decanting of the supernate and delivery of solid free LAW to the treatment plant, as required by the feed specification. The current design for these pumps (flexible hose) does not allow simultaneous mixer pump operation. However, these tanks may also require simultaneous mixer pump and transfer pump operation for specific situations, such as solids accumulation mitigation, or contingency space for HLW staging. A transfer pump that can draw waste from pre-selected levels that range from the surface to within 10" or less of the tank bottom, and can be operated simultaneously with mixer pumps is needed.
9*	***Priority:*** ☐ HIGH Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction ☐ MEDIUM Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction X LOW Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation

9b	***Prioirity***		
	Schedule Impact	☐ HIGH ☐ MED ☐ LOW	Needed to meet PBIs Needed to meet mission targets (2033 closure) no schedule impact or can improve mission targets (<2033 closure).
	Cost Savings	☐ HIGH ☐ MED ☐ LOW	>$1B total life-cycle savings >$100M but <$1B total life-cycle savings <$100M total life-cycle savings
	Implementation Cost/Schedule	☐ HIGH ☐ MED ☐ LOW	<$10M and <2 yrs. >$10M and <2 yrs or <$10M and > 2 yrs. >$10M and > 2yrs. or significant technical risk
	Baseline Risk Reduction	☐ HIGH ☐ MED ☐ LOW	The baseline technical solution has not been proven at large scale or on actual radioactive waste. The baseline technical solution has been demonstrated at large scale but not implemented in radioactive operations. The baseline technical solution has been implemented at Hanford.
Cost Information			
17A*	***Current Baseline Cost:*** Current baseline transfer pump cost is $385,000 including the drive motor and variable frequency drive (VFD).		
17B	***Estimated Cost Impact:*** $200,000,000		
18*	***Cost Impact Explanation:*** A potentially significant risk (unplanned cost) may be avoided if transfer pumps can be operated concurrently with mixer pumps. This unplanned cost would come from need for contingency staging space, or out-of-spec waste transfers that require additional time, analysis, tank transfers and potentially treatment delays. Each out-of-specification event could have cost impacts up to $100K or more. This transfer pump is needed if the recently installed new-generation transfer pump (in 101-SY) fails to perform.		
Risk Information			
37 new	***Risk Identifier:*** ☐ CR-_____ [e.g., CR-047] ☐ New ***Risk Statement:*** If the new generation transfer pump fails to perform as expected, then a variable suction level transfer pump will be needed in order to retrieve waste from tanks to meet retrieval requirements.		
12B	***Risk Narrative:*** *[further explanation, if warranted]*		
Schedule Information			
21	***Regulatory Drivers:*** There are no identified regulatory issues associated with this activity over those already identified as part of the project.		
22*	***Milestones:*** Waste feed delivery milestones (2005 and onwards)		
28*	***Earliest Date Required:*** FY 2002		
29*	***Latest Date Required:*** September 2009		
13B	***Schedule Explanation:*** The results of this activity must be completed to provide design criteria and guidance to projects W-211and W-521 to support feed delivery of LAW and HLW to the		

	waste treatment plant. Based on the design requirements, the method selected may be able to be adapted to already complete designs. The demonstration should be completed no later than FY 2002 to generate the greatest benefit.
30	***Technology Insertion Point:*** ☐ New ☐ Existing Code: Official Date: A Waste Feed Delivery Project Implementation Plan (IP) required by PBI-2 will provide the opportunity to include mixer pump and transfer pump modifications. **Technology Insertion Point(s):** N/A
Additional Points of Contact (POC)	
34	***Contractor End User POCs:*** Tim Oten, CH2M HILL, 509-376-3563, Fax: 509-372-3106, timothy_c_oten@rl.gov
35	***DOE End User POCs:*** Roger Quintero, DOE-ORP, 509-373-0421, Fax: 509-373-1313, roger_a_quintero@rl.gov
36*	***Other Contacts:*** W. J. (Bill) Powell, CH2M HILL, 509-373-1072, william_j_bill_powell@rl.gov K.A. (Ken) Gasper, CH2M HILL, 509-373-1948, F/509-373-9093, kenneth_a_ken_gasper@rl.gov

Office of River Protection
Technology Opportunity Statement

General Reference Information	**ACTIVE**
2*	***Assigned Tracking Number:*** WT063
1*	***Title:*** Hanford Single Shell Tank (SST) Saltcake Dissolution Retrieval
3*	***Summary:*** Performance data and efficiency of selective dissolution data are required for sluicing of saltcake to retrieve Hanford's single-shell tanks (SSTs). Application of this method to a representative simulant of waste shall provide the necessary data to select this method for baseline implementation.
38new	***Principal Contact:*** W. Blaine Barton, CH2M HILL, (509) 376-5118, F/(509) 373-4641, w_b_blaine_barton@rl.gov
Technology Opportunity Description	
8A*	***Project:*** ☐ Safe Storage – Operations and Maintenance ☐ Safe Storage – Life Extension X Waste Retrieval and Transfer – Waste Inventory Properties ☐ Waste Retrieval and Transfer – Equipment ☐ Closure ☐ Disposal
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW04 Work Breakdown Structure (WBS) No.: 5.02.01.02.07.12
12A	***Problem Description:*** A significantly less costly system is desired for SST saltcake waste retrieval. The current SST baseline cost is $ 120 Million per tank using the past practice sluicing method. To meet the current PBIs retrieval of SSTs must be accomplished with significant cost savings. Selective dissolution can achieve beneficial separations of radionuclides (Cs, Tc) from wastes destined to Supplemental Treatments and separation of problem chemicals (sulfate and phosphate) from WTP feed. Selective dissolution also causes separation of hydroxide and nitrite from the nitrate. This separation can cause problems with waste compatibility for the receiver tanks. Separation of $^{-}$OH early in the retrieval leaves nitrate concentrations above tank chemistry specifications later in the retrieval. The baseline approach would be to add large amounts of hydroxide to the nitrate rich fraction so that the NO3/OH ratio was within specifications. This can cause significant cost. The concept as developed today would add water to the waste and allow salt cake to dissolve. The brine would be removed and replaced by water. This effectively removes the chemicals that are present in the interstitial liquor. Hydroxide is essentially totally soluble. The removal of hydroxide may allow aluminum to precipitate or not dissolve. The hydroxide may be washed out first and latter brines may not be within corrosion specifications to allow the brines to be received into double shell tanks. Hydroxide may also be important in solubility of other species besides aluminum. This may mean that some of the early brine may need to be recycled just for hydroxide control or additional hydroxide may need to be added with the water. Indications from tests done to date in the laboratory are that the highly soluble salts such as

sodium nitrate may be dissolved and removed first. The brine may be high density (>1.35 SpG) at this time. Eventually, the sparingly soluble solids such as sodium carbonate will make up the bulk of the waste being solubilized. These produce brines of low density (<1.35). It is not fully understood what this means to the time it takes to empty a tank and has potential of causing some post transfer difficulties including stratification of waste and precipitations. There is also the potential for sparingly soluble salts to dissolve at one location in the tank and reprecipitate in another location.

Variables that determine the amount of selective dissolution that will occur during sluicing retrieval and how to control them need to be better understood.

Many of the waste chemistry needs are addressed under RL-WT091, *Chemical and Physical Behavior of Saltcake Wastes*. This Technology Opportunity is directed to the kinetic and fluid dynamic factors that affect sluicing retrieval and selective dissolution. Studies should be done to determine how much waste is effectively contacted by sluicing type retrievals and the kinetics of dissolution under sluicing conditions

The strategy of how waste retrieval can be quickly accomplished has not been fully worked out. Some of the options are to uniformly add water on the surface of the waste – with or without standing pools. The outside—in method would focus on retrieving waste from the outside edge of the tank. The inside-out method has the potential of using the least water inventory.

Related Opportunities: WT-091 Chemical Physical Behavior of Salt Cake is similar. WT-091 is directed toward chemistry (during retrieval and transport) and physical behavior related to transport. This opportunity is directed toward the physical phenomena related to retrieval.

9*	***Priorities:***		
	Schedule Impact	X HIGH ☐ MED ☐ LOW	Needed to meet PBIs Needed to meet mission targets (2033 closure) no schedule impact or can improve mission targets (<2033 closure).
	Cost Savings	X HIGH ☐ MED ☐ LOW	>$1B total life-cycle savings >$100M but <$1B total life-cycle savings <$100M total life-cycle savings
	Implementation Cost/Schedule	☐ HIGH X MED ☐ LOW	<$10M and <2 yrs. >$10M and <2 yrs or <$10M and > 2 yrs. >$10M and > 2yrs. or significant technical risk
	Baseline Risk Reduction	X HIGH ☐ MED ☐ LOW	The baseline technical solution has not been proven at large scale or on actual radioactive waste. The baseline technical solution has been demonstrated at large scale but not implemented in radioactive operations. The baseline technical solution has been implemented at Hanford.

Cost Information	
17A*	***Current Baseline Cost:*** $120 million/tank
17B	***Estimated Cost Impact:*** $4billion
18*	***Cost Impact Explanation:*** The current system of past practice sluicing cost estimate is approximately $ 120 million per tank. If a system could be developed and demonstrated, it could subsequently be applied for waste retrievals to realize cost savings of 50% or more in 66 SSTs

	containing 23 million gallons of saltcake.
Risk Information	
37 new	***Risk Identifier:*** ☐ CR- related to CR-21 and CR-13, but not exactly expressed ☐ New ***Risk Statement:*** If the Salt Cake dissolution retrieval is not better understood, then the delivery of salt cake waste to the WTP may be vastly different than expected to receive. Negative interactions such as precipitation within processing tanks or excessive waste volume to DST will occur. CR-21 If SST retrieval volume is greater than estimated then insufficient DST space will be available); and CR-131 If the waste chemistry or physical properties are different than planned, then new safety analysis and systems may be required.
12B	***Risk Narrative:***
Schedule Information	
21	***Regulatory Drivers:*** A failure to deliver feed to the WTP, which is within the correct feed envelopes, will result in delay in processing, and may impact agreements to proceed with the RPP program commitments.
22*	***Milestones:*** T04-18-1B1 Retrieve Waste from all Remaining Single-Shell Tanks (M-45-05) 9/28/18 Risk Score: T04-03-100, T04-04-100, T04-05-100
28*	***Earliest Date Required:*** *S-112 retrieval demonstration—FY'03*
29*	***Latest Date Required:*** Need will continue through SST retrieval, 2018.
13B	***Schedule Explanation:*** Based on the SST Retrieval Program Mission analysis Report HNF-2944 and current Tri-Party Agreement milestones for SST retrieval, a full-scale demonstration of saltcake retrieval using dissolution is to be completed in tank S-112 by September 30, 2005. The introduction of water into S-112 will not happen before September 2002. A total of 36 SSTs are required to be retrieved by the year 2012 and all of the SSTs being retrieved by 2018. This effort could provide a cost effective retrieval technology to support current waste retrieval commitments that might otherwise be missed because of budget or time constraints.
30	***Technology Insertion Point:*** ☐ New ☐ Existing Code: 2-0300 Official Date: 2/23/09
Additional Points of Contact (POC)	
34	***Contractor End User POCs:*** W. Blaine Barton, CH2M HILL, (509) 376-5118, F/(509) 373-4641, w_b_blaine_barton@rl.gov
35	***DOE End User POCs:*** B.M. (Billie) Mauss, ORP, 509-373-9876, F/509-372-2781, billie_m_mauss@rl.gov; James F. Thompson, Jr, Office of River Protection, (509) 373-9757, james_f_jr_thompson@rl.gov; Roger Quintero, DOE-ORP, 509-373-0421, Fax: 509-373-1313, roger_a_quintero@rl.gov
36*	***Other Contacts:*** D.A. (Dan) Reynolds, CH2M HILL, 509-373-3115, F/509-373-4641 daniel_a_reynolds@rl.gov K.A. (Ken) Gasper, CH2M HILL, 509-373-1948, F/509-373-9093, kenneth_a_ken_gasper@rl.gov Kayle Boomer, CH2M HILL, 509-372-3629, Fax: 509-376-1788, kayle_d_boomer@rl.gov.

Office of River Protection
Technology Opportunity Statement

General Reference Information	ACTIVE
2*	***Assigned Tracking Number:*** WT066
1*	***Title:*** Compositional Dependence of the Long Term Performance of Glass as a Low-Activity Waste Form
3*	***Summary:*** There is a need for the database to be expanded so the effect of different glass compositions on long-term disposal performance can be determined. Also needed are an understanding of the degradation process and numerical simulation tools that combine the database and a mathematical model of the glass corrosion process. This work is important for consideration of alternative waste forms, such as the supplemental technologies for immobilized LAW: bulk vitirification and containerized grout. Vendors awarded contracts in response to FY03 Requests for Proposals may supply this information.
38new	**Principal Contact:** Fred Mann, CH2M HILL, 509-373-3978, Fax: 509-373-3974, frederick_m_mann@rl.gov
Technology Opportunity Description	
8A*	***Project:*** ☐ Safe Storage – Operations and Maintenance ☐ Safe Storage – Life Extension ☐ Waste Retrieval and Transfer – Waste Inventory Properties ☐ Waste Retrieval and Transfer – Equipment ☐ Closure X Disposal
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: TW-13 Work Breakdown Structure (WBS) No.: 5.9.4
12A	***Problem Description:*** The present plan for the 54 million gallons of Hanford tank waste is to retrieve the waste from the underground tanks, separate the waste into a high-level fraction (containing most of the radionuclides and hazardous materials) and into a low-activity fraction (containing most of the waste). Both fractions will be immobilized, with the immobilized high-level fraction stored until shipped to a federal geologic repository and the immobilized low-activity fraction disposed of on the Hanford Site. Because of the relatively large amount of contaminants in the Immobilized Low Activity Waste (ILAW) form, the rate of release must be slow and the rate limited for hundreds of thousands of years. Estimating such a long-term release rate from short-term experiments (even those lasting many years) requires a strong database, an understanding of the degradation process, and numerical simulation tools that combine the database and a mathematical model of the glass corrosion process. DOE will enter into a contract for the treatment of the tank waste. However, a particular glass composition is not expected to in the near future. As a result, the Immobilized Waste Program is performing a series of tests on representative LAW glasses to better understand how likely glasses will perform over these long periods of time. The vision for this work is given in *A Strategy to Conduct an Analysis of the Long-Term Performance of Low-Activity Waste Glass in a Shallow Subsurface Disposal System at Hanford* (PNNL-18834 or Appendix G of DOE/RL-97-

	69). However, there are some areas presently not being funded by EM-30. Rather the support is from EM-50, because of its greater applicability to other potential disposal actions. In particular, the database must be expanded so the affect of different glass compositions on long-term performance can be determined. An important subset of this need is to understand how glass composition impacts the rate of sodium ion exchange in LAW glasses, which has been found to significantly affect the calculated pH in the disposal system and thus the long-term radionuclide release rate.
9a*	***Priority:*** ☐ HIGH Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction ☐ MEDIUM Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction X LOW Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation

9b*	**Priorities**		
	Schedule Impact	☐ HIGH x MED ☐ LOW	Needed to meet PBIs Needed to meet mission targets (2033 closure) Can improve mission targets or no schedule impact
	Cost Savings	x HIGH ☐ MED ☐ LOW	>$1B total life-cycle savings >$100M but <$1B total life-cycle savings <$100M total life-cycle savings
	Implementation Cost/Schedule	☐ HIGH x MED ☐ LOW	<$10M and <2 yrs. >$10M and <2 yrs or <$10M and > 2 yrs. >$10M and > 2yrs. or significant technical risk
	Baseline Risk Reduction	x HIGH ☐ MED ☐ LOW	The baseline technical solution has not been proven at large scale or on actual radioactive waste. The baseline technical solution has been demonstrated at large scale, but not implemented in radioactive operations. The baseline technical solution has been implemented at Hanford.

Cost Information	
17A*	***Current Baseline Cost:*** Conservatism will be used to bound expected behaviors. Because of the extrapolation from short-term tests on a very few glass compositions and environments and the impacts of a poor extrapolation, a significant amount of conservatism will occur.
17B	***Estimated Cost Impact:*** The possible elimination of the technetium separation processes and increases in waste loadings, either of which would save at least a billion dollars, are already identified. Reduced costs for the construction and operation of the disposal facilities would probably be an order of magnitude less, but still mounting to hundreds of millions of dollars.
18*	***Cost Impact Explanation:*** The contract for the treatment of Hanford tank waste is the largest contract DOE will be involved with. The value of initial contract is about 10 billion dollars, with the succeeding contracts totaling many times more. By balancing the requirements of environmental protection and cost, DOE should be able to save at least 5% of the contract costs, mounting to billions of dollars. The possible elimination of the technetium separation processes and increases in waste loadings, either of which would save at least a billion dollars, are already identified. Reduced costs for the construction and operation of the disposal facilities would probably be an order of magnitude less, but still mounting to hundreds of millions of dollars.

Risk Information	
37 new	***Risk Identifier:*** ☐ CR-_____ [e.g., CR-047] ☐ New ***Risk Statement:*** If assumptions on intrinsic release rate are inaccurate, CH2M HILL will not be able to evaluate BNI waste form for Envelope B and Envelope C glass when ORP needs to approve it.
12B	***Risk Narrative:*** Without these data, the ILAW disposal system approval process (involving DOE, Washington State, and the Nuclear Regulatory Commission) will require the use of overly conservative parameters, resulting in significant costs.
Schedule Information	
21	***Regulatory Drivers:*** As documented in the ILAW performance assessment (approved by EM-1), the long-term contaminant release rate is the driving factor in determining human health and environmental impact from the disposal of the low-activity fraction of the Hanford Site tank waste. PBI-2 Complete construction of facility for 880 IHLW containers by 9/30/06. Complete construction of an ILAW disposal facility (13,000 to 15,000 containers) by 9/30/06.
22*	***Milestones:*** Data Packages for 2005 ILAW PA (2004)
28*	***Earliest Date Required:*** October 2001
29*	***Latest Date Required:*** September 2008 If waste tank waste treatment is accelerated, then this capability would be needed by 2006.
13B	***Schedule Explanation:*** For use in the 2005 Hanford Immobilized Low-Activity Tank Waste Performance Assessment, the results of the tests are needed by April 2003. For use in shaping the requirements of the Phase 2 contract to treat tank waste, the results of the tests are needed by September 2008.
30	***Technology Insertion Point:*** ☐ New ☐ Existing Code: _____ Official Date: _____ ***Technology Insertion Point(s):*** 2005 ILAW PA Data Package
Additional Points of Contact (POC)	
34	***Contractor End User POCs:*** F.M. (Fred) Mann, CH2M HILL, (509) 373-3978, Fax: (509) 373-3974, frederick_m_mann@rl.gov
35	***DOE End User POCs:*** Billie Mauss, DOE-ORP, 509-373-5113, Fax: 509-373-1313, billie_m_mauss@rl.gov; Bill Hamel, DOE-ORP, 509-373-1569, Fax: 509-373-9140, william_hamel@rl.gov
36*	***Other Contacts:*** G.L. (Greg) Parsons, CH2M HILL, (509) 371-3783, Fax: (509) 371-3510, greg_l_parsons@rl.gov K.A. (Ken) Gasper, CH2M HILL, 509-373-1948, F/509-373-9093, kenneth_a_ken_gasper@rl.gov

Office of River Protection
Technology Opportunity Statement

General Reference Information	**ACTIVE**
2*	***Assigned Tracking Number:*** WT072
1*	***Title:*** *Automation of Tank Farm field Processes and Wireless Communication*
3*	***Summary:*** Wireless communication and automation of Tank Farm processes can reduce costs for routine operations. Additionally, wireless data collection and process control of retrieval process equipment can save installation cost and reduce deployment schedules for retrieval equipment that must be deployed and relocated for multiple uses during the current contract. When equipment is hard wired the wiring must be disconnected and then reconnected to relocate the equipment. With wireless technology, the equipment can be moved and relocated and all the process control and monitoring communication remain intact. Current steps to monitor and control the MRS retrieval system using digital "Device Net" technology collects all the instrumentation signals into a single communication line. This makes disconnecting and reconnecting easier than traditional hard wired, but doesn't achieve the full benefits as wireless communication. It does, however, facilitate the implementation of wireless for the next deployment thereby benefiting all subsequent deployments.
38new	***Principal Contact:*** Tom Moore, CH2M HILL, 509-373-6175, Fax: 509-372-3599, thomas_l_jr_moore@rl.gov
Technology Opportunity Description	
8A*	***Project:*** X Safe Storage – Operations and Maintenance ☐ Safe Storage – Life Extension ☐ Waste Retrieval and Transfer – Waste Inventory Properties X Waste Retrieval and Transfer – Equipment ☐ Closure ☐ Disposal
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW03 Work Breakdown Structure (WBS) No.: 5.7.1/5.8.7
12A	***Problem Description:*** Field work processes are often time consuming because of limited access points to the HLAN in the field: for example, workers have to wait on line to clear the Access Control Entry System, and roundsheets have to be manually entered into electronic databases. A higher productivity could be reached with the use of portable computers (handheld for roundsheets) and wireless communication. Wireless communication could also reduce significantly the cost of connecting remote tanks to the TMACS system by avoiding costly excavations (currently, surveillance of most remote tanks is manual). Field work processes are often time consuming because of limited access points to the HLAN in the field: for example, workers have to wait on line to clear the Access Control Entry System, and roundsheets have to be manually entered into electronic databases. Also, a large percentage of tank farm *surveillance* data are manually collected on Operator Rounds data sheets on a daily, weekly, monthly, and quarterly basis. These Operator Rounds data sheets require daily review, database input (for some data types), distribution of the data sheets, and short and long-term storage. A higher productivity could be reached with the use of portable computers (handheld for roundsheets) and wireless communication. Wireless communication could also reduce

	significantly the cost of connecting remote tanks to the TMACS system by avoiding costly excavations (currently, surveillance of most remote tanks is manual). Specific activities targeted for automation and wireless communication are: • Field data collection o In-line cesium monitoring/measurement • Field routine and ticklers • Work planning and execution • Field access to procedures • Access control Expected benefits include: • Eliminate geography as a constraint • Dynamic versus static information delivery • Improved accuracy and reliability • Reduced infrastructure costs • Accelerated field process cycle time • Reduced business and labor cost Several pilot projects have already been completed, such as East Tank Farm wireless ACES access, wireless connection of two catch tanks to TMACs, Tank U-107 and Tank S-112 flow meters and cesium radiation detector systems. Plans are ready for more implementations in FY04 on Tank S-102 and Tank S-103. Retrieval projects will deploy skid mounted and tank mounted equipment for modified sluicing and Waste Retrieval System (WRS) retrieval of tanks. The equipment will include process instrumentation such as the flow meter and process controls. These instrumentation and controls must communicate with a central facility (e.g. trailer) that monitors and controls the retrieval operation. Conventional communication requires significant connection and wiring. With rapid retrievals necessary to meet schedule the same equipment must be quickly redeployed after retrieval is complete. Conventional instrumentation must be disconnected and new wiring connected at the new location. If wireless communication is employed there is no disconnecting to be done. Furthermore, when set up in its new location the field unit and receiver unit are automatically connected as long as the antennae and transmission capability is available. Adaptation of wireless communications will greatly reduce the cost and schedule to redeploy retrieval equipment instrumentation.
9A	***Priority:*** X HIGH Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction ☐ MEDIUM Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction ☐ LOW Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation
9B	***Priorities:***

Schedule Impact	☐ HIGH X MED ☐ LOW	Needed to meet PBIs Needed to meet mission targets (2033 closure) no schedule impact or can improve mission targets (<2033 closure).
Cost Savings	☐ HIGH ☐ MED X LOW	>$1B total life-cycle savings >$100M but <$1B total life-cycle savings <$100M total life-cycle savings

	Implementation Cost/Schedule	X HIGH ☐ MED ☐ LOW	<$10M and <2 yrs. >$10M and <2 yrs or <$10M and > 2 yrs. >$10M and > 2yrs. or significant technical risk
	Baseline Risk Reduction	☐ HIGH ☐ MED X LOW	The baseline technical solution has not been proven at large scale or on actual radioactive waste. The baseline technical solution has been demonstrated at large scale but not implemented in radioactive operations. The baseline technical solution has been implemented at Hanford.

Cost Information	
17A*	***Current Baseline Cost:*** $
17B	***Estimated Cost Impact:*** $800K savings per year
18*	***Cost Impact Explanation:*** Potential cost saving of $800K per year includes surveillance data automation ($300K on field preparation and rechecks thanks to immediate notification of out of range data, $200K on data entry and trending, and $300K on data search). Cost of installing antennas for wireless communication to cover Tank Farms is as follows: $82.1K for all West Area, $49.4K to complete East Area (one antenna installed in AP farm already), $63K for the 2750E building and $43.9K for the 2704HV building.
Risk Information	
37 new	***Risk Identifier:*** ☐ CR- [e.g., CR-047] x New ***Risk Statement:*** If Tank Farm field processes continue to lack automation and wireless communication, then Tank Farm Operations will miss an opportunity of efficiency increase that will be necessary to accommodate higher workloads during SST retrieval, Waste Feed Delivery, and Accelerated Closure Operations.
12B	***Risk Narrative:*** *[further explanation, if warranted]*
Schedule Information	
21	***Regulatory Drivers:*** ALARA
22*	***Milestones:***
28*	***Earliest Date Required:*** *[month, year]*
29*	***Latest Date Required:*** *[month, year]*
13B	***Schedule Explanation:*** This will be put in operation as soon as available, and will be beneficial until the end of the Safe Storage, Retrieval, and Closure Functions.
30	***Technology Insertion Point:*** ☐ New ☐ Existing Code: Official Date:

Additional Points of Contact (POC)	
34	***Contractor End User POCs:*** Ron Nelson, CH2M HILL, 509-372-1452, Fax: 509-372-8036, ronald_l_nelson@rl.gov; Roger Bauer, CH2M HILL, 509-376-5908, Fax: 509-373-4238, roger_e_bauer@rl.gov
35	***DOE End User POCs:*** Mike Royack, DOE-ORP, 509-376-4420, Fax: 509-373-1313, michael_j_royack@rl.gov
36*	***Other Contacts:*** Mike Bryden, CH2M HILL, 509-373-4624, Fax: 509-376-0396, michael_j_bryden@rl.gov

Office of River Protection
Technology Opportunity Statement

General Reference Information	**ACTIVE**
2*	***Assigned Tracking Number:*** WT088
1*	***Title*:** Advanced Approaches for Reducing Waste Volume Stored in DSTs
3*	***Summary:*** The volume of double-shell tank (DST) space is limited and may restrict the volume of single-shell tank (SST) waste retrieved for storage and staging in DSTs. Given the current SST retrieval schedule at Hanford, it is projected that additional DST space will be needed in the FY 2010 time frame. The Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement) calls for evaluation of options and actions to increase available DST space in support of SST retrieval. The current process is to remove water through the 242-A Evaporator within administrative controls limiting waste concentration. Advanced approaches for reducing waste volumes sent to and contained within DSTs are needed to minimize the need for additional DST space and reduce the associated costs for storing and staging retrieved SST wastes. Possible options include treatment of retrieved SST waste to remove LAW that can then be stored or disposed outside the DST System and developing a better understanding of waste concentration to relax administrative control on evaporator operations. Several options were discussed in the Tank Space Options Report, RPP-7702, issued in March 2001, to help increase the available DST waste storage space including raising the allowable waste levels, combining aging waste, using restricted tank capacity, concentrating to higher specific gravity, etc. This includes tough technical problem #2, Double-Shell Tank Space: one of the critical resources needed for storing and staging waste retrieved from single-shell tanks. (Jim Honeyman)
38new	***Principal Contact:*** Nick Kirch, CH2M HILL, 509-373-2380, Fax: 509-376-1788, nicholas_w_kirch@rl.gov
Technology Opportunity Description	
8A*	***Project:*** ☐ Safe Storage – Operations and Maintenance ☐ Safe Storage – Life Extension X Waste Retrieval and Transfer – Waste Inventory Properties ☐ Waste Retrieval and Transfer – Equipment ☐ Closure ☐ Disposal
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.ORP-TW04 Work Breakdown Structure (WBS) No.: 5.02.02
12A	***Problem Description:*** The volume of available tank storage space currently within the DST system is limited and may potentially restrict the volume and rate at which SST waste can be retrieved and then stored in these DSTs without constructing new DSTs at a large cost. Given the current schedule for SST retrieval, it is projected that additional DST space will be needed in 2010. The M-45-00-01A modifications to the Tri-Party Agreement calls for an evaluation of options for actions that could be taken to increase the available tank space for SST retrieval. The only currently active waste processing option for increasing available DST space is the removal of water by evaporation in the 242-A Evaporator. Other options were identified in RPP-7702. For continued safe storage of waste in the DSTs, administrative controls restrict how much the waste can be concentrated by this process. The greatest opportunities to provide extra DST space exist by removing some conservatism built into those administrative controls. Five areas to

	address include: 1) raising the allowable waste levels from 416 to 436 inches in 22 tanks; 2) reducing the emergency reserve capacity from 2.2 million gallons to 1.1 million gallons; 3) using space in tanks restricted for staged feed to WTP; 4) retrieving and processing separately TRU waste stored in DSTs, 5) concentrating to higher specific gravity. Raising the sp. gr. includes setting the sp. gr. targets based upon the waste composition and the receiving tank content. In some cases, the targeted sp. gr. may be as high as 1.6. When the pretreatment and LAW vitrification plants are operating, this will become the baseline process for removing waste for the DSTs to make space for continued SST retrieval. Process technologies or scientific advances that will create options for increasing the available space in the DST's are needed to ensure optimal retrieval capabilities are available to retrieve SST waste. These technologies could be used in conjunction with the existing piping and infrastructure associated with the 242-A Evaporator as an enhanced waste management facility, could be separate units, or could be part of the waste treatment plant. Some possible approaches included: 1) removing a low activity waste (LAW) stream from retrieved SST waste or other stored waste that would be suitable for storage outside a DST or disposal if converted to an acceptable waste form; 2) accelerating or improving the processing rate of the waste treatment plant, particularly the immobilization of the LAW fraction because this comprises the majority of the waste volume; 3) developing improved technical understanding that would relax administrative limits on evaporator operation; or 4)combining aging waste. Other approaches that may be worth considering also include: 1) electrodialysis reversal (EDR); 2) fractional crystallization, 3) cation exchanging molecular seize, sized to allow sodium exchange, and to exclude strontium and larger alkali and actinide cations, and use a portable evaporators at the job location. 4) anion (nitrate, nitrite, carbonate, etc) destruction or separation.
9a*	***Priority:*** X HIGH Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction ☐ MEDIUM Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction ☐ LOW Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation
9B	***Priority***

Schedule Impact	☐ HIGH ☐ MED ☐ LOW	Needed to meet PBIs Needed to meet mission targets (2033 closure) Can improve mission targets or no schedule impact
Cost Savings	☐ HIGH ☐ MED ☐ LOW	>$1B total life-cycle savings >$100M but <$1B total life-cycle savings <$100M total life-cycle savings
Implementation Cost/Schedule	☐ HIGH ☐ MED ☐ LOW	<$10M and <2 yrs. >$10M and <2 yrs or <$10M and > 2 yrs. $10M and > 2yrs. or significant technical risk
Baseline Risk Reduction	☐ HIGH ☐ MED ☐ LOW	The baseline technical solution has not be proven at large scale or on actual radioactive waste. The baseline technical solution has been demonstrated at large scale but not implemented in radioactive operations. The baseline technical solution has been implemented at Hanford.

Cost Information	
17A*	***Current Baseline Cost:*** $150M
17B	***Estimated Cost Impact:*** $150M (avoid building two DSTs)
18*	***Cost Impact Explanation:*** Current estimates are that each additional DST will cost $75M and at least two new DSTs will need to be constructed through 2010 per document RPP-8554. Additional DSTs will be needed beyond the 2010 time frame at a cost of roughly $75,000,000 each to support SST retrieval targets. Planning studies have updated previous detailed estimates for construction of new DSTs.
Risk Information	
37 new	***Risk Identifier:*** ☐ CR- [e.g., CR-047] X New ***Risk Statement:*** If DST space is not available then retrieval of SSTs must be delayed or new DSTs must be built.
12B	***Risk Narrative:*** Schedules to retrieve waste from DST indicate volume of retrieved waste exceeds volume processed through WTP plus currently available space. Additional DSTs will be needed about 2010 or additional volume made available to support SST retrieval.
Schedule Information	
21	***Regulatory Drivers:*** M-45-00-01A modifications to the Tri-Party Agreement
22*	***Milestones:*** M-45-12-T01 (2/28/2002) Options report on assessment of actions that could be taken to increase available tank space for SST waste retrieval (completed). 9/30/03 (approaches defined) Need updated milestones
28*	***Earliest Date Required:*** 9/30/03 (approaches defined)
29*	***Latest Date Required:*** 9/30/06 (path forward selected)
13B	***Schedule Explanation:*** Additional DST space will be needed in 2010
30	***Technology Insertion Point:*** ☐ New X Existing Code: 1-0305 Official Date: 4/29/05
Additional Points of Contact (POC)	
34	***Contractor End User POCs:***
35	***DOE End User POCs:*** Mike Royack, DOE-ORP, 509-376-4420, Fax: 509-373-1313, michael_j_royack@rl.gov
36*	***Other Contacts:*** Kayle D. Boomer, CH2M HILL, 509-372-3629, Fax: 509-376-1788, kayle_d_boomer@rl.gov K.A. (Ken) Gasper, CH2M HILL, 509-373-1948, F/509-373-9093, kenneth_a_ken_gasper@rl.gov

Office of River Protection
Technology Opportunity Statement

General Reference Information	**ACTIVE**
2*	***Assigned Tracking Number:*** WT089
1*	***Title:*** Single-Shell Tanks (SSTs) Retrieval with Minimal Water Addition
3*	***Summary:*** Hanford Single-Shell Tanks (SSTs) retrievals planned in FY2003 to 2006 will be performed by enhanced sluicing, which is considered as the most cost-effective method, with the exception of tanks with the following characteristics: • Assumed leakers • Tanks containing dry sludge, for which downstream processing/conditioning is done in dry conditions For tanks with these characteristics the baseline technology selection is the Mobile Retrieval System (MRS), which consists of an Articulated Mast System (AMS) pneumatic assisting vacuum pumping device, and an In-Tank Vehicle System (ITV), which conveys the waste toward the AMS. The ITV requires a 30" diameter access, while the AMS fits in a 12" diameter access. Access to the tanks is through risers that vary in diameter from 4" to 42", with numerous tanks with no risers larger than 12" in diameter. (The need to cost-effectively install a larger riser to accommodate ITV access is captured in WT-136 "Installation of New Risers in SSTs".) Tanks that are assumed leakers, or contain dry sludge that will be dry-processed, need to be retrieved with minimal addition of water. The subject tanks vary in size and waste volume: • 55 kgal tanks, 20 feet in diameter and 26 feet high, containing from 1 kgal of sludge, up to 51kgal of waste, • 530 and 750 kgal tanks, 75 feet in diameter and 30-37 feet high, containing from 16 to 440 kgal of waste, • 1 Mgal tanks, 75 feet in diameter and 45 feet high, containing from 30 to 100 kgal of waste. Beginning in 2003 twenty-seven tanks are targeted to be retrieved by the MRS. The wastes vary from fine powders to hard solids. Tanks are expected to contain high-level waste, with others containing transuranic wastes, some requiring remote handling, and a few low-level waste tanks Current plans are to use the AMS without the ITV in the 20 feet diameter tanks, and to use the full MRS for the 75 feet diameter tanks. Several issues have been identified with these solutions, such as: • Uncertain effectiveness of the ITV to handle steep slopes potentially present in dry waste tanks; this uncertainty might increase if selected tanks containing "dry salts" with ledges of varying elevations are added to the list of retrievals with minimal water addition (in case salts from these tanks are interim stored in selected SSTs, which would preclude the use of significant amounts of water for retrieval). • Uncertain effectiveness of the systems to mobilize "hard pan" wastes in the 20 ft. diameter tanks. • Amount of waste clinging to walls after retrieval relative to the targets for residual waste ($30ft^3$ for 20 ft. tanks). Resolution of these issues is in progress and may yet require some design changes in the MRS platform. In addition, retrieval costs need to be reduced from current estimates. In order to ensure successful retrieval of 26 to 40 tanks within limited budgets by the end of FY2006, more cost

	effective implementation approaches are needed. The Office of Science and Technology has funded AEA Technology Engineering Services, Inc. to develop and test a full-scale prototype retrieval system to mix and dissolve saltcake/sludge wastes using a minimum amount of water. The prototype systems will be tested at the Hanford Cold Test Facility in early FY04. This approach is considered backup in case difficulties are encountered in using the MRS system for some of the SST saltcake/sludge waste retrieval.
38new	***Principal Contact:*** Warren Thompson, CH2M HILL, 509-372-8053, Fax: 509-373-4095, warren_t_thompson@rl.gov Dave Smet, CH2M HILL. 509-539-1674 or 509-376-1730, F/509-372-2825, david_b_smet@rl.gov
Technology Opportunity Description	
8A*	***Project:*** ☐ Safe Storage – Operations and Maintenance ☐ Safe Storage – Life Extension ☐ Waste Retrieval and Transfer – Waste Inventory Properties X Waste Retrieval and Transfer – Equipment ☐ Closure ☐ Disposal ☐ Supplemental Treatment
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW04 *Work Breakdown Structure (WBS) No.: 5.8.2 (primary), 5.8.5 (secondary)*
12A	***Problem Description:*** *See Summary*
9A	***Overall Priority:*** X HIGH Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction ☐ MEDIUM Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction ☐ LOW Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation
9B	***Priority Matrix***

Schedule Impact	X HIGH ☐ MED ☐ LOW	Needed to meet PBIs Needed to meet mission targets (2033 closure) no schedule impact or can improve mission targets (<2033 closure).
Cost Savings	X HIGH ☐ MED ☐ LOW	>$1B total life-cycle savings >$100M but <$1B total life-cycle savings <$100M total life-cycle savings
Implementation Cost/Schedule	☐ HIGH X MED ☐ LOW	<$10M and <2 yrs. >$10M and <2 yrs or <$10M and > 2 yrs. >$10M and > 2yrs. or significant technical risk

	Baseline Risk Reduction	☐ HIGH	The baseline technical solution has not been proven at large scale or on actual radioactive waste.
		X MED	The baseline technical solution has been demonstrated at large scale but not implemented in radioactive operations.
		☐ LOW	The baseline technical solution has been implemented at Hanford.
Cost Information			
17A*	***Current Baseline Cost:*** $20M to $75M per tank		
17B	***Estimated Cost Impact:*** $ TBD		
18*	***Cost Impact Explanation:*** Retrieval costs need to be reduced to $2M to $3M per tank		
Risk Information			
37 new	***Risk Identifier:*** ☐ CR-_____ [e.g., CR-047] ☐ New ***Risk Statement:*** If the baseline MRS technology is unsuccessful, then retrieval schedule commitments will be missed and/or budget needs will exceed available funds. The baseline MRS technology employs high-pressure (~1200 psi) water to scarify or break up hard wastes. The high- pressure water presents a possibility of creating tank leaks or exacerbating existing leaks thereby driving contaminants deeper into the vadose zone and possibly into the groundwater system beneath the SST tank farms.		
12B	**Risk Narrative:** *Given (1) the age of the SSTs, (2) the fact that 67 SSTs are confirmed or assumed leakers and they continue to deteriorate, (3) all SSTs have exceeded their design lives, and (4) tank configuration makes it difficult to perform tank integrity inspections, the consequences of not filling this need is increased potential for leakage losses during retrieval operations if past practice sluicing is used. This could result in cessation of tank waste retrieval operations with resultant impacts to waste feed delivery to the Waste Treatment Plant. Furthermore, if the leakage losses are great enough and migration to the water table is imminent, then the tank farm could be thrust into RCRA assessment and corrective action mode with associated costs for characterization, evaluation, and remediation. At a minimum, increased tank farm surveillance will be required to track the fate and transport of leaked contaminants through the vadose zone.*		
Schedule Information			
21	***Regulatory Drivers:*** Tri-Party Agreement M-45 Series milestones require alternative retrieval technology demonstrations and SST retrievals by certain dates. Demonstration of retrieval technologies that use little to no liquid will minimize the likelihood for leakage losses during retrieval providing a more environmentally and regulatory acceptable situation.		
22*	**Milestones:** • *Complete tank cold technology demonstration of crawler system retrieval by 6/30/04. (Cold Test Report submitted to ORP, June '03).* *First MRS Retrieval – C-200 series tanks—12/03* *MRS Retrieval– T-200 series tanks—05/04*		
28*	***Earliest Date Required:*** September 2003		
29*	***Latest Date Required:*** September 2006		

13B	***Schedule Explanation:*** Performance Based Incentive PBI-3 requires retrieval of 26 tanks by Sept. 2006. This includes C-200 (20ft diameter tanks to be retrieved by MRS).
30	***Technology Insertion Point:*** ☐ New ☐ Existing Code: Official Date: ***Technology Insertion Point(s):*** C-200 series tank retrieval, C-101 retrieval for ITV.
Additional Points of Contact (POC)	
34	***Contractor End User POCs:*** Paul Branson, CH2M HILL 509-372-0086, F/509-373-6101, paul_m_branson@rl.gov Dave Smet, CH2M HILL. 509-372-3537, F/509-372-2825, david_b_smet@rl.gov
35	***DOE End User POCs:*** James F. Thompson, Jr, ORP, 509- 373-9757, james_f_jr_thompson@rl.gov
36*	***Other Contacts:*** K.A. (Ken) Gasper, CH2M HILL, 509-373-1948, F/509-373-9093, kenneth_a_ken_gasper@rl.gov

Office of River Protection
Technology Opportunity Statement

General Reference Information	CLOSED
2*	***Assigned Tracking Number:*** WT090
1*	***Title:*** Chemical Behavior of Sludge Wastes
3*	***Summary:*** Provide additional chemical information to guide the caustic leaching of Hanford tank sludge wastes. The current ORP strategy is to conduct leaching as part of the WTP pretreatment. This outside of the tank farm contractor's scope, but the potential benefits from greater understanding of the Chemical behavior of sludges still exists. Also, the possibilities still exist for in-tank leaching.
38new	***Principal Contact:*** Dan Herting, CH2M HILL, 373-2532, daniel_l_herting@rl.gov
Technology Opportunity Description	
8A*	***Project:*** ☐ Safe Storage – Operations and Maintenance ☐ Safe Storage – Life Extension X Waste Retrieval and Transfer – Waste Inventory Properties ☐ Waste Retrieval and Transfer – Equipment ☐ Closure ☐ Disposal
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW04 Work Breakdown Structure (WBS) No.: 5.8.5 primary; 5.8.2 secondary
12A	***Problem Description:*** An understanding of the chemical behavior of compounds present in sludge wastes, especially the chromium and aluminum species, is important to predict the manner in which leach rate and completeness are affected by variations in process parameters. **Needs related to leaching:** Knowledge of the chemical compositions of the wastes alone provides general indications of leachability and the effect of process parameters on leachability. However, to develop a reliable capability for quantitative prediction of leachability, this knowledge must be coupled with leach tests on actual waste samples. Such leach tests have already been performed on 30 samples of sludge, representing 75% of the total sludge volume at Hanford. Testing of another 17 samples would complete a plan to cover 93% of the sludge. 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. Information is needed about the rate, as well as the total extent of dissolution that may be obtained under potential processing conditions. Kinetic information will assist in designing and operating the leaching step most efficiently. Our present level of understanding of the behavior of chromium in the Hanford waste tanks is based only on observations at a few selected conditions for specific wastes. There are few available data on the equilibrium behavior of chromium compounds in tank-like environments, and kinetic information under these conditions is virtually nonexistent. Chromium dissolution in basic solutions is not an instantaneous process; preliminary unpublished data on the dissolution of chromium solids in high base suggests a significant decrease in solubility with time. A special

	concern involves the REDOX-type sludge wastes, which contain most of the hard-to-remove chromium. The chromium system is complicated by its redox chemistry. The oxidation state of chromium in the waste is surmised only from its solubility behavior. Thus, systematic evaluation of the solubility and kinetics of chromium compounds must also cover the oxidation of Cr (III) to Cr (VI). Fundamental investigations of the equilibria and kinetics of reactions involving the Cr (III) – Cr (VI) transitions are necessary. The chemistry is likely to be strongly dependent on temperature, alkalinity and various other parameters. Thus, a systematic investigation of the general equilibria and dissolution/precipitation kinetics of chromium compounds in concentrated alkaline solutions is key to predicting the behavior and speciation of chromium in the Hanford tank systems. **Needs related to leach solution stability:** Once chemical constituents have been leached from the waste, it must be ascertained that subsequent processing will not cause re-precipitation or gel formation. This question will be addressed mainly by the Environmental Simulation Program (ESP) chemical equilibrium software (OLI Systems, Inc., Morris Plains, NJ), but the applicability of this software for predicting the solubilities of chromium, aluminum, and other elements of concern in alkaline solutions of high ionic strength must be demonstrated by laboratory testing.
9a	***Priority:*** ☐ HIGH Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction ☐ MEDIUM Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction X LOW Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation
9b	***Priorities:***

Schedule Impact	☐ HIGH ☐ MED X LOW	Needed to meet PBIs Needed to meet mission targets (2033 closure) no schedule impact or can improve mission targets (<2033 closure).
Cost Savings	X HIGH ☐ MED ☐ LOW	>$1B total life-cycle savings >$100M but <$1B total life-cycle savings <$100M total life-cycle savings
Implementation Cost/Schedule	☐ HIGH ☐ MED X LOW	<$10M and <2 yrs. >$10M and <2 yrs or <$10M and > 2 yrs. >$10M and > 2yrs. or significant technical risk
Baseline Risk Reduction	☐ HIGH X MED ☐ LOW	*The baseline technical solution has not been proven at large scale or on actual radioactive waste.* The baseline technical solution has been demonstrated at large scale but not implemented in radioactive operations. The baseline technical solution has been implemented at Hanford.

Cost Information	
17A*	***Current Baseline Cost:*** $25 billion (= 12,500 canisters @ ~$2M/canister)

17B	***Estimated Cost Impact:*** $6 billion (= 3000 canisters @ ~$2M/canister)
18*	***Cost Impact Explanation:*** The canister cost avoidance is difficult to calculate because the leachability of chromium may be in error by a factor of two. The estimate given is based on the current estimate that HLW will fill 12,500 canisters, and, if all the chromium could be removed, about 3000 canisters could be avoided. The cost of making and disposing of a single canister is estimated to be $2M. Despite the vagaries of this estimate, the possible cost savings are certainly large.
Risk Information	
37 new	***Risk Identifier:*** ☐ CR-part CR-624 ☐ New ***Risk Statement:*** If Cr can be solubilized through in-tank leaching processes then the HLW glass waste loading can be increased. If leachates are combined with other incompatible streams then precipitation and line plugging could occur.
12B	***Risk Narrative:***
Schedule Information	
21	***Regulatory Drivers:*** Tri-Party Agreement
22*	***Milestones:*** Supports technical basis of TPA milestone M-45-02 "Submit annual updates to SST retrieval sequence document," due at the end of each fiscal year.
28*	***Earliest Date Required:*** Not needed during WTP Phase I, past 2010.
29*	***Latest Date Required:*** 2028
13B	***Schedule Explanation:*** Phase 1 tanks do not need Cr separation. Chrome separation is important for Phase II, Balance of Mission.
30	***Technology Insertion Point:*** ☐ New ☐ Existing Code: Official Date:
Additional Points of Contact (POC)	
34	***Contractor End User POCs:*** Dan Herting, CH2M HILL, 509-373-2532, daniel_l_herting@rl.gov
35	***DOE End User POCs:*** C. S. (Cathy) Louie, DOE-ORP, 509-376-6834, F/509-373-0628, catherine_s_louie@rl.gov
36*	***Other Contacts:*** K.A. (Ken) Gasper, CH2M HILL, 509-373-1948, F/509-373-9093, kenneth_a_ken_gasper@rl.gov N.W. (Nicholas) Kirch, CH2M HILL, 509-373-2380, fax 509-372-0065, nicholas_w_nick_kirch@rl.gov

Office of River Protection
Technology Opportunity Statement

General Reference Information	**ACTIVE**
2 *	***Assigned Tracking Number***: WT091
1 *	***Title***: Chemical and Physical Behavior of Saltcake Wastes
3 *	***Summary***: Provide additional equilibrium solubility and physical behavior data to guide the retrieval, delivery, and treatment of Hanford tank saltcake wastes. Retrieval can proceed forward without this work being complete, but plugging problems may occur that may cause delays or over dilution may cause excessive evaporator load.
38new	***Principal Contact:*** Dan Reynolds, CH2M HILL, 373-3115, daniel_a_reynolds@rl.gov Nick W. Kirch, CH2M HILL, 509-373-2380, F/509-376-1788, nicholas_w_nick_kirch@rl.gov
	Technology Opportunity Description
8a *	***Project:*** ☐ Safe Storage – Operations and Maintenance ☐ Safe Storage – Life Extension ☒ Waste Retrieval and Transfer – Waste Inventory Properties ☐ Waste Retrieval and Transfer – Equipment ☐ Closure ☐ Disposal
8b	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW04 Work Breakdown Structure (WBS) No.: 5.8.5
12a	***Problem Description***: Wastes must be transported and treated with minimum cost and delay. To this end, the transfer and treatment equipment must be designed correctly, and the operating plans must be accurate. Successful planning, equipment design, and plant operation all rely on accurate knowledge of the chemistry and physical properties of the wastes to be treated. In particular, detailed knowledge of waste component solubilities permits planning to take place to ensure that production expectations are achieved. Although a good deal of information has been obtained about the elemental composition of the waste, we do not yet have complete knowledge of the chemical compounds and mineralogy formed by these elements. Accurate knowledge of the chemical compounds present in saltcake wastes is important to predict how much of the waste will dissolve as a function of the amount of dilution water added, temperature, and other process parameters. The chemical equilibrium software package Environmental Simulation Program (ESP; OLI Systems, Inc., Morris Plains, NJ) is used on the Hanford Site to calculate the amounts of each waste component in the solid and liquid phases of partially dissolved saltcakes. However, these calculations are very challenging for the software because of the many species present in the waste; the high ionic strengths of typical Hanford wastes also strain the reliability of these calculations. Therefore, equilibria must be measured with actual wastes under expected process conditions to verify ESP calculations and to correct any deviations that are discovered. Major components include sodium salts of hydroxide, nitrate, nitrite, and carbonate. Aluminum is abundant in some tanks, kept in solution by the high pH. Also present are sulfate, phosphate, and fluoride that are known to form double salts. Some data may be in the open literature, or may reside in private or individual databases developed by others. A systematic study should be continued to identify ESP shortcomings, determine the data

required to correct them, determine whether the data already exists (in the open literature or in DOE-sponsored reports), and organize and perform an efficient laboratory test program to obtain missing data.

Saltcake transfers are expected to occur at a nominal sodium concentration of 5M, so the possibility of a pipe plugging during a saltcake waste transfer is very low. However, unusual processing scenarios, such as a pump failure during cold weather may lead to situations where solid phase formation could occur. ESP should be able to predict solid formation (insofar as the process conditions, such as pipe temperature, can be predicted). However, ESP will not (directly) predict the physical form of the solids, which may range from gel or sludge to large, pipe-filling crystals, depending on the chemical composition, cool-down rate, and other such factors. Information about the physical form of solids that may be expected is needed to plan for recovering from such process upsets.

ESP is a powerful tool with an extensive database that takes considerable time to run. PREDICT is a simpler equilibrium model that is based upon only a few of the most common chemicals in the waste. PREDICT has been used for several years to make "quick and dirty" estimates to support evaporator campaigns. With a greater number of evaporator campaigns to occur in the future and more solubility calculations to be performed to support field operations it is highly desirable to have a simpler and faster tool than ESP. PREDICT should be upgraded or replaced with another simple to use model.

Studies to date (SL Lambert, personal communication, 11/25/2002) show that there can be sizable portions of nominally soluble species such as sodium ion or cesium ion that remain in solids after extensive water contact. The form that these soluble species exist in should be explored and suggested methods to retrieve these should be tried.

Sluicing techniques to recover salt cake waste introduce issues of physical properties in addition to chemical solubilities and equilibrium issues.

Saltcake Strength: From past practice sluicing, sludge is understood to have a modest strength but does show plastic behavior and flows under pressure. It is also known to break apart into particles easily. Salt cake does not show this behavior. During saltwell pumping, saltcake will collapse as the interstitial liquor is removed. The collapse may not be due to plastic deformation but could be caused by thin walled chambers collapsing once a hydraulic head is removed. There is a difference between sludge and saltcake when a core sample is extruded in the laboratories. Sludges tend to bend to reach the tray and then may relax and loss the round shape. Saltcakes can extend beyond the extruder several inches and then snap off and fall to the tray. On the tray, it is common for saltcakes to be a round cylinder that must be broken up to put into sample bottles.

The strength of saltcake will be beneficial, as it will tend to present a cliff face to sluicing streams in an inside-to-outside sluicing scheme. The strength will prevent slumping and slopes forming. On the other hand, the strength may cause problems in cutting and moving solids to a sluice pump. If the saltcake is monolithic instead of a loose pile of granules, then the sluice stream may need to be used to dissolve and erode a channel to make a cut. This could be time consuming.

Sandbars of waste dams can form, causing liquid to cover the waste and preventing direct impact of the sluicing jets. The dams can also inhibit movement of sluiced slurry to the transfer pump. Also, dislodged saltcake may remain in large chunks that are not easily moved

	to the pump inlet and too large to enter the inlet. On the other hand, the sluicing fluid may soften a hard saltcake such that it will crumble easily and be very amenable to sluicing. *Pumping of Saltcake Slurries:* Pumping of saltcake slurries is being considered. The liquid in these slurries will be saturated with large amounts of dissolved salts. Variation of temperature during pipeline transport, whether anticipated or unplanned, may cause large quantities of solid salt to be formed in the pipe. The nature of these solids, including particle size and density, must be understood to avoid pipeline plugging. Continuing development of pipeline unplugging methods is required. The effects of in-line dilution, if employed, will be mostly beneficial. However, there are two phenomena that may have deleterious effects. • Sodium nitrate, which is the major component in saltcake, cools when dissolved. A recent test in Florida in dissolving a column of synthetic saltcake reached temperatures as low as 50 to 60 °F. One sparingly soluble species is sodium phosphate. This species solubility is a strong function of temperature. Cooling may cause this species to form. The sodium phosphate tends to crystallize in long crystals that form mats. These mats have plugged pipelines in the past, though this was probably due to exposure of the pipeline to cold weather. • The common ion effect may cause sparingly soluble salts to precipitate out of the solution when a more soluble species is dissolved. This could affect solubility of sodium phosphate and potentially aluminum salts. These two salts have been a concern with pumping in the past. **Problem Background:** Solids and gels may form in the Hanford tank waste under certain processing conditions. Transfer lines have been plugged when solids or gels inadvertently formed. Knowledge of the solubility envelope for the waste is necessary to avoid unwanted precipitation or gel formation in supernatants. Improvements in processing efficiency are expected if the retrieval, pipeline delivery and treatment plant processes are based on an understanding of the dissolution thermodynamics and kinetics rather than just empirical data. Water use and makeup chemical addition can also be reduced which, together with the improvement in efficiency, can reduce the amount of glass produced. Knowledge of waste solubility is necessary to avoid unwanted precipitation or gel formation in supernatants and to recover from such events should they occur. **Similar needs:** Technology Opportunity Statements WT090 and WT138 deals with the solubility and physical property issues related to retrieval and treatment of sludge wastes.
9a	***Priority:*** ☒ HIGH Large cost benefit, short term implementation needed to maximize benefits, easy to implement, high risk reduction ☐ MEDIUM Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction ☐ LOW Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation
9b	***Priorities:***

	Schedule Impact	☐ HIGH X MED ☐ LOW	Needed to meet PBIs Needed to meet mission targets (2033 closure) no schedule impact or can improve mission targets (<2033 closure).
	Cost Savings	☐ HIGH ☐ MED X LOW	>$1B total life-cycle savings >$100M but <$1B total life-cycle savings <$100M total life-cycle savings
	Implementation Cost/Schedule	☐ HIGH X MED ☐ LOW	<$10M and <2 yrs. >$10M and <2 yrs or <$10M and > 2 yrs. >$10M and > 2yrs. or significant technical risk
	Baseline Risk Reduction	X HIGH ☐ MED ☐ LOW	The baseline technical solution has not been proven at large scale or on actual radioactive waste. The baseline technical solution has been demonstrated at large scale but not implemented in radioactive operations. The baseline technical solution has been implemented at Hanford.

Cost Information	
17A*	***Current Baseline Cost:*** $Retrieval & Storage (including evaporation)
17B	***Estimated Cost Impact:*** $Save unplugging efforts and evaporator operation
18*	***Cost Impact Explanation:*** Better knowledge of plugging potential and of operational conditions that avoid plugging may permit loosening of overly restrictive process control requirements. This would reduce waste volume and programmatic time and costs.
Risk Information	
37 new	***Risk Identifier:*** ☐ CR- CR-21; CR-624 ☐ New ***Risk Statement:*** If the Salt Cake dissolution retrieval is not better understood, then the delivery of salt cake waste to the DSTs may be vastly different than expected to receive. Negative interactions such as precipitation within piping or processing tanks or excessive waste volume delivered to the DSTs If transfer and consolidation of waste solids causes the waste to behave differently, then new safety analyses and control systems may be required.
12B	***Risk Narrative:*** *[further explanation, if warranted]*
Schedule Information	
21	***Regulatory Drivers*:** Tri-Party Agreement. This need supports the regulatory requirements for storage and transfer of waste.
22 *	***Milestones*:** Supports technical basis of TPA milestone M-45-02 "Submit annual updates to SST retrieval sequence document," 9/30/2000 and annually thereafter.
28 *	***Earliest Date Required*:** January 2001
29 *	***Latest Date Required*:** FY 2020
13B	***Schedule Explanation:*** Solubility information obtained in answer to this need will support the SST retrieval sequence analysis, which is updated annually throughout the life of the project, in accordance with Tri-Party Agreement Interim Milestones M-45-02D through M-45-02I.
30	***Technology Insertion Point:*** ☐ New ☐ Existing Code: Official Date:

	***Baseline Technology/Process*:** A thermodynamic model known as the Environmental Simulation Program (ESP) is used in conjunction with the process tests. The ESP has been only partially validated with actual waste solubility data. **Technology Insertion Point(s):** N/A
Additional Points of Contact (POC)	
34	***Contractor End User POCs*:** D.A. (Dan) Reynolds, CH2M HILL, 509-373-3115, F/509-373-4641 daniel_a_reynolds@rl.gov
35	***DOE End User POCs*:** B.M. (Billie) Mauss, ORP, 509-373-9876, F/509-372-2781, billie_m_mauss@rl.gov;_James F. Thompson, Jr, Office of River Protection, (509) 373-9757, james_f_jr_thompson@rl.gov; Roger Quintero, DOE-ORP, 509-373-0421, Fax: 509-373-1313, roger_a_quintero@rl.gov
36	***Other Contacts:*** Nick W. Kirch, CH2M HILL, 509-373-2380, F/509-376-1788, nicholas_w_nick_kirch@rl.gov W. Blaine Barton, CH2M HILL, 509-376-5118, F/509-373-4641, w_b_blaine_barton@rl.gov Dan Herting, CH2M HILL, 509-373-2532, F/509-373-2843, daniel_l_herting@rl.gov K.A. (Ken) Gasper, CH2M HILL, 509-373-1948, F/509-373-9093, kenneth_a_ken_gasper@rl.gov

Office of River Protection
Technology Opportunity Statement

General Reference Information	**ACTIVE**
2*	***Assigned Tracking Number:*** WT102
1*	***Title:*** Post-Retrieval Evaluation: In-Situ Characterization
3*	***Summary:*** Technology is needed to support post-retrieval evaluations of residual waste, as well as contamination in soils beneath RPP facilities. An accurate technology or methodology to evaluate tank contents remaining before, during and after retrieval and transfer would also meet the new requirements listed in Appendix H of the TPA. A fundamental understanding of the true radionuclide source-term from tank residuals is needed to base sound cost/benefit/risk decisions regarding the extent of waste removal actually required from the tanks to meet site-wide groundwater protection standards. A better understanding of the presence and impact of complexants on contaminant mobility is also required. Finally, methods to determine the release rate (i.e. leach rate) from any remaining residuals left in the tank at the completion of retrieval are needed to support interim closure decisions and path forward. *There is a potential that sampling will not be required if in situ analysis will be considered sufficient, an issue which still remains to be negotiated. Some types of in situ analysis that have potential application include: thermal imaging to show where a hot spot might remain; neutron activation; Raman spectrograph; gamma energy spectra; etc.* This technology opportunity combines CH2M HILL Workshop #63, #82 (WT102), #85, #86, and #87. See CH2M HILL Workshop #46 (WT068) and #63 for Technology to support "Extent of Retrieval Possible" Decisions (WT115). This technology opportunity crosswalks to tough technical problem (#14) for in situ tank assay, which is for a aapability for determining how much waste is in ancillary equipment (e.g., in the pipes). (Ed Fredenburg). It includes tough technical problem (#16 and 21) for a remote sampler. For #16, it is assumed that the tank has been retrieved, and residual waste must be sampled. There are several nearly off-the-shelf remote crawler systems that can provide this type of service. This would require procurement of a crawler system, which would be a consumable, but the control system could be used for multiple deployments. During the inspection and characterization of U-Plant, PNNL successfully acquired samples during the inspection. For #21, the tank may still have large volumes of waste that the system needs to negotiate. If this is applied to SSTs, it is likely that the system for the residual off-riser sampler could be modified for this sort of sampling.
38new	***Principal Contact:*** Ron Calmus, CH2M HILL, 509-372-3385, Fax: 509-372-2862, ronald_b_ron_calmus@rl.gov
Technology Opportunity Description	
8A*	***Project:*** ☒ Safe Storage – Operations and Maintenance ☒ Safe Storage – Life Extension ☐ Waste Retrieval and Transfer – Waste Inventory Properties ☐ Waste Retrieval and Transfer – Equipment ☒ Closure ☐ Disposal

8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW04 Work Breakdown Structure (WBS) No.: 5.8.5
12A	***Problem Description:*** From the SST perspective, all SSTs have exceeded their intended design lives and continue to degrade. Pumpable liquids have been, and are being, removed from the SSTs through the Interim Stabilization Project saltwell pumping activities. Furthermore, retrieval systems are being designed to use very little, if any, liquids to dislodge, mobilize, retrieve, and transfer the wastes into newer double-shell tanks. Liquids used to facilitate tank waste retrieval operations will be introduced in a confined and controlled manner. At present, sampling is used as the method of choice. Two cores are typically extracted from a tank, extruded in the laboratory, and are analyzed in accordance with applicable Data Quality Objectives (DQOs). These core samples are supplemented by grab, vapor, and other samples. Although this level of sampling and analysis is considered the best available that can be done at present, questions exist regarding the representativeness of these samples due to incomplete core recoveries, heterogeneities in waste layers and composition, limited riser locations, relative volume of samples versus tank waste volumes, and other considerations. Furthermore, core sample collection and analysis is relatively expensive at $750K to $1,000K per core. Better in situ characterization techniques for previously mentioned contaminants of concern could have a high return on investment in terms of reduced sampling and analysis costs, and better tank waste inventories in support of retrieval, LDMM system designs, and closure planning. In situ characterization could also be used to support evaluating ancillary piping and other equipment, as well as characterization of tank waste residuals and contaminants in soils in support of tank farm closure planning and execution. A key consideration in performing better in situ characterization of tank wastes is providing capability for off-riser sampling and analyses. It is also important to determine interstitial liquid volumes and associated inventories of contaminants of concern. Potentially applicable technologies include, but are not limited to, in-tank spectral gamma techniques, in situ beta time-of-flight measurement techniques, and pressure transducer technologies from the petroleum industry. To measure whether TPA goals (550 curies of mobile long lived radioisotopes, 99% of tank contents for Tank S-112) have been met, a system will be needed to determine residual tank waste volume to measure whether TPA waste volume retrieval goals have been met. Sampling tools for large amounts amount of hard waste will be needed to characterize the residual waste heel prior to tank closure.
9a*	***Priority:*** ☒ HIGH Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction ☐ MEDIUM Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction ☐ LOW Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation

9b*	Priorities		
	Schedule Impact	☐ HIGH x MED ☐ LOW	Needed to meet PBIs Needed to meet mission targets (2033 closure) Can improve mission targets or no schedule impact
	Cost Savings	☐ HIGH ☐ MED x LOW	>$1B total life-cycle savings >$100M but <$1B total life-cycle savings <$100M total life-cycle savings
	Implementation Cost/Schedule	x HIGH ☐ MED ☐ LOW	<$10M and <2 yrs. >$10M and <2 yrs or <$10M and > 2 yrs. >$10M and > 2yrs. or significant technical risk
	Baseline Risk Reduction	☐ HIGH ☐ MED x LOW	The baseline technical solution has not been proven at large scale or on actual radioactive waste. The baseline technical solution has been demonstrated at large scale, but not implemented in radioactive operations. The baseline technical solution has been implemented at Hanford.

Cost Information	
17A*	***Current Baseline Cost:*** Core sample collection and analysis is relatively expensive at $750K to $1,000K per core At present, two cores are typically extracted from a tank, extruded in the laboratory, and are analyzed in accordance with applicable Data Quality Objectives (DQOs). These core samples are supplemented by grab, vapor, and other samples.
17B	***Estimated Cost Impact:*** High return on investment in terms of reduced sampling and analysis costs, and better residual tank waste inventories to support tank closure decisions.
18*	***Cost Impact Explanation:*** Substantial cost savings could result if site characterization activities can be performed without the need to conduct full-suite laboratory analyses on soil samples. Current costs to extract and analyze core samples from SSTs ranges from $750K to $1,000K per core, and two cores are typically extracted from each tank. Better in situ characterization methods could greatly reduce the costs associated with tank waste characterization. Furthermore, defensible methods for in situ characterization could save tens of millions of dollars per tank by demonstrating that tank waste residuals do not exceed risk guidelines and may be disposed of in-place without additional removal and treatment. This need is targeted at obtaining information that will help develop a better understanding of the Hanford Site contamination. This understanding will be used to determine appropriate solutions to these contamination problems. These solutions may offer a cost savings potential over solutions selected based on the current more limited knowledge of contaminant distribution and migration potential at the Site.

Risk Information	
37 new	***Risk Identifier:*** ☐ CR- [e.g., CR-047] ☒ New ***Risk Statement:*** If defensible representative samples of the remaining waste are not able to be collected where waste is located—not where risers are located—it will not be possible to meeting the new requirements listed in Appendix H of the TPA. If the PCB concentration exceeds 10 ppm in an unreviewed SST waste heel, then it does not meet

	the LDR limit and further actions will be required prior to closure or special approval from Ecology will be required (CH2M HILL-0204559, App.C for WBS 5.5.1). If characterization of tank waste residuals and contaminants in soils in support of tank farm closure planning and execution is not timely and cost-effective, then tank farm closure schedules will be delayed and budgets will be unacceptable. If the accuracy of residual waste volume measurement tools is not adequate to assess HFFACO compliance, then additional tool development and deployment may be required to obtain regulatory acceptance. Without adequate post-retrieval characterization tools, it will be difficult to demonstrate that closure requirements are met.
12B	***Risk Narrative:*** Continued use of current methods that includes costly boring, labor-intensive sampling, and laboratory analysis. From a SST retrieval and closure perspective, it will be difficult to demonstrate that retrieval goals and closure requirements are met without capabilities for cost effectively performing in situ characterization of tank waste residuals that may not be located directly beneath a tank riser. The consequences of this include the possibility of a secondary retrieval operation to attempt to remove tank waste residuals. This could require the development and demonstration of alternative retrieval technologies for tank waste residuals.
Schedule Information	
21	***Regulatory Drivers:*** Analyses completed as part of the effort to address this technology need will serve as the basis for reaching agreement with regulatory agencies on establishing performance objectives and criteria for remediation and closure of Hanford facilities; including the retrieval of tank wastes. Also, information obtained by addressing this need will provide an improved technical basis for making site regulatory decisions and therefore reduce the uncertainty associated with the basis for these decisions. In addition, capability to collect this information would also be useful to support selection and monitoring of effective remediation alternatives and final closure schemes.
22*	***Milestones:*** T04005-W18 – Submit a Corrective Measures Study (TW04), TPA M-45 Series Milestones T09-06-100 – M90-10 CD-4 Initiate Hot Operations W-520 (TW09)
28*	**Earliest Date Required:** September 2001
29*	**Latest Date Required:** September 2003
13B	***Schedule Explanation:*** Support Tank Waste Closure Work Plan 2004 Update. Soil Remediation and 200 Area site characterization activities are ongoing. Goals established in the Hanford Ten-Year Challenge would have all soil sites and burial grounds in the 100 Area and 300 Area completed by 2006. Characterization and remediation of the 200 Area began in FY 1999 and will extend several years past 2006. Tank farm characterization is ongoing with planning for remedial action and closure having started. PBI-3 includes interim closure of M-45 high risk SSTs (S-112, S-102, C-104), C-106, 4 low risk/volume tanks, additional HLW tanks (>fee over and above 19), individual tank farms (> fee over and above 2), and 244-AR vault by 9/30/2006.
u	***Technology Insertion Point:*** ☐ New ☐ Existing Code: Official Date: Technology Insertion Point(s): N/A

Additional Points of Contact (POC)	
34	***Contractor End User POCs:*** F.M. (Fred) Mann, CH2M HILL, 509-372-9204, F/509-372-9447, Frederick_m_mann@rl.gov
35	***DOE End User POCs:*** R.W. (Bob) Lober, DOE-ORP, 509-373-7949; F/509-373-1313; robert_w_lober@rl.gov Roger Quintero, DOE-ORP, 509-373-0421, Fax: 509-373-1313, roger_a_quintero@rl.gov
36*	***Other Contacts:*** K.A. (Ken) Gasper, CH2M HILL, 509-373-1948, F/509-373-9093, kenneth_a_ken_gasper@rl.gov

Office of River Protection
Technology Opportunity Statement

General Reference Information	**CLOSED**
2*	***Assigned Tracking Number:*** WT104
1*	***Title:*** Cleanable HEPA Filter
3*	***Summary:*** SST breather filters fail frequently upon aerosol testing, including by leaks around the filter: 113 have failed over the last seven years among the 166 in the Tank Farms (all tested each year), that is 11.42% per year. Failures are partially attributed to the low tolerance of the current filters to outside conditions such as dust and ashes from regional fires, and partially to age. The need is for a filter that could operate at flow rates of a few cfm, with a differential pressure of one to two inches, and would be durable in the tank farm conditions. Durability could be achieved through periodic cleaning (a six month periodicity would be acceptable). CeraMem, a company funded by a Small Business Innovative Research grant, is developing a ceramic filter; with end-user data from Hanford.
38new	***Principal Contact:*** Randy Robinson, CH2M HILL, 509-373-1236; randall_s_robinson@rl.gov
Technology Opportunity Description	
8A*	***Project:*** X Safe Storage – Operations and Maintenance ☐ Safe Storage – Life Extension ☐ Waste Retrieval and Transfer – Waste Inventory Properties ☐ Waste Retrieval and Transfer – Equipment ☐ Closure ☐ Disposal
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW03 Work Breakdown Structure (WBS) No.: 5.7.1
12A	***Problem Description:*** Most of the Hanford 169 Single Shell Tanks are passively ventilated. They are equipped with fiberglass filters, which are operating at a very low flow rate (under 10 cfm). High failure rates are being experienced with these filters, upon periodical aerosol testing. Failures are partially attributed to a combination of age (numerous filters are approaching end of life), and the low tolerance of the current filters to outside conditions such as dust and ashes from regional fires. 113 have failed over the last seven years among the 166 in the Tank Farms (all tested each year), that is 11.42% per year. The need is for a filter that would operate at flow rates of a few cfm, with a differential pressure of less than four inches (preferably one or two inches), and would be durable in the tank farm conditions. Durability could be achieved through periodic cleaning (a six month periodicity would be acceptable). The Tanks Focus Area has developed metallic filters that could potentially be applicable. One of the two finalists was the CeraMem filter, a silicon carbide ceramic filter with characteristics of being robust, high temperature resistant, corrosion resistant, and capable of withstanding pH environments of 2-13. CeraMem is funded through Phase 2 of a Small Business Innovative Research (SBIR) grant, and contacts have been initiated to provide them with Hanford end-user data.

9*	***Priority:*** ☐ HIGH Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction X MEDIUM Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction ☐ LOW Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation		
9*	***Priority:***		
	Schedule Impact	☐ HIGH ☐ MED ☐ LOW	Needed to meet PBIs Needed to meet mission targets (2033 closure) Can improve mission targets or no schedule impact
	Cost Savings	☐ HIGH ☐ MED ☐ LOW	>$1B total life-cycle savings >$100M but <$1B total life-cycle savings <$100M total life-cycle savings
	Implementation Cost/Schedule	☐ HIGH ☐ MED ☐ LOW	<$10M and <2 yrs. >$10M and <2 yrs or <$10M and > 2 yrs. >$10M and > 2yrs. or significant technical risk
	Baseline Risk Reduction	☐ HIGH The baseline technical solution has not been proven at large scale or on actual radioactive waste. ☐ MED The baseline technical solution has been demonstrated at large scale but not implemented in radioactive operations. ☐ LOW The baseline technical solution has been implemented at Hanford.	
Cost Information			
17A*	***Current Baseline Cost:*** $TBD estimate for filter replacement under preparation		
17B	***Estimated Cost Impact:*** $TBD Solution and cost benefit to be identified		
18*	***Cost Impact Explanation:*** One filter replacement takes up to six months including planning and ordering. Replacement of one filter costs $3 to $5K. For an average of 16 filters per year, the current cost of repair is $50K to $80K per year.		
Risk Information			
37 new	***Risk Identifier:*** ☐ CR- [e.g., CR-047] x New ***Risk Statement:*** If breather filters continue to fail at the same rate or higher, Tank Farm Operations will miss an opportunity of efficiency increase that will be necessary to accommodate higher work loads during SST retrieval, Waste Feed Delivery, and Accelerated Closure Operations. Radiation & Contamination CR-011. If unplanned radiological exposures or releases occur while contaminated equipment is being removed, then installation of retrieval equipment and subsequent feed delivery operations may be delayed.		
12B	***Risk Narrative:*** *[further explanation, if warranted]*		
Schedule Information			
21	***Regulatory Drivers:***		
22*	***Milestones:***		
28*	***Earliest Date Required:*** *[month, year]*		

29*	***Latest Date Required:*** *[month, year]*
13B	***Schedule Explanation:*** A cost-benefit analysis would be necessary to determine how many years and how many SST need to be left to operate for a technology insertion to be valuable.
30	***Technology Insertion Point:*** ☐ New ☐ Existing Code: Official Date:
Additional Points of Contact (POC)	
34	***Contractor End User POCs:*** Randall Robinson, CH2M HILL, (509) 373-1236, Fax: 509-373-9093 randall_s_robinson@rl.gov; D.C. (Doug) Larsen, CH2M HILL, 509-373-5995, F/509-373-4275, douglas_c_larsen@rl.gov
35	***DOE End User POCs:*** Mike Royack, (509) 376-4420, michael_j_royack@rl.gov
36*	***Other Contacts:*** *[name, organization, telephone, fax, email]*

Office of River Protection
Technology Opportunity Statement

General Reference Information	**DEFERRED**
2*	***Assigned Tracking Number:*** WT105
1*	***Title:*** Coalescer for Tank Waste in Pits and Airborne Contamination
3*	***Summary:*** Tank Farm work requires tents to contain contamination. In case of contamination spread in the atmosphere of these tents, the airborne contamination is currently swept away through ventilation (very time consuming). Time could be saved if a substance could be spread, that would result in coalescing the airborne contamination into an easily recoverable form. Pits are commonly contaminated with dried tank waste. Recovery of the waste from the pits would be eased if a substance could be sprayed or flooded on the waste deposited in the pit, that would "gelify", or otherwise pre-condition the waste to ease its retrieval, and prevent airborne contamination.
38new	***Principal Contact:*** D. P. (Dan) Niebuhr, CH2M HILL, 509-373-4639, F/509-373-4275, daniel_p_dan_niebuhr@rl.gov
Technology Opportunity Description	
8A*	***Project:*** X Safe Storage – Operations and Maintenance ☐ Safe Storage – Life Extension ☐ Waste Retrieval and Transfer – Waste Inventory Properties ☐ Waste Retrieval and Transfer – Equipment ☐ Closure ☐ Disposal
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW03 Work Breakdown Structure (WBS) No.: 5.7.1
12A	***Problem Description:*** Tank Farm work frequently requires the erection of tents to contain contamination from open pits or other areas. In case of contamination spread in the atmosphere of these tents, remediation is currently conducted by sweeping away the airborne contamination through ventilation. This process is very time consuming. The need is for a substance that could be spread, or any other action on a confined contaminated (tent) atmosphere, that would result in coalescing the airborne contamination into an easily recoverable form. Pits containing valves, pumps, and instrumentation are commonly contaminated with dried tank waste. Pit cleanup is required prior to performing maintenance and upgrade activities in the pits. Recovery of the waste from the pits is difficult. The need is for a substance that could be sprayed or flooded on the waste deposited in the pit, that would "gelify", or otherwise pre-condition the waste to ease its retrieval, by capturing the particles and prevent them from becoming airborne and spreading. Funding is needed to identify and evaluate solutions. Especially seeking solutions from commercial vendors.

9* old	***Priority:*** ☐ HIGH Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction X MEDIUM Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction ☐ LOW Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation		
9* new	***Priority***		
	Schedule Impact	☐ HIGH Needed to meet PBIs ☐ MED Needed to meet mission targets (2033 closure) ☒ LOW Can improve mission targets or no schedule impact	
	Cost Savings	☐ HIGH >$1B total life-cycle savings ☐ MED >$100M but <$1B total life-cycle savings ☒ LOW <$100M total life-cycle savings	
	Implementation Cost/Schedule	☒ HIGH <$10M and <2 yrs. ☐ MED >$10M and <2 yrs or <$10M and > 2 yrs. ☐ LOW >$10M and > 2yrs. or significant technical risk	
	Baseline Risk Reduction	☐ HIGH The baseline technical solution has not been proven at large scale or on actual radioactive waste. ☐ MED The baseline technical solution has been demonstrated at large scale but not implemented in radioactive operations. ☒ LOW The baseline technical solution has been implemented at Hanford.	
Cost Information			
17A*	***Current Baseline Cost:*** $		
17B	***Estimated Cost Impact:*** $		
18*	***Cost Impact Explanation:*** A cost benefit analysis is needed.		
Risk Information			
37 new	***Risk Identifier:*** ☐ CR- [e.g., CR-047] x New ***Risk Statement:*** If no contamination coalescer is available, then Tank Farm Operations may miss an opportunity of efficiency increase that will be necessary to accommodate higher workloads during SST retrieval, Waste Feed Delivery, and Accelerated Closure Operations. Radiation & Contamination CR-011. If unplanned radiological exposures or releases occur while contaminated equipment is being removed, then installation of retrieval equipment and subsequent feed delivery operations may be delayed.		
12B	***Risk Narrative:*** *[further explanation, if warranted]*		
Schedule Information			
21	***Regulatory Drivers:***		
22*	***Milestones:***		
28*	***Earliest Date Required:*** *[month, year]*		
29*	***Latest Date Required:*** *[month, year]*		

13B	***Schedule Explanation:*** This would be put into operation as soon as available, and would be beneficial until the end of the Safe Storage function.
30	***Technology Insertion Point:*** ☐ New ☐ Existing Code: Official Date:
Additional Points of Contact (POC)	
34	***Contractor End User POCs:*** D. P. (Dan) Niebuhr, CH2M HILL, 509-373-4639, F/509-373-4275, daniel_p_dan_niebuhr@rl.gov
35	***DOE End User POCs:*** Chris Bosted, (509) 376-222, c_j_chris_bosted@rl.gov
36*	***Other Contacts:*** *[name, organization, telephone, fax, email]*

Office of River Protection
Technology Opportunity Statement

General Reference Information	**ACTIVE**
2*	***Assigned Tracking Number:*** WT106
1*	***Title*:** Double Shell Tank (DST) Transfer Piping Non-Destructive Examination (NDE) Tools
3*	***Summary:*** Compliance with TPA M48, Washington Administrative Code (WAC) 173-303-640(2) and Washington Department of Ecology Administrative Orders 00NWPKW-1250 and -1251 requires that by March 31, 2006 an integrity assessment report for the Hanford Site Double-Shell Tank System (including piping) be submitted. Standard industry visual or eddy-current based inspections are not possible for buried pipes. Hydrostatic testing is increasingly difficult with the new jumper systems. Specific requirements are yet to be finalized. Secondary pressure tests are under consideration, disposable cameras or other tools may be useful.
38new	***Principal Contact:*** G. P. (Gary) Duncan, CH2M HILL, 509- 376-6008, F/509-372-0065, gary_p_duncan@rl.gov
Technology Opportunity Description	
8A*	***Project:*** ☐ Safe Storage – Operations and Maintenance X Safe Storage – Life Extension ☐ Waste Retrieval and Transfer – Waste Inventory Properties ☐ Waste Retrieval and Transfer – Equipment ☐ Closure ☐ Disposal
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW03 Work Breakdown Structure (WBS) No.: 5.7.2
12A	***Problem Description:*** Compliance to *Washington Administrative Code* (WAC) 173-303-640(2) requires the assessment of existing dangerous waste tank system's integrity. This assessment must determine that the tank system is adequately designed and has sufficient structural strength and compatibility with the waste(s) to be stored or treated, to ensue that it will not collapse, rupture, or fail. In addition, Washington Department of Ecology Administrative Orders 00NWPKW-1250 and -1251 requires that by March 31, 2006 an integrity assessment report for the Hanford Site Double-Shell Tank System be submitted that assesses the integrity of the 28 DSTs and their ancillary equipment. The DST buried transfer pipelines are considered as ancillary equipment, and thus part of the DST system. Current practice for NDE examination of DST system buried transfer piping is to perform a visual examination and video recording of the condition of the piping when it is exposed by excavation activities as a result of conducting project related activities. This practice only allows for examination of the outer surface of primary transfer line or the outer surface of the secondary piping for lines that are double encased. Alternative technologies suitable for remote examination of contaminated pipes could be beneficial.
9*	***Priority:*** X HIGH Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction ☐ MEDIUM Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction ☐ LOW Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation

9* new	***Priority***		
	Schedule Impact	☒ HIGH ☐ MED ☐ LOW	Needed to meet PBIs Needed to meet mission targets (2033 closure) Can improve mission targets or no schedule impact
	Cost Savings	☐ HIGH ☒ MED ☐ LOW	>$1B total life-cycle savings >$100M but <$1B total life-cycle savings <$100M total life-cycle savings
	Implementation Cost/Schedule	☒ HIGH ☐ MED ☐ LOW	<$10M and <2 yrs. >$10M and <2 yrs or <$10M and > 2 yrs. >$10M and > 2yrs. or significant technical risk
	Baseline Risk Reduction	☒ HIGH ☐ MED ☐ LOW	The baseline technical solution has not been proven at large scale or on actual radioactive waste. The baseline technical solution has been demonstrated at large scale but not implemented in radioactive operations. The baseline technical solution has been implemented at Hanford.
Cost Information			
17A*	***Current Baseline Cost:*** $		
17B	***Estimated Cost Impact:*** $		
18*	***Cost Impact Explanation:*** No data available		
Risk Information			
37 new	***Risk Identifier:*** ☐ CR- [e.g., CR-047] ☒ New ***Risk Statement:*** If transfer piping integrity inspection requirements are not specified and inspection tools are not deployed, then systems may be out of compliance or fail unexpectedly.		
12B	***Risk Narrative:*** *[further explanation, if warranted]*		
Schedule Information			
21	***Regulatory Drivers:*** *Washington Administrative Code* (WAC) 173-303-640(2) requires physical examination (NDE) or leak test as part of an integrity assessment program. Washington Department of Ecology Administrative Orders NWPKW-1250 and -1251.		
22*	***Milestones:*** Submit DST system integrity assessment report by March 31, 2006 per Washington Department of Ecology Administrative Orders NWPKW-1250 and -1251.		
28*	***Earliest Date Required:***		
29*	***Latest Date Required:*** *end of FY03*		
13B	***Schedule Explanation:*** Availability of DST transfer line NDE equipment by the end of FY 2003 would allow time for conducting transfer line examinations to support preparation of the DST integrity assessment report by March 31, 2006, per Washington Department of Ecology Administrative Orders 00NWPKW-1250 and -1251.		
30	***Technology Insertion Point:*** ☐ New ☐ Existing Code: _____ Official Date: _____		

Additional Points of Contact (POC)	
34	***Contractor End User POCs:*** D. L. (Dave) Becker, CH2M HILL, 509-373-5302, F/509-372-0065, David_l_becker@rl.gov; C.E. (Chris) Jensen, CH2M HILL, (509) 373-5058, Chris_e_jensen@rl.gov
35	***DOE End User POCs:*** *[name, organization, telephone, fax, email]*
36*	***Other Contacts:*** *[name, organization, telephone, fax, email]*

Office of River Protection
Technology Opportunity Statement

General Reference Information	CLOSED
2*	***Assigned Tracking Number***: WT107
1*	***Title***: Grab Sampling Dose Reduction
3*	***Summary:*** Operating crew currently receiving 200-300mR/yr under the current operation. Ten potential modifications to the grab sampling system have been identified that could reduce exposure significantly and simplify the grab sampling operation, thus reducing its duration and cost. Note: Field development work was completed in FY03.
38new	***Principal Contact:*** Roland Brown, CH2M HILL, 509-373-5694, Fax: 509-376-9191, roland_g_brown@rl.gov
Technology Opportunity Description	
8A*	***Project:*** X Safe Storage – Operations and Maintenance ☐ Safe Storage – Life Extension ☐ Waste Retrieval and Transfer – Waste Inventory Properties ☐ Waste Retrieval and Transfer – Equipment ☐ Closure ☐ Disposal
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORPTW03 Work Breakdown Structure (WBS) No.: 5.7.1
12A	***Problem Description:*** In order to reduce dose exposure and simplify the grab sampling operation to meet future sampling requirements the following will need to be developed: 1. Replace the current disposable glove bag with a stainless steel glove box. The disposable glove bag requires temporary shielding and high spare parts inventory. Converting to the steel glove box will reduce spare parts inventory. Thus reducing the amount of mixed waste in the grab sampling campaign for disposal. Using the steel glove box will also eliminate the need for temporary shielding, reducing sampling time by decreasing the inspection time for the glove box, and eliminating one operator from the sampling crew. 2. Relocate the retrieval device from top of the glove bag/box to inside the side port of the glove bag/box by using an "off-the-shelf model". This relocation move will eliminate the requirement for the operator to stand on a ladder and reduce his radiation exposure received from the shine from the open riser. The redesign of the retrieval device will also reduce the current grab sampler retrieval cost and eliminate long delivery of parts by going to an "off-the-shelf model". 3. Develop a containment housing and stand for the new hand winch retrieval assembly for use in either the glove bag or those occasions where one must sample over open riser. 4. Modify the grab sampler cage to un-stopper and re-stopper the sample bottle at the desired depth. 5. Modify the grab sampler cage release mechanism to reduce the stopper release force. In the 500 ml wide mouth sample bottle case, 85 lb_f must be overcome in order to release the stopper from the sample bottle when sampling a full tank. 6. Segmented mast assembly

	7. Combination spray wash ring/riser adapter for mast decontamination 8. Foot clamp sized for the mast requiring 60-100 psi Nitrogen or compressed air source. On application of pneumatic pressure, the Foot clamp jaws will open and allow movement or insertion of the mast segments. Upon loss of air, the Foot clamp jaws will close to retain the mast. 9. Spray wash nozzles mounted in the top flange of the mast for the sample bottles. 10. Bellows plate or transition assembly for mating with the glove box.
9A*	***Priority:*** ☐ HIGH Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction ☐ MEDIUM Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction X LOW Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation.
9B	***Priority***

Schedule Impact	☐ HIGH ☐ MED ☐ LOW	Needed to meet PBIs Needed to meet mission targets (2033 closure) Can improve mission targets or no schedule impact
Cost Savings	☐ HIGH ☐ MED ☐ LOW	>$1B total life-cycle savings >$100M but <$1B total life-cycle savings <$100M total life-cycle savings
Implementation Cost/Schedule	☐ HIGH ☐ MED ☐ LOW	<$10M and <2 yrs. >$10M and <2 yrs or <$10M and > 2 yrs. >$10M and > 2yrs. or significant technical risk
Baseline Risk Reduction	☐ HIGH ☐ MED ☐ LOW	The baseline technical solution has not be proven at large scale or on actual radioactive waste. The baseline technical solution has been demonstrated at large scale but not implemented in radioactive operations. The baseline technical solution has been implemented at Hanford.

Cost Information	
17A*	***Current Baseline Cost:*** $
17B	***Estimated Cost Impact:*** $65,000/yr
18*	***Cost Impact Explanation:*** Potential cost savings found in the reduction of spare parts that must be maintained in warehouse inventory, reduction in mixed waste disposal costs, eliminate the paper work involved in temporary shielding permits, elimination of glove bag inspection that take 1-1.5 hours to perform in the field, and reduction in whole body dose.
Risk Information	
37 new	***Risk Identifier:*** ☐ CR- [e.g., CR-047] x New ***Risk Statement:*** If the grab sampling systems are not modified, then Sampling Operations will miss an opportunity to reduce workers exposure from the current 200-300 mR/yr to an estimated 100-150 mR/yr.
12B	***Risk Narrative:*** *[further explanation, if warranted]*
Schedule Information	

21	***Regulatory Drivers:***
22*	***Milestones:***
28*	***Earliest Date Required:*** *This will be put into operation as soon as available, and will be beneficial until the end of the Safe Storage function.*
29*	***Latest Date Required:*** *[month, year]*
13B	***Schedule Explanation:***
30	***Technology Insertion Point:*** ☐ New ☐ Existing Code: Official Date:
Additional Points of Contact (POC)	
34	***Contractor End User POCs:*** George Stanton, CH2M HILL, 509-373-5590, Fax: 509-373-6101, george_a_jr_stanton@rl.gov
35	***DOE End User POCs:*** *[name, organization, telephone, fax, email]*
36*	***Other Contacts:*** *[name, organization, telephone, fax, email]*

Office of River Protection
Technology Opportunity Statement

General Reference Information	**ACTIVE**
2*	***Assigned Tracking Number:*** WT108
1*	***Title:*** In-Tank Camera and Lighting
3*	***Summary:*** Current cameras have some weaknesses and limitations and only one vendor is available. Lighting is limited in flammable gas environments (75 watts). Alternative cameras and powerful white light for flammable gas environments are needed, that can be inserted into 4-inch risers. In addition to current usages (Safe Storage Operations, Life Extension Project activities), W-211 Project is assuming the use of to-be-developed shielded portable cameras during DST retrieval operations, and SST Retrieval and Closure Operations will also increase usage.
38new	***Principal Contact:*** Dan Niebuhr, CH2M HILL, 509-373-4639, F/509-373-4275, daniel_p_dan_niebuhr@rl.gov
Technology Opportunity Description	
8A*	***Project:*** X Safe Storage – Operations and Maintenance ☐ Safe Storage – Life Extension ☐ Waste Retrieval and Transfer – Waste Inventory Properties ☐ Waste Retrieval and Transfer – Equipment ☐ Closure ☐ Disposal
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW03 Work Breakdown Structure (WBS) No.: 5.7.1
12A	***Problem Description:*** Storage, Retrieval, and Closure preparation activities currently require frequent in-tank camera observations. The current (intrinsically safe) cameras, although significantly improved over the recent years, still have some weaknesses or limitations. In addition, there is only one known supplier for cameras that meet the minimum tank farm requirements, which creates a significant mission risk. There are occasions where the in-tank conditions necessitate more and brighter light in order to get satisfactory images. These conditions include fogging in tanks with dome space ambient temperatures that are above outside air temperatures, and tanks where waste disturbing processes are occurring that add aerosols to the tank dome space. The new DSA in October 2003 will change safety-basis requirements, but the problem of lack of light will remain. The need is for an intrinsically safe camera, radiation resistant, that can be deployed in a four-inch riser, includes a lens defogging system (e.g. purge air blow), robust gears, and can be tilted to reach the tank dome. Future sluicing operations may require a different lens cleaning system, if significant splashing of salt-loaded solutions occur: blowing air would lead to deposits of dry salts on the lenses. Adequate in-tank lighting is required for in-tank camera observations. The current technology incorporates the use of a single 75-watt bright white light to view across a distance of up to 75 feet. This is insufficient lighting to view all the necessary detail due to the distances and subsequent light diffusion involved. For some Single Shell tanks with low flammability ratings, a supplemental 1000-watt light is available which provides excellent coverage, but this cannot be

	used in the Double Shell tanks. A similarly bright light (1000 watts of bright white light) for use in Double Shell tanks is highly desirable, as this will add detail and definition to video imaging. The lights need to be deployable in a four-inch riser. Vendors were consulted and could not provide equipment meeting the requirements. The need is for a lighting system that includes multiple lights used alternatively or simultaneously depending on the need, within flammable gas environments, providing clean white light, deployable in a four-inch riser, and perhaps with a lens cleaning capability. Cyberia (France) cameras were identified as promising. Regarding the lighting issue, very sensitive cameras using the Peltier effect may help, although they are slow (may take 10 minutes per picture). Exavision (France) lighting systems may also be promising. Technical solutions need to be identified and evaluated. TF Operations is considering purchase to test, funding needs to be identified. Matt Landon pursued an RFI in FY03, and if suitable responses are obtained, this will proceed to an RFP in FY04. This work will be funded as part of the ongoing TF video imaging budget throughout the contract.
9A	***Priority:*** ☐ HIGH Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction X MEDIUM Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction ☐ LOW Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation
9B	***Priority***

Schedule Impact	☒ HIGH ☐ MED ☐ LOW	Needed to meet PBIs Needed to meet mission targets (2033 closure) Can improve mission targets or no schedule impact
Cost Savings	☐ HIGH ☐ MED ☒ LOW	>$1B total life-cycle savings >$100M but <$1B total life-cycle savings <$100M total life-cycle savings
Implementation Cost/Schedule	☒ HIGH ☐ MED ☐ LOW	<$10M and <2 yrs. >$10M and <2 yrs or <$10M and > 2 yrs. >$10M and > 2yrs. or significant technical risk
Baseline Risk Reduction	☒ HIGH ☐ MED ☐ LOW	The baseline technical solution has not been proven at large scale or on actual radioactive waste. The baseline technical solution has been demonstrated at large scale but not implemented in radioactive operations. The baseline technical solution has been implemented at Hanford.

Cost Information	
17A*	***Current Baseline Cost:*** $
17B	***Estimated Cost Impact:*** $100K to $1M per year

18*	***Cost Impact Explanation:*** Potential cost savings are $100K to $1M per year based on current usage, for reduced repair and increased observation efficiency. Current video cameras cost $70K each. For W-211, two portable shielded cameras are planned for an estimated total cost of $1M.
Risk Information	
37 new	***Risk Identifier:*** ☐ CR- [e.g., CR-047] x New ***Risk Statement:*** If improved cameras and lighting are not available, then Tank Farm Operations will miss an opportunity of efficiency increase that will be necessary to accommodate higher work loads during SST retrieval, Waste Feed Delivery, and Accelerated Closure Operations
12B	***Risk Narrative:***
Schedule Information	
21	***Regulatory Drivers:***
22*	***Milestones:***
28*	***Earliest Date Required:*** *[month, year]*
29*	***Latest Date Required:*** *2005 for W-211*
13B	***Schedule Explanation:*** This will be put into operation as soon as available, and will be beneficial until the end of the Safe Storage, Retrieval, and Closure functions. The shielded camera for Project W-211 is needed by 2005 to support readiness review.
30	***Technology Insertion Point:*** ☐ New ☐ Existing Code: Official Date:
Additional Points of Contact (POC)	
34	***Contractor End User POCs:*** Curt Rieck, NHC, (509) 372-2913, F (509) 373-3072, Curtis_A_Rieck@rl.gov; Scott Werry, CH2M HILL, (509) 373-1831, F (509) 376-5145, Scott_M_Werry@rl.gov
35	***DOE End User POCs:*** Roger Quintero, DOE-ORP, 509-373-0421, Fax: 509-373-1313, roger_a_quintero@rl.gov
36*	***Other Contacts:*** Matt Landon, CH2M HILL, 509-373-1379, Fax: 373-6101, matthew_r_landon@rl.gov

Office of River Protection
Technology Opportunity Statement

General Reference Information			INACTIVE
2*	***Assigned Tracking Number:*** WT109		
1*	***Title:*** Radiation Survey		
3*	***Summary:*** Radiation surveys must be performed periodically along the length of transfer line during transfers and in contaminated areas. They consume time and resources. Remote survey systems, or systems that would survey large surfaces faster could save time, money, and reduce the radiation exposure to personnel.		
38new	***Principal Contact:*** D.R. (Darin) Hekkala, CH2M HILL, 509-373-2360, F/509-373-0181, Darin_r_hekkala@rl.gov		
Technology Opportunity Description			
8A*	***Project:*** X Safe Storage – Operations and Maintenance ☐ Safe Storage – Life Extension ☐ Waste Retrieval and Transfer – Waste Inventory Properties ☐ Waste Retrieval and Transfer – Equipment ☐ Closure ☐ Disposal		
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW03 Work Breakdown Structure (WBS) No.: 5.7.1		
12A	***Problem Description:*** Radiation surveys must be performed periodically along the length of transfer line during transfers and in contaminated areas. They consume time and resources. Remote survey systems, or systems that would survey large surfaces faster could save time, money, and reduce the radiation exposure to personnel. Survey tractors evaluated for AY farm, but cannot access tank farms. Funding is needed to identify and evaluate solutions.		
9*	***Priority:*** ☐ HIGH Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction X MEDIUM Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction ☐ LOW Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation		
9	***Priority:***		
	Schedule Impact	☐ HIGH ☒ MED ☐ LOW impact	Needed to meet PBIs Needed to meet mission targets (2033 closure) Can improve mission targets or no schedule
	Cost Savings	☐ HIGH ☐ MED ☒ LOW	>$1B total life-cycle savings >$100M but <$1B total life-cycle savings <$100M total life-cycle savings
	Implementation Cost/Schedule	☒ HIGH ☐ MED ☐ LOW	<$10M and <2 yrs. >$10M and <2 yrs or <$10M and > 2 yrs. >$10M and > 2yrs. or significant technical risk

	Baseline Risk Reduction	☐ HIGH The baseline technical solution has not been proven at large scale or on actual radioactive waste. ☐ MED The baseline technical solution has been demonstrated at large scale but not implemented in radioactive operations. ☒ LOW The baseline technical solution has been implemented at Hanford.
Cost Information		
17A*	***Current Baseline Cost:*** $	
17B	***Estimated Cost Impact:*** $100K to $1M saving per year	
18*	***Cost Impact Explanation:*** $100K to $1M per year, for reduced time in controlled areas.	
Risk Information		
37 new	***Risk Identifier:*** ☐ CR- [e.g., CR-047] x New ***Risk Statement:*** If radiation survey systems are not improved for faster survey of large surfaces, then Tank Farm Operations will miss an opportunity of efficiency increase that will be necessary to accommodate higher work loads during SST retrieval, Waste Feed Delivery, and Accelerated Closure Operations	
12B	***Risk Narrative:*** *[further explanation, if warranted]*	
Schedule Information		
21	***Regulatory Drivers:***	
22*	***Milestones:***	
28*	***Earliest Date Required:*** *[month, year]*	
29*	***Latest Date Required:*** *[month, year]*	
13B	***Schedule Explanation:*** This will be put into operation as soon as available, and will be beneficial until the end of the Safe Storage, Retrieval, and Closure functions	
30	***Technology Insertion Point:*** ☐ New ☐ Existing Code: Official Date:	
Additional Points of Contact (POC)		
34	***Contractor End User POCs:*** D.R. (Darin) Hekkala, CH2M HILL, 509-373-2360, F/509-373-0181, Darin_r_hekkala@rl.gov	
35	***DOE End User POCs:*** Roger Quintero, DOE-ORP, 509-373-0421, Fax: 509-373-1313, roger_a_quintero@rl.gov	
36*	***Other Contacts:*** *[name, organization, telephone, fax, email]*	

Office of River Protection
Technology Opportunity Statement

General Reference Information	**CLOSED**
2*	***Assigned Tracking Number:*** WT111
1*	***Title:*** Remote Tank Wall Repair
3*	***Summary:*** The Hanford DSTs will be used beyond their design life for storage and staging of waste for treatment. A tank integrity program is underway, but tank failure (penetrations through the wall) are not to be excluded. The schedule and cost impacts of taking a DST out of service before the end of its needed service would be very significant. A remote tank wall repair technology would reduce the mission risk significantly
38new	***Principal Contact:*** Gary Duncan, CH2M HILL, 509-376-6008, Fax: 509-372-0065, gary_p_duncan@rl.gov
Technology Opportunity Description	
8A*	***Project:*** ☐ Safe Storage – Operations and Maintenance X Safe Storage – Life Extension ☐ Waste Retrieval and Transfer – Waste Inventory Properties ☐ Waste Retrieval and Transfer – Equipment ☐ Closure ☐ Disposal
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW03 Work Breakdown Structure (WBS) No.: 5.7.2
12A	***Problem Description:*** DSTs at Hanford are needed for storage, for staging of waste feed for transfer to the Waste Treatment Plant that is scheduled to begin operation in FY 07, and to receive waste retrieved from Single-Shell Tanks. Surface corrosion has been observed on the exterior of the primary shell on several of Hanford's DSTs as part of the Corrosion Mitigation Program. If a penetration or leak in a DST is confirmed, the tank will most likely have to be taken out of service, further reducing the shortage of tank storage space. Localized repair of DST primary tank wall penetrations are required to prolong the life of the tanks to meet mission needs. The system must be deployed through riser penetrations into the tank annulus, and then operated remotely. The riser diameters range from 4 to 24 inches. The repair process must not cause any damage to the tank wall. The system must also be capable of testing repairs to verify integrity. Potential solutions have been identified, adaptation to DSTs needs to be evaluated and funded. *Note: CH2M HILL conducted a vendor search in FY2002 and found there is commercially available technologies* *to make this kind of repair. It was decided that if needed this would be contracted out.*
9A*	***Priority:*** ☒ HIGH Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction ☐ MEDIUM Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction ☐ LOW Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation

9B	***Priority***		
	Schedule Impact	☐ HIGH ☐ MED ☐ LOW	Needed to meet PBIs Needed to meet mission targets (2033 closure) Can improve mission targets or no schedule impact
	Cost Savings	☐ HIGH ☐ MED ☐ LOW	>$1B total life-cycle savings >$100M but <$1B total life-cycle savings <$100M total life-cycle savings
	Implementation Cost/Schedule	☐ HIGH ☐ MED ☐ LOW	<$10M and <2 yrs. >$10M and <2 yrs or <$10M and > 2 yrs. >$10M and > 2yrs. or significant technical risk
	Baseline Risk Reduction	☐ HIGH ☐ MED ☐ LOW	The baseline technical solution has not be proven at large scale or on actual radioactive waste. The baseline technical solution has been demonstrated at large scale but not implemented in radioactive operations. The baseline technical solution has been implemented at Hanford.
Cost Information			
17A*	***Current Baseline Cost:*** $		
17B	***Estimated Cost Impact:*** Potential cost saving in the order of $100,000,000 (per saved DST that would not need to be replaced)		
18*	***Cost Impact Explanation:*** FY03 BIP proposed conducting a vendor search and demonstration on the tank mock-up facility.		
Risk Information			
37 new	**Risk Identifier:** ☒ RPP-CR-014, CR-070A **Risk Statement:** If no tank wall remote repair capability is developed, then any tank failure will result in taking the tank out of service before the end of its service life. If a DST fails before the end of the RPP mission, then a tank space shortfall may occur (Technical Risk List) Double Shell Tank integrity must be maintained and space saving initiatives must be successful to avoid replanning of the TFC baseline strategy (including possible tank sequencing adjustments and potential construction of new tanks.		
12B	***Risk Narrative:*** *While the probability of needing this technology is low, the consequence is high.*		
Schedule Information			
21	***Regulatory Drivers:***		
22*	***Milestones:***		
28*	***Earliest Date Required:*** *[month, year]*		
29*	***Latest Date Required:*** *[month, year]*		
13B	***Schedule Explanation:*** This risk mitigation will be beneficial until the end of the Safe Storage function.		
30	***Technology Insertion Point:*** ☐ New ☐ Existing Code: Official Date:		

Additional Points of Contact (POC)	
34	***Contractor End User POCs:*** J. R. (Jim) Bellomy, III, CH2MHIL, 509-372-1673, J_r_iii_jim_bellomy@rl.gov; Jim Castleberry, CH2M HILL, (509) 373-5011, jim_l_castleberry@rl.gov; Gary Duncan, CH2M HILL (509)376-6008, F(509)372-0065, gary_p_duncan@rl.gov; C.E. (Chris) Jensen, CH2M HILL, (509) 373-5058, chris_e_jensen@rl.gov; Wes Bryan,CH2M HILL (509)373-9740, F(509)3720065, wes_bryan@rl.gov
35	***DOE End User POCs:*** *[name, organization, telephone, fax, email]*
36*	***Other Contacts:*** *[name, organization, telephone, fax, email]*

Office of River Protection
Technology Opportunity Statement

General Reference Information	**DEFERRED**
2*	***Assigned Tracking Number:*** WT112
1*	***Title:*** Chemical Dissolution of Water Insoluble Wastes from Single Shell Tanks (SSTs)
3*	***Summary:*** The low volume density gradient method of retrieval from the SSTs is currently only applicable to the soluble salts in the tanks. Essentially all tanks contain some insoluble material. Chemical methods are needed to dissolve and retrieve the insoluble material that will remain after the soluble salts are recovered. The methods must be compatible with carbon steel tanks.
38new	***Principal Contact:*** W. B. (Blaine) Barton, CH2M HILL, 509-376-5118, F/509-373-4641, W_b_blaine_barton@rl.gov
Technology Opportunity Description	
8A*	***Project:*** ☐ Safe Storage – Operations and Maintenance ☐ Safe Storage – Life Extension X Waste Retrieval and Transfer – Waste Inventory Properties ☐ Waste Retrieval and Transfer – Equipment ☐ Closure ☐ Disposal
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: TW04 Work Breakdown Structure (WBS) No.: 5.8.5
12A	***Problem Description:*** The tank wastes have a varied chemistry. The majority of the waste is various salts of sodium and potassium stored in a wet, high-caustic environment. However, much of the waste is in the form of sodium aluminum, silicates and metal hydroxides, predominantly iron. These materials are stored in carbon steel tanks. The current plan envisions dissolving the soluble salts in water and pumping them from the tanks. This will leave behind the aluminum silicates and metal hydroxides. A chemical cocktail(s) is desired that will dissolve the remaining materials in the tank without significantly attacking the tank walls. It is desired that the dissolution can take place under conditions of short contact time, i.e., hours rather than weeks, and low mechanical agitation. The resulting stream must be compatible with pumped transfer and extended storage in carbon steel tanks. The chemical cocktail should be able to be destroyed with little residue in downstream processes. If released to the environment, the chemicals should breakdown so as not to present a long-term radionuclide mobility challenge in the Hanford soils. Because the receiving tank space is limited, it is desired that the chemical cocktail be able to retrieve the waste at concentrations of waste greater than 0.5 molar. Lower concentrations will be evaluated on an economic feasibility basis. The initial attempt to chemically dissolve water insoluble residuals (heels) will use 0.9M oxalic acid to retrieve heels from C-106. Oxalic acid is not very corrosive to mild steel, but the neutralized anions (oxalate) are expected to create low solubility material that will create subsequent retrieval challenges or processing problems for the Waste Treatment Plant (WTP). This is the best selection in FY'03 and should accomplish the necessary heel retrieval, but there remains significant room for improvement. Addition of organic complexants could enhance the dissolution, but the complexants would

exceed the WTP feed specification for total organic carbon. It will be necessary to destroy these complexants before the wastes are sent to the WTP. EM-50 did some development work on a broad selection of organic destruction technologies in the early 1990s. This could be a good starting point to select a preferred organics destruction technology. The tank farm contractor will provide the detailed listing of requirements of the system.

David Hobbs (SRTC) has followed Russian work on oxalic/citric acid mixtures and also conducted experiments on dilute nitric acid. Dilute nitric acid avoids the issues of dealing with organics.

Nuclear criticality safety currently requires that the solids particle size in waste disposed to RPP be demonstrably less than 10 μm. The requirement is based solely on hydrodynamics and was instituted because insufficient data exist on the actual distribution of plutonium to sludge-forming elements (e.g., iron, chromium, aluminum, and manganese) in actual HLW. Conversely, plutonium potentially can segregate from neutronic poisons present in current HLW by chemical mechanisms through HLW blending or retrieval operations, and thus constrain present or planned process operations.

Consequence of Not Filling Need: In the event that no satisfactory cocktail can be found the insoluble wastes will be retrieved by slurry or mechanical techniques at a significant cost penalty to the project. These methods are cost prohibitive for small volumes of waste residue remaining after saltcake dissolution.

9a ***Priority:***

- ☐ HIGH — Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction
- ☐ MEDIUM — Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction
- X LOW — Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation

9b ***Priorities:***

Schedule Impact	X HIGH	Needed to meet PBIs
	☐ MED	Needed to meet mission targets (2033 closure)
	☐ LOW	no schedule impact or can improve mission targets (<2033 closure).
Cost Savings	X HIGH	>$1B total life-cycle savings
	☐ MED	>$100M but <$1B total life-cycle savings
	☐ LOW	<$100M total life-cycle savings
Implementation Cost/Schedule	☐ HIGH	<$10M and <2 yrs.
	X MED	>$10M and <2 yrs or <$10M and > 2 yrs.
	☐ LOW	>$10M and > 2yrs. or significant technical risk
Baseline Risk Reduction	☐ HIGH	The baseline technical solution has not been proven at large scale or on actual radioactive waste.
	X MED	The baseline technical solution has been demonstrated at large scale but not implemented in radioactive operations.
	☐ LOW	The baseline technical solution has been implemented at Hanford.

Cost Information

17A*	***Current Baseline Cost:*** $
17B	***Estimated Cost Impact:*** $ 5-40 million per tank
18*	***Cost Impact Explanation:*** Previous planning shows a cost of ~$30 million to retrieve saltcake tank, $40 million for tanks with mixed saltcake and sludge, and $77 million to retrieve sludge tanks. Current planning targets much lower retrieval costs, but the methods to achieve lower-cost retrievals are still uncertain. The use of a solution mining technique allows for a simplified mechanical system which could significantly reduce the cost of any of these waste retrieval activities. It is expected that a single organic destruction system would be required which when pro rated across the tanks would still result in significant savings to the baseline.
Risk Information	
37 new	***Risk Identifier:*** ☐ CR-21, CR-131 ☐ New ***Risk Statement:*** If only water is used to solubilize the waste then the lesser soluble components will be left behind and retrieval targets cannot be achieved. If enough water is used to solubilize the low solubility wastes then the DST space will be insufficient to maintain retrieval rates.
12B	***Risk Narrative:***
Schedule Information	
21	***Regulatory Drivers:***
22*	***Milestones:*** This technology would be deployed in SST retrieval as soon as it become available.
28*	***Earliest Date Required:*** Dec. 2003
29*	***Latest Date Required:*** : ~FY 2020
13B	***Schedule Explanation:***
30	***Technology Insertion Point:*** ☐ New ☐ Existing Code: Official Date:
Additional Points of Contact (POC)	
34	***Contractor End User POCs:*** W. B. (Blaine) Barton, CH2M HILL, 509-376-5118, F/509-373-4641, W_b_blaine_barton@rl.gov
35	***DOE End User POCs:*** James F. Thompson, Jr, Office of River Protection, (509) 373-9757, james_f_jr_thompson@rl.gov; Roger Quintero, DOE-ORP, 509-373-0421, Fax: 509-373-1313, roger_a_quintero@rl.gov
36**	***Other Contacts:*** Dan Reynolds, CH2M HILL, 373-3115, daniel_a_reynolds@rl.gov K.A. (Ken) Gasper, CH2M HILL, 509-373-1948, F/509-373-9093, kenneth_a_ken_gasper@rl.gov

Office of River Protection
Technology Opportunity Statement

General Reference Information	**ACTIVE**
2*	***Assigned Tracking Number:*** WT113
1*	***Title:*** Selective Species Removal
3*	***Summary:*** Certain chemicals are a problem when making glass because they do not enter the glass form easily or produce poor quality of glass. While the main responsibility for glass making and waste pre-treatment is with WTP, there may exist an opportunity for the tank farms to do some in-tank processes that may assist WTP. Sulfate is the highest priority species to separate and is the topic of its own Technology Opportunity (WT-146). This Opportunity identifies separation of Tc-99, Sr-90, and I-129 also having benefits.
38new	***Principal Contact:*** K.A. (Ken) Gasper, CH2M HILL, 509-373-1948, F/509-373-9093, kenneth_a_ken_gasper@rl.gov
Technology Opportunity Description	
8A*	***Project:*** ☐ Safe Storage – Operations and Maintenance ☐ Safe Storage – Life Extension X Waste Retrieval and Transfer – Waste Inventory Properties ☐ Waste Retrieval and Transfer – Equipment ☐ Closure ☐ Disposal
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: TW-04 and TW-09 Work Breakdown Structure (WBS) No.: 5.02.01.01.01.01
12A	***Problem Description:*** There are certain chemical species in the SST and DST waste that are difficult for the WTP to deal with because of difficulties with getting these chemical species incorporated into the glass matrix. If these can be removed or controlled in the tank farms then there is a potential for large savings. The chemical species are sulfur, Tc-99, Sr-90 in complexant waste, and I-129. Technetium-99 should go to the HLW waste stream. However, much of the Tc-99 in the waste is in the soluble pertechnetate form. If Tc-99 could be moved to another valence state, then the Tc-99 would form an insoluble mineral that would move with the solids to the HLW waste stream. Much of the Tc-99 in the tank farms is not in the pertechnetate form and has shown to be difficult to leach. The complexants in complexed waste hold the Sr-90 in solution. A permanganate precipitation step is currently utilized in the WTP head end to remove this Sr-90. If this could be done in the tank farm, it may be cheaper than in the WTP pretreatment. Iodine is another element that a change in valence state may be all that is necessary to remove it from the liquid portion of the waste. Much of the iodine is in the solids as iodates but enough remains in the liquids as iodide to potentially bother WTP processing. If there is a simple method for removing the iodine by perhaps changing the valence state to an iodate, then there may be one less stream at WTP with a problem. Selective removal of these constituents could be accomplished for the SST wastes as part of the

	SST retrieval operation before entry into the DSTs, by processing DST waste and returning it to the DSTs, or as part of the transfer process from the DSTs to the WTP.
9a	***Priority:*** ☐ HIGH Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction ☐ MEDIUM Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction X LOW Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation
9b	***Priorities:***

Schedule Impact	☐ HIGH ☐ MED X LOW	Needed to meet PBIs Needed to meet mission targets (2033 closure) no schedule impact or can improve mission targets (<2033 closure).
Cost Savings	☐ HIGH ☐ MED X LOW	>$1B total life-cycle savings >$100M but <$1B total life-cycle savings <$100M total life-cycle savings
Implementation Cost/Schedule	☐ HIGH ☐ MED X LOW	<$10M and <2 yrs. >$10M and <2 yrs or <$10M and > 2 yrs. >$10M and > 2yrs. or significant technical risk
Baseline Risk Reduction	☐ HIGH X MED ☐ LOW	The baseline technical solution has not been proven at large scale or on actual radioactive waste. The baseline technical solution has been demonstrated at large scale but not implemented in radioactive operations. The baseline technical solution has been implemented at Hanford.

Cost Information	
17A*	***Current Baseline Cost:*** $
17B	***Estimated Cost Impact:*** $5M
18*	***Cost Impact Explanation:*** If these chemical species can be put in the waste stream that is most appropriate for disposal to WTP in the tank farms, then treatment in WTP will not be necessary. Even if WTP is constructed with capabilities to treat these species, not having to run a WTP process is a cost savings.
Risk Information	
37 new	***Risk Identifier:*** ☐ CR- ☐ New ***Risk Statement:*** If selected elements can be separated during tank retrieval then subsequent processing can be less difficult and less expensive.
12B	***Risk Narrative:*** The tanks contain several elements that cause subsequent processing difficulty and limitations. Tc is the major contributor to ILAW glass risk assessment. Iodine causes melter off-gas problems. Strontium can be complexed by organics and be difficult to separate in the WTP.
Schedule Information	

21	***Regulatory Drivers:***
22*	***Milestones:*** There are currently no milestones that these activities would directly affect. However, a proven technology would allow changes in the baseline operations at Hanford.
28*	***Earliest Date Required:*** 2010
29*	***Latest Date Required:*** 2020
13B	***Schedule Explanation:*** The need can be met as early as 2010 or as late as 2020
30	***Technology Insertion Point:*** ☐ New ☐ Existing Code: _____ Official Date: _____
Additional Points of Contact (POC)	
34	***Contractor End User POCs:*** D.A. (Dan) Reynolds, CH2M HILL, 509-373-3115, F/509-373-4641 daniel_a_reynolds@rl.gov
35	***DOE End User POCs:***
36*	***Other Contacts:*** Michael E. Johnson, CH2M HILL, 509-372-3628,Fax 509-376-1788, Michael_e_johnson@rl.gov Kayle D. Boomer, CH2M HILL, 509-372-3629, Fax: 509-376-1788, kayle_d_boomer@rl.gov K.A. (Ken) Gasper, CH2M HILL, 509-373-1948, F/509-373-9093, kenneth_a_ken_gasper@rl.gov

Office of River Protection
Technology Opportunity Statement

General Reference Information	**ACTIVE**
2*	***Assigned Tracking Number:*** WT115
1*	***Title:*** Technology to Support Post-Retrieval Evaluation of SSTs
3*	***Summary:*** An accurate technology or methodology is needed to evaluate tank contents before, during, and after retrieval and transfer. This includes the need for a reliable, fast and accurate tank volume measurement system that provides accurate measurement of tank waste volume retrieved and remaining. In addition, an in situ measurement technique for characterizing mobile, long-lived, contaminants of concern in tank waste residuals is needed. Waste residual assessment is a required criterion for successful closure of retrieved SSTs. This includes tough technical problem #8 for non-contact surface-level measurement, and #24 for the ability to assay the tank with a tool lowered into the tank.
38new	***Principal Contact*** Ron Calmus, CH2M HILL, 509-372-3385, Fax: 509-372-2862, Ronald_B_Ron_Calmus@rl.gov
Technology Opportunity Description	
8A*	***Project:*** ☐ Safe Storage – Operations and Maintenance ☐ Safe Storage – Life Extension ☐ Waste Retrieval and Transfer – Waste Inventory Properties ☐ Waste Retrieval and Transfer – Equipment X Closure ☐ Disposal
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW04 Work Breakdown Structure (WBS) No.: 5.8.5
12A	***Problem Description:*** To measure whether TPA goals (550 curies of mobile long lived radioisotopes, 99% of tank contents by volume for Tank S-112) have been met, SST Retrieval projects need a technology or methodology to evaluate tank contents remaining before, during and after retrieval. In addition to measuring residual waste volumes, it is also important to be able to characterize the concentrations of mobile, long-lived, contaminants of concern. To evaluate the performance of the retrieval methods, the amount of the waste in the tank before retrieval may need to be determined. This volume determination will also allow a comparison with the estimation from the Best-Basis Inventory. In addition, the volume of waste may be required for closure decision-making. During retrieval, the technology or methodology will be used to perform a volumetric analysis of the amount of waste removed from the tank and can be used in support of the determination of the most accurate mass balance. Eventually, the system will be used to determine residual tank waste volume to measure whether TPA waste volume retrieval goals have been met. In addition to measuring against TPA goals, the SST retrieval program's near term projects are tasked with improvement upon the baseline retrieval technology of past practice sluicing. The Tank Volume Measurement System (TVMS), formerly known as the Upgraded Topographical Mapping System (TMS), could be used to develop waste retrieval efficiency and cost profiles for

	the various alternative retrieval technologies. This will assist in out-year planning and address the challenges of funding the baseline scope. A method of determining the volume of waste that is potentially cheaper than laser mapping (but most likely not as accurate) is stereo photographs. This may require videos from more than one location in the tank, but it is still possible to use the stereo concept to measure volume in piles. Closure Projects need tools to evaluate/characterize the residuals left in the tank at the conclusion of retrieval to support waste reclassification determinations under DOE Order 435.1 and the design of engineered barrier systems to stabilize, isolate, and immobilize residual wastes to ensure protection of human health and the environment. It is desirable that characterization tools be capable of in situ analyses of key mobile, long-lived, contaminants of concern to avoid the need to extract waste samples from the tanks and incur the turn-around times and costs associated with sending the samples to the laboratory for analyses. From a groundwater perspective, the key contaminants of concern include Technetium-99 and uranium. Other mobile, long-lived, contaminants of concern include Iodine-129, Selenium-79, and Carbon-14. Other critical aspects of the residual waste characterization problem include the possible need for off-riser sampling capabilities to access waste piles that are not directly beneath sampling risers. This may necessitate interface with robotic crawlers and/or articulated masts to provide the access necessary for in situ residual waste characterization.
9a	***Priority:*** X HIGH — Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction ☐ MEDIUM — Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction ☐ LOW — Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation

9b	**Priorities**		
	Schedule Impact	☐ HIGH ☐ MED ☐ LOW	Needed to meet PBIs Needed to meet mission targets (2033 closure) Can improve mission targets or no schedule impact
	Cost Savings	☐ HIGH ☐ MED ☐ LOW	>$1B total life-cycle savings >$100M but <$1B total life-cycle savings <$100M total life-cycle savings
	Implementation Cost/Schedule	☐ HIGH ☐ MED ☐ LOW	<$10M and <2 yrs. >$10M and <2 yrs or <$10M and > 2 yrs. >$10M and > 2yrs. or significant technical risk
	Baseline Risk Reduction	☐ HIGH ☐ MED ☐ LOW	The baseline technical solution has not been proven at large scale or on actual radioactive waste. The baseline technical solution has been demonstrated at large scale, but not implemented in radioactive operations. The baseline technical solution has been implemented at Hanford.

Cost Information	
17A*	***Current Baseline Cost:*** It currently costs in excess of $1 million per tank core sample to extract the sample from a tank directly beneath an available riser, prepare it for shipment to the laboratory, analyze it in laboratory hot cells, and issue characterization reports. It is common to take at least two cores from each tank for purposes of waste characterization. Currently, deployment of the video inspection system is the baseline approach for monitoring retrieval progress.
17B	***Estimated Cost Impact:*** $ Cost savings of greater than $2M have been identified over continuing to use current methods along with a significant acceleration of the project schedule. Potential reduction in personnel radiation exposure will also be significant. No corollary baseline volume measurement system exists to compare costs against current approaches; e.g., level, mass balance, etc.
18*	***Cost Impact Explanation:*** Measurements (scans) are performed in real time (minutes) not hours. The baseline video approach takes days to measure and interpret the results. Mapping efforts with the TVMS will not hold up operations. By combining the viewing system and the dimensional mapping in one device, it will save available risers for others operations. The system is a useful and effective support for retrieval (mass balance, leak monitoring) and for post-retrieval (residual waste volume). Due to limited accessibility in Hanford SSTs, the new system would be safely deployable in a four-inch riser, making available several more access points per tank and minimizing costly equipment removal needed to support TMS operation. A combined viewing system frees yet an additional riser for the retrieval system.
Risk Information	
37 new	***Risk Identifier:*** ☐ CR-_____ [e.g., CR-047] ☐ New ***Risk Statement:*** If a reliable technique for quantitatively measuring the residual waste volume and concentrations of mobile, long-lived contaminants of concern in the tanks is not available, then the Performance Based Incentive related to accelerated tank cleanup and closure, and the TPA retrieval schedule may be jeopardized, and the radiation exposure to operators will be increased. Furthermore, the inability to characterize tank waste residuals may necessitate expensive retrieval of residuals if waste reclassification cannot be performed. If TVMS, the preferred system to provide data that demonstrates compliance to the TPA waste retrieval criteria, is unavailable, then the TPA commitment must be renegotiated before C-104 and S-112 retrieval completion will be agreed upon with Ecology.
12B	***Risk Narrative:***
Schedule Information	
21	***Regulatory Drivers:*** See milestones described in item #30 below.
22*	***Milestones:*** See milestones described in item #30 below.
28*	***Earliest Date Required:***
29*	***Latest Date Required:*** FY2003 to support S-112 and S-102 retrieval projects.
13B	***Schedule Explanation:*** CH2M HILL Performance Based Incentive Number PBI-3 incentivizes accelerated retrieval of S-112 and other high-risk tanks. Addressing this need is co-funded by the Accelerated Site Technology Deployment-Upgraded Topographical Mapping System for use in the S-112 retrieval. Mississippi State University Diagnostic Instrumentation and Analysis Laboratory (MSU-DIAL) is seeking Office of Science and Technology FY2003 funding to support the Fourier Transform Profilometry and Laser Induced Breakdown Spectroscopy techniques for characterizing deposits left in tanks following retrieval.

30	***Technology Insertion Point:*** ☐ New ☐ Existing Code: Official Date: TPA Milestones: M-45-03D Complete S-112 Saltcake Waste Retrieval Technology Demonstration Design 5/31/2003; M-45-03E Complete S-112 Saltcake Waste Retrieval Technology Demonstration Construction 9/30/2004; M-45-03C Complete Full Scale Saltcake Waste Retrieval Technology Demonstration at SST S-112 9/30/2005
Additional Points of Contact (POC)	
34	***Contractor End User POCs:*** Roger E. Bauer, CH2M HILL, (509) 376-5908, Roger_e_bauer@rl.gov
35	***DOE End User POCs:*** Bob Lober, ORP, (509) 373-7949, Robert_w_lober@rl.gov Roger Quintero, DOE-ORP, 509-373-0421, Fax: 509-373-1313, roger_a_quintero@rl.gov
36*	***Other Contacts:*** Julian Laurenz, CH2M HILL, 509-372-9301, Fax: 509-372-9292, julian_e_laurenz@rl.gov

Office of River Protection
Technology Opportunity Statement

General Reference Information	**CLOSED**
2*	***Assigned Tracking Number:*** WT116
1*	***Title:*** VOC Treatment and Monitoring
3*	***Summary:*** Single-shell tanks contain gases that have the potential of being hazardous or at least a nuisance. These gases include ammonia and certain volatile organic species. The sluicing campaign of C-106 had substantial delays because of potential problems with toxic gases. In the future, the schedule may be tighter and such delays may be very costly. How toxic gases are released, how fast and how to control them need to be better understood, based on applicable regulations. Cost-effective systems for treatment of VOCs and corresponding stack instrumentation for very low allowable emissions may be needed. This includes tough technical problem #20, which is OSHA issues regarding vapor emission from the tanks. We will have more vapor emissions as we retrieve new tanks. Are comfort masks (carbon canisters) available? What about fans (which would simulate a gentle breeze)? What about misters? Humidification fans? (e.g., like those used at WIPP where the salt absorbs all available moisture and the resulting dryness needs to be mitigated for safety and OSHA reasons)
38new	***Principal Contact:*** Markis Hughey, CH2M HILL, 509-373-2874, Fax: 509-373-5030, markis_t_hughey@rl.gov
Technology Opportunity Description	
8A*	***Project:*** X Safe Storage – Operations and Maintenance ☐ Safe Storage – Life Extension ☐ Waste Retrieval and Transfer – Waste Inventory Properties ☐ Waste Retrieval and Transfer – Equipment ☐ Closure ☐ Disposal
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW03 Work Breakdown Structure (WBS) No.: 5.7.1
12A	***Problem Description:*** Single-shell tanks contain gases that have the potential of being hazardous or at least a nuisance. These gases include ammonia and certain volatile organic species. Headspace sampling of single-shell tanks has demonstrated that hazardous gases are present. The ammonia may not be a problem, as any retrieval method will add water. Ammonia is soluble in water and so may not present a problem for the current baseline retrieval method, sluicing. However, some alternative retrieval methods are being considered that do not involve addition of large quantities of water, and therefore may not prevent ammonia release as well. In addition, sluicing may disturb zones where volatile organic gases are currently residing. How toxic gases are released, how fast, and how they can be controlled are not well understood. These need to be better understood to develop compliance strategies with applicable regulatory requirements for Environmental, Safety, and Health for future SST retrieval. The needed information will help design cost effective and compliant retrieval systems. RPP 6023 Non Radioactive Environmental Emissions Chemical Source Term for the DST Vapor Space During Waste Retrieval Operations for AN and SY Farms recommends installation of

	VOC monitoring systems. Project W-314 provides a stack sampling port for future expanded monitoring of the DST ventilation systems' exhaust. If the conservative assumption of RPP-6023 to assume AN Farm requires VOC monitoring (like SY) for waste disturbing retrieval activities, then design and construction modifications will be required resulting in increase in cost and schedule delays. Identification and evaluation of potential solutions need to be based on an accurate evaluation of the risk. Funding needs to be identified for all these activities.
9a*	***Priority:*** ☐ HIGH Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction X MEDIUM Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction ☐ LOW Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation
9b*	***Priority***

	Schedule Impact	☐ HIGH ☐ MED ☐ LOW	Needed to meet PBIs Needed to meet mission targets (2033 closure) Can improve mission targets or no schedule impact
	Cost Savings	☐ HIGH ☐ MED ☐ LOW	>$1B total life-cycle savings >$100M but <$1B total life-cycle savings <$100M total life-cycle savings
	Implementation Cost/Schedule	☐ HIGH ☐ MED ☐ LOW	<$10M and <2 yrs. >$10M and <2 yrs or <$10M and > 2 yrs. >$10M and > 2yrs. or significant technical risk
	Baseline Risk Reduction	☐ HIGH ☐ MED ☐ LOW	The baseline technical solution has not be proven at large scale or on actual radioactive waste. The baseline technical solution has been demonstrated at large scale but not implemented in radioactive operations. The baseline technical solution has been implemented at Hanford.

Cost Information	
17A*	***Current Baseline Cost:*** $
17B	***Estimated Cost Impact:*** $500K to $1M avoidance for W-314
18*	***Cost Impact Explanation:*** The cost impact to the W-314 project would be between $500K and $1,000K Retrieval delays due to unexpected releases would also have negative cost impacts.
Risk Information	
37 new	***Risk Identifier:*** ☐ CR- [e.g., CR-047] x New ***Risk Statement:*** If potentially hazardous VOC emissions occur unexpectedly during retrieval, then retrieval will have to be stopped for resolution. AOP Compliance. If a tank farm event requires the use of respiratory protection in the farm (e.g., organic vapor release), then construction, testing, and retrieval operations could be impacted, adding to cost and schedule duration.
12B	***Risk Narrative:*** *[further explanation, if warranted]*

Schedule Information	
21	***Regulatory Drivers:*** TBD
22*	***Milestones:***
28*	***Earliest Date Required:*** *FY03 for W-314*
29*	***Latest Date Required:*** *FY05 for W-314*
13B	***Schedule Explanation:*** W-314 is planning to procure six ventilation systems in the period FY03 to FY05, two per farm in AN, AW and AP farms. VOC treatment and monitoring equipment could be added anytime during W-314 lifetime or afterwards prior to starting the mixer pumps for retrieval.
30	***Technology Insertion Point:*** ☐ New ☐ Existing Code: Official Date:
Additional Points of Contact (POC)	
34	***Contractor End User POCs:*** John Bailey, CH2M HILL (509) 372-0045, F (509) 372-2403, john_w_bailey@rl.gov; Dan Reynolds, CH2M HILL (509) 373-3115, F (509) 373-4641 daniel_a_reynolds@rl.gov
35	***DOE End User POCs:*** Andy Stevens, DOE-ORP, 509-376-8235, Fax: 509-373-1313, andrew_j_stevens@rl.gov
36*	***Other Contacts:*** *[name, organization, telephone, fax, email]*

Office of River Protection
Technology Opportunity Statement

General Reference Information	**ACTIVE**
2*	***Assigned Tracking Number:*** WT123
1*	***Title:*** Continuous Air Monitors Reliability
3*	***Summary:*** Resolve Continuous Air Monitoring reliability issue by improving existing CAMs system or replacing them by more robust equipment. As part of the replacement of ventilation systems in AN, AW and AP, W-314 is providing new CAMs. The project has specified the same units as the ones currently used in the Farms. Resolving reliability issues before procurement is complete would mitigate cost and schedule impacts on the project.
38new	***Principal Contact:*** Mark Roberts, CH2M HILL, 509-376-4852, Fax: 509-373-9889, mark_a_roberts@rl.gov
Technology Opportunity Description	
8A*	***Project:*** X Safe Storage – Operations and Maintenance ☐ Safe Storage – Life Extension ☐ Waste Retrieval and Transfer – Waste Inventory Properties ☐ Waste Retrieval and Transfer – +Equipment ☐ Closure ☐ Disposal
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW03 Work Breakdown Structure (WBS) No.: 5.7.1
12A	***Problem Description:*** Resolve Continuous Air Monitoring reliability issue by improving existing CAMs system or replacing them by more robust equipment. As part of the replacement of ventilation systems in AN, AW and AP, W-314 is providing new CAMs. The project has specified the same units as the ones currently used in the Farms. Resolving reliability issues before procurement is complete would mitigate cost and schedule impacts on the project. The Canberra iCAM system was identified as promising. TF Maintenance is considering testing it. Funding needs to be identified. W-314 covers three tank farms, but CAMs equipment is needed in several locations in east tank farms. W314 is in the process of installing the ventilation system in AN farm with CAMs for the primary systems. (A different vacuum pump was installed, but this replacement did not result from studies related to this technology opportunity statement.) There is still a need for installation of an annulus system, and this is being pursued with normal operating funds. The plan is to temporally install alternative vacuum pumps for the CAM systems in selected locations to demonstrate whether they will function. There is also opportunity for improvement with the airborne radiation monitoring equipment itself, either by improving existing electronics or finding new equipment that is more reliable. This is not yet being pursued because of limits on funding and manpower. Additional efforts with vendors to identify more options for air monitoring equipment would be valuable. Limited searches on vacuum pumps have been completed, but additional searches are needed on the availability of more robust CAM equipment.

9*	***Priority:*** X HIGH Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction ☐ MEDIUM Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction ☐ LOW Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation

9*	***Priority:***	
	Schedule Impact	☐ HIGH Needed to meet PBIs ☒ MED Needed to meet mission targets (2033 closure) ☐ LOW Can improve mission targets or no schedule impact
	Cost Savings	☐ HIGH >$1B total life-cycle savings ☐ MED >$100M but <$1B total life-cycle savings ☐ LOW <$100M total life-cycle savings
	Implementation Cost/Schedule	☐ HIGH <$10M and <2 yrs. ☐ MED >$10M and <2 yrs or <$10M and > 2 yrs. ☐ LOW >$10M and > 2yrs. or significant technical risk
	Baseline Risk Reduction	☐ HIGH The baseline technical solution has not been proven at large scale or on actual radioactive waste. ☒ MED The baseline technical solution has been demonstrated at large scale but not implemented in radioactive operations. ☐ LOW The baseline technical solution has been implemented at Hanford.

Cost Information	
17A*	***Current Baseline Cost:*** $
17B	***Estimated Cost Impact:*** Saves the amount spent on corrective maintenance for CAMs.
18*	***Cost Impact Explanation:*** The Tank Farms currently have 86 CAMs, they are functionally checked every 30 days. Potential cost avoidance not quantified. The amount spent on corrective maintenance on these systems is not known. Potential adverse impact for W-314 is $60K.
Risk Information	
37 new	***Risk Identifier:*** ☒ CR ☒ New ***Risk Statement:*** If more reliable CAM systems are not installed, then Tank Farm Operations will miss an opportunity of efficiency increase that will be necessary to accommodate higher workloads during SST retrieval, Waste Feed Delivery, and Accelerated Closure Operations. AOP Compliance. If a tank farm event requires the use of respiratory protection in the farm (e.g., organic vapor release), then construction, testing, and retrieval operations could be impacted, adding to cost and schedule duration.
12B	***Risk Narrative:*** *[further explanation, if warranted]* Right now the CAMs are unreliable and TSR actions must be put in place when they fail. When the new DSA is implemented in October FY04, CAMs will no longer be required for safety basis purposes. CAMs will be required from an environmental/air quality perspective. The CAMs will be important for meeting the mission of producing waste for the vitrification plant. If the CAM system is down, there will be no method to monitor airborne radiation during transfer of waste. Process inefficiencies during retrieval and vitrification may result from more time spent fixing CAM systems.

Schedule Information	
21	***Regulatory Drivers:***
22*	***Milestones:***
28*	***Earliest Date Required:*** *FY03 for W-314 .*
29*	***Latest Date Required:*** *FY05*
13B	***Schedule Explanation:*** This will be put into operation as soon as available, and will be beneficial until the end of the Safe Storage, Retrieval, and Closure functions. First W-314 HVAC system procured in FY03, last one in FY05.
30	***Technology Insertion Point:*** ☐ New ☐ Existing Code: Official Date:
Additional Points of Contact (POC)	
34	***Contractor End User POCs:*** Mark Roberts, CH2M HILL, (509) 376-4852, Mark_a_roberts@rl.gov; Robert Steele, CH2M HILL (509) 373-6591, Robert_steele@rl.gov; John Bailey, CH2M HILL (509) 372-0045, F (509) 372-2403, john_w_bailey@rl.gov
35	***DOE End User POCs:*** Dennis Irby, (509) 376-5652, dennis_h_irby@rl.gov
36*	***Other Contacts:*** *[name, organization, telephone, fax, email]*

Office of River Protection
Technology Opportunity Statement

General Reference Information			**INACTIVE**
2*	***Assigned Tracking Number:*** WT124		
1*	***Title:*** Replacement of Annulus Monitoring Flake Boxes with Newer Technology		
3*	***Summary:*** Existing Flake Boxes are expensive to operate and maintain (labor intensive). Newer electronic (possibly with wireless remote reading) could be more cost effective.		
38new	***Principal Contact:*** Craig Jorgensen, CH2M HILL, 509-373-6593, Fax: 509-372-3106, craig_w_jorgensen@rl.gov		
Technology Opportunity Description			
8A*	***Project:*** X Safe Storage – Operations and Maintenance ☐ Safe Storage – Life Extension ☐ Waste Retrieval and Transfer – Waste Inventory Properties ☐ Waste Retrieval and Transfer – Equipment ☐ Closure ☐ Disposal		
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW03 Work Breakdown Structure (WBS) No.: 5.7.1		
12A	***Problem Description:*** Existing Flake Boxes are expensive to operate and maintain (labor intensive). Newer electronic (possibly with wireless remote reading) could be more cost effective. Solutions need to be identified and evaluated.		
9*	***Priority:*** ☐ HIGH Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction ☐ MEDIUM Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction X LOW Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation		
9*	***Priority***		
	Schedule Impact	☐ HIGH ☐ MED ☒ LOW	Needed to meet PBIs Needed to meet mission targets (2033 closure) Can improve mission targets or no schedule impact
	Cost Savings	☐ HIGH ☐ MED ☒ LOW	>$1B total life-cycle savings >$100M but <$1B total life-cycle savings <$100M total life-cycle savings
	Implementation Cost/Schedule	☒ HIGH ☐ MED ☐ LOW	<$10M and <2 yrs. >$10M and <2 yrs or <$10M and > 2 yrs. >$10M and > 2yrs. or significant technical risk

	Baseline Risk Reduction	☐ HIGH The baseline technical solution has not been proven at large scale or on actual radioactive waste. ☒ MED The baseline technical solution has been demonstrated at large scale but not implemented in radioactive operations. ☐ LOW The baseline technical solution has been implemented at Hanford.
Cost Information		
17A*	***Current Baseline Cost:*** $TBD	
17B	***Estimated Cost Impact:*** $TBD	
18*	***Cost Impact Explanation:*** A cost benefit analysis is needed.	
Risk Information		
37 new	***Risk Identifier:*** ☐ CR- [e.g., CR-047] ☒ New ***Risk Statement:*** If existing Flake Boxes continue to be used, then Tank Farm Operations may miss an opportunity of efficiency increase that will be necessary to accommodate higher workloads during SST retrieval, Waste Feed Delivery, and Accelerated Closure Operations.	
12B	***Risk Narrative:*** *[further explanation, if warranted]* Flake boxes are backup to ENRAFs. If this project is not funded, tank farms will lose backup capability. AY-AZ tank farm is talking about replacing flake boxes with more ENRAFs or newer electronics.	
Schedule Information		
21	***Regulatory Drivers:***	
22*	***Milestones:***	
28*	***Earliest Date Required:*** *[month, year]*	
29*	***Latest Date Required:*** *[month, year]*	
13B	***Schedule Explanation:*** This would be put into operation as soon as available, and would be beneficial until the end of the Safe Storage function.	
30	***Technology Insertion Point:*** ☐ New ☐ Existing Code: Official Date:	
Additional Points of Contact (POC)		
34	***Contractor End User POCs:*** Craig Jorgensen, CH2M HILL, (509) 373-6593, fax: 509-372-3106 craig_w_jorgensen@rl.gov; Bob Thacker, CH2M HILL, (509) 373-1897, bob_h_thacker@rl.gov; Mike Geffre, CH2M HILL (509) 373-5658, michael_b_geffre@rl.gov	
35	***DOE End User POCs:*** Vic Callahan, (509) 373-9880, victor_l_callahan@rl.gov	
36*	***Other Contacts:*** *[name, organization, telephone, fax, email]*	

Office of River Protection
Technology Opportunity Statement

General Reference Information	**INACTIVE**
2*	***Assigned Tracking Number:*** WT125
1*	***Title:*** Interstitial Liquid Level Measurement in SSTs
3*	***Summary:*** SST liquid level is currently measured through the Liquid Observation Wells, which are periodically monitored with vehicle/van-mounted systems (71 surveys per week, 83 per week in two years). Information is automatically transferred to the SACS database. This method is labor intensive. The TPA Leak Detection, Mitigation and Monitoring commitments (RCRA compliance) include evaluation of new liquid level measurement technologies. Negotiations are underway to determine long term monitoring requirements.
38new	***Principal Contact:*** David Barnes, CH2M HILL, 509-373-3667; Fax: 509-376-7951, david_a_barnes@rl.gov
Technology Opportunity Description	
8A*	***Project:*** X Safe Storage – Operations and Maintenance ☐ Safe Storage – Life Extension ☐ Waste Retrieval and Transfer – Waste Inventory Properties ☐ Waste Retrieval and Transfer – Equipment ☐ Closure ☐ Disposal
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW03 Work Breakdown Structure (WBS) No.: 5.7.1
12A	***Problem Description:*** SST liquid level is currently measured through the Liquid Observation Wells, which are periodically monitored with vehicle/van-mounted systems (71 surveys per week, 83 per week in two years). Information is automatically transferred to the SACS database. This method is labor intensive. The TPA Leak Detection, Mitigation and Monitoring commitments (RCRA compliance) include evaluation of new liquid level measurement technologies. The Leak Detection, Mitigation and Monitoring Functions and Requirements TPA deliverable recently submitted to Ecology includes a proposal for significantly reducing the LOW measurement requirements. The outcome of this proposed change will drive the potential benefit of enhancing the liquid-level measurement technology.
9*	***Priority:*** ☐ HIGH Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction X MEDIUM Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction ☐ LOW Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation

9	***Priority:***	
	Schedule Impact	☐ HIGH Needed to meet PBIs ☒ MED Needed to meet mission targets (2033 closure) ☐ LOW Can improve mission targets or no schedule impact
	Cost Savings	☐ HIGH >$1B total life-cycle savings ☐ MED >$100M but <$1B total life-cycle savings ☒ LOW <$100M total life-cycle savings
	Implementation Cost/Schedule	☒ HIGH <$10M and <2 yrs. ☐ MED >$10M and <2 yrs or <$10M and > 2 yrs. ☐ LOW >$10M and > 2yrs. or significant technical risk
	Baseline Risk Reduction	☐ HIGH The baseline technical solution has not been proven at large scale or on actual radioactive waste. ☐ MED The baseline technical solution has been demonstrated at large scale but not implemented in radioactive operations. ☐ LOW The baseline technical solution has been implemented at Hanford.
Cost Information		
17A*	***Current Baseline Cost:*** $ 400K per year for all SSTs, including $31K for maintenance	
17B	***Estimated Cost Impact:*** $ TBD, depending on future surveillance requirements	
18*	***Cost Impact Explanation:*** . An installed automatic system would require investments, but could reduce the cost to only maintenance needs.	
Risk Information		
37 new	***Risk Identifier:*** ☐ CR- [e.g., CR-047] x New ***Risk Statement:*** If interstitial liquid levels continues to be measured by current methods, then the TPA commitment to evaluate new technologies may not be met and Tank Farm Operations will miss an opportunity of efficiency increase that will be necessary to accommodate higher work loads during SST retrieval, Waste Feed Delivery, and Accelerated Closure Operations. Tank Integrity SST (CR-084RPP-CR-035). If a Single Shell Tank (SST) has significant leakage, then overall TFC baseline strategy may have to be reconsidered (including possible tank sequencing adjustments) to accommodate different retrieval methods and to limit the amount of leakage.	
12B	***Risk Narrative:*** *[further explanation, if warranted]*	
Schedule Information		
21	***Regulatory Drivers:*** TPA	
22*	***Milestones:*** M-45 series TPA milestones (LDMM commitments)	
28*	***Earliest Date Required:*** *TBD*	
29*	***Latest Date Required:*** *TBD*	
13B	***Schedule Explanation:*** A cost-benefit analysis would be necessary to determine how many years and how many SST need to be left to operate for a technology insertion to be valuable. This	

	analysis should be based on the results of the on going negotiations on long term monitoring requirements.
30	***Technology Insertion Point:*** ☐ New ☐ Existing Code: Official Date:
Additional Points of Contact (POC)	
34	***Contractor End User POCs:*** David Barnes, CH2M HILL (509) 373-3667, F (509) 376-7951, david_a_barnes@rl.gov
35	***DOE End User POCs:*** Andy Stevens(509)376-8235, andrew_j_stevens@rl.gov
36*	***Other Contacts:*** *[name, organization, telephone, fax, email]*

Office of River Protection
Technology Opportunity Statement

General Reference Information		**CLOSED FOR SSTs/DEFERRED FOR DSTs**
2*	***Assigned Tracking Number:*** WT126—Pipeline Unplugging/Plug Location	
1*	***Title:*** Line Unplugging/Plug Location	
3*	***Summary:*** Despite pipeline plugging over many years at Hanford, the technologies available for removing plugs are limited and not always effective. Additional and advanced technologies for unplugging pipelines need to be readily available to improve overall project efficiency. This includes tough technical problem #6, which is a toolbox for dealing with a plugged line such as the line that affected transfer from Tank U-107. (Ralph Wilson)	
38new	***Principal Contact:*** Tim Oten, CH2M HILL, 509 376-3563, F/509 372-3106, timothy_c_oten@rl.gov	
Technology Opportunity Description		
8A*	***Project:*** X Safe Storage – Operations and Maintenance ☐ Safe Storage – Life Extension ☐ Waste Retrieval and Transfer – Waste Inventory Properties ☐ Waste Retrieval and Transfer – Equipment ☐ Closure ☐ Disposal	
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW03 Work Breakdown Structure (WBS) No.: 5.7.1	
12A	***Problem Description:*** Despite pipeline plugging over many years at Hanford, the technologies available for removing plugs are limited and not always effective. Additional and advanced technologies for unplugging pipelines need to be readily available to improve overall project efficiency. The CH2M HILL team and Florida International University (working under the TFA) identified potential technologies and toolbox staging approaches. A company strategy needs to be defined, and funding needs to be identified for its implementation.	
9A	***Priority:*** X HIGH Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction ☐ MEDIUM Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction ☐ LOW Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation	
9B	***Priorities:***	
	Schedule Impact	☐ HIGH Needed to meet PBIs ☐ MED Needed to meet mission targets (2033 closure) X LOW no schedule impact or can improve mission targets (<2033 closure).
	Cost Savings	☐ HIGH >$1B total life-cycle savings ☐ MED >$100M but <$1B total life-cycle savings X LOW <$100M total life-cycle savings

	Implementation Cost/Schedule	☐ HIGH X MED ☐ LOW	<$10M and <2 yrs. >$10M and <2 yrs or <$10M and > 2 yrs. >$10M and > 2yrs. or significant technical risk
	Baseline Risk Reduction	X HIGH ☐ MED ☐ LOW	*The baseline technical solution has not been proven at large scale or on actual radioactive waste.* The baseline technical solution has been demonstrated at large scale but not implemented in radioactive operations. The baseline technical solution has been implemented at Hanford.

Cost Information	
17A*	***Current Baseline Cost:*** $
17B	***Estimated Cost Impact:*** $2M avoidance per year
18*	***Cost Impact Explanation:*** Pluggage cost avoidance estimated at $2M per year
Risk Information	
37 new	***Risk Identifier:*** ☐ CR- ☐ New ***Risk Statement:*** If the waste viscosity is higher than predicted, then plugging may occur in the lines (Technical Risk List) If the particle size exceeds 700 microns, then equipment and lines could plug (Technical Risk List) If a pipeline plugs, then the line will no longer be available to support waste retrieval and Waste Feed Delivery (Technical Risk List). Significant mission delays and cost increase (from system down time and either unplugging activities or line replacement) will result.
12B	***Risk Narrative:*** *[further explanation, if warranted]*
Schedule Information	
21	***Regulatory Drivers:***
22*	***Milestones:***
28*	***Earliest Date Required:*** *[month, year]*
29*	***Latest Date Required:*** *[month, year]*
13B	***Schedule Explanation:*** This will be put into operation as soon as available, and will be beneficial until the end of the Retrieval and Waste Feed Delivery functions.
30	***Technology Insertion Point:*** ☐ New ☐ Existing Code: Official Date:
Additional Points of Contact (POC)	
34	***Contractor End User POCs:*** Tim Oten, CH2M HILL, 509 376-3563, F/509 372-3106, timothy_c_oten@rl.gov
35	***DOE End User POCs:*** Roger Quintero, (509)373-0421, roger_a_quintero@rl.gov
36*	***Other Contacts:*** K.A. (Ken) Gasper, CH2M HILL, 509-373-1948, F/509-373-9093, kenneth_a_ken_gasper@rl.gov

Office of River Protection
Technology Opportunity Statement

General Reference Information	**ACTIVE**

2*	***Assigned Tracking Number:*** WT127
1*	***Title:*** Maintenance Tracking System
3*	***Summary:*** Need a new maintenance tracking system that provides more efficient tracking & trending. The Job Control System is becoming Windows-based, and should allow easier feed back of data to System Engineers for their System Health monthly reports. Solutions are being evaluated for implementations.
38new	***Principal Contact:*** David Braun, CH2M HILL 509-373-6799, Fax: 509-373-9889, david_j_braun@rl.gov
Technology Opportunity Description	
8A*	***Project:*** X Safe Storage – Operations and Maintenance ☐ Safe Storage – Life Extension ☐ Waste Retrieval and Transfer – Waste Inventory Properties ☐ Waste Retrieval and Transfer – Equipment ☐ Closure ☐ Disposal
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW03 Work Breakdown Structure (WBS) No.: 5.7.1
12A	***Problem Description:*** The JCS system will be Windows-based in September 2003. This will enable tracking and trending of preventative maintenance (PM) and corrective maintenance (CM). The effectiveness is uncertain. The new Windows based version will include tracking identifiers for pieces of equipment. However, effectiveness in uncertain at this time, as the system has not been fully implemented (per DB on July 16, 2003).
9*	***Priority:*** ☐ HIGH Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction ☐ MEDIUM Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction X LOW Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation
9*	***Priority can't estimate at this time***

Schedule Impact	☐ HIGH	Needed to meet PBIs
	☒ MED	Needed to meet mission targets (2033 closure)
	☐ LOW	Can improve mission targets or no schedule impact
Cost Savings	☐ HIGH	>$1B total life-cycle savings
	☐ MED	>$100M but <$1B total life-cycle savings
	☐ LOW	<$100M total life-cycle savings
Implementation Cost/Schedule	☒ HIGH	<$10M and <2 yrs.
	☐ MED	>$10M and <2 yrs or <$10M and > 2 yrs.
	☐ LOW	>$10M and > 2yrs. or significant technical risk

	Baseline Risk Reduction	☐ HIGH The baseline technical solution has not been proven at large scale or on actual radioactive waste. ☐ MED The baseline technical solution has been demonstrated at large scale but not implemented in radioactive operations. ☐ LOW The baseline technical solution has been implemented at Hanford.
Cost Information		
17A*	***Current Baseline Cost:*** $	
17B	***Estimated Cost Impact:*** $The system will cost money, but it will enable contractor to catch components before they fail instead of going into an LCO condition. This will save money by keeping the WTP operating. The magnitude of savings is difficult to estimate.	
18*	***Cost Impact Explanation:*** Current system is expensive to track & trend maintenance information	
Risk Information		
37 new	***Risk Identifier:*** ☐ CR- [e.g., CR-047] ☒ New ***Risk Statement:*** If and improved maintenance tracking system is not implemented, then Tank Farm Operations may miss an opportunity of efficiency increase that will be necessary to accommodate higher work loads during SST retrieval, Waste Feed Delivery, and Accelerated Closure Operations. Equipment failures. If an LOW or ENRAF fails, then tank farms will be out of compliance with environmental monitoring requirements requiring alternative monitoring procedures that are more labor intensive. If sampling equipment breaks or fails requiring redesign and reprocurement/fabrication, then delays and added costs may result. If a major equipment failure occurs, requiring unbudgeted repairs/replacements that substantially exceed planned day to day maintenance costs, then CH2M HILL costs will exceed its budget.	
12B	***Risk Narrative:*** *[further explanation, if warranted]*	
Schedule Information		
21	***Regulatory Drivers:***	
22*	***Milestones:***	
28*	***Earliest Date Required:*** *[month, year]*	
29*	***Latest Date Required:*** *[month, year]*	
13B	***Schedule Explanation:*** This would be put into operation as soon as available, and would be beneficial until the end of the Safe Storage function.	
30	***Technology Insertion Point:*** ☐ New ☐ Existing Code: _____ Official Date: _____	
Additional Points of Contact (POC)		
34	***Contractor End User POCs:*** David Braun, CH2M HILL, 509-373-6799, Fax: 509-373-9889 david_j_braun@rl.gov	
35	***DOE End User POCs:*** Mike Royack, (509) 376-4420, Michael_j_royack@rl.gov	
36*	***Other Contacts:*** *[name, organization, telephone, fax, email]*	

Office of River Protection
Technology Opportunity Statement

General Reference Information			CLOSED
2*	***Assigned Tracking Number:*** WT128		
1*	***Title:*** Develop/Find Maintenance Predictive Tools		
3*	***Summary:*** Reliability Centered Maintenance is exploring four technologies: (1) full scale vibration analysis on rotating machinery (2) shock pulse monitoring-read bearing signature (e.g. AY-101 annulus fan bearing failure) (3) thermography, and (4) motor current monitoring/analysis (e.g. startup current). Vendors need to be consulted, potential additional technologies may exist.		
38new	***Principal Contact:*** David Braun, CH2M HILL, 509-373-6799, Fax: 509-373-9889 david_j_braun@rl.gov		
Technology Opportunity Description			
8A*	***Project:*** X Safe Storage – Operations and Maintenance ☐ Safe Storage – Life Extension ☐ Waste Retrieval and Transfer – Waste Inventory Properties ☐ Waste Retrieval and Transfer – Equipment ☐ Closure ☐ Disposal		
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW03 Work Breakdown Structure (WBS) No.: 5.7.1		
12A	***Problem Description:*** The technology is in the field. shock pulse monitoring reports are generated on a quarterly. The equipment and procedures are on hand for full-scale vibration analysis and thermography, Machine modification is underway for motor current monitoring analysis and readings will be taken this month.		
9*	***Priority:*** ☐ HIGH Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction X MEDIUM Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction ☐ LOW Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation		
9*	***Priority:***		
	Schedule Impact	☐ HIGH ☐ MED ☒ LOW	Needed to meet PBIs Needed to meet mission targets (2033 closure) Can improve mission targets or no schedule impact
	Cost Savings	☐ HIGH ☐ MED ☒ LOW	>$1B total life-cycle savings >$100M but <$1B total life-cycle savings <$100M total life-cycle savings
	Implementation Cost/Schedule	☐ HIGH ☐ MED ☐ LOW	<$10M and <2 yrs. >$10M and <2 yrs or <$10M and > 2 yrs. >$10M and > 2yrs. or significant technical risk

	Baseline Risk Reduction	☐ HIGH The baseline technical solution has not been proven at large scale or on actual radioactive waste. ☐ MED The baseline technical solution has been demonstrated at large scale but not implemented in radioactive operations. ☐ LOW The baseline technical solution has been implemented at Hanford.
Cost Information		
17A*	***Current Baseline Cost:*** $	
17B	***Estimated Cost Impact:*** $	
18*	***Cost Impact Explanation:*** Excessive corrective maintenance costs are incurred, predictive maintenance needs to increase (currently only 14% of budget, should be 50%).	
Risk Information		
37 new	***Risk Identifier:*** ☐ CR- [e.g., CR-047] ☒ New ***Risk Statement:*** If additional predictive maintenance tools are not identified, then Tank Farm Operations may miss an opportunity of efficiency increase that will be necessary to accommodate higher workloads during SST retrieval, Waste Feed Delivery, and Accelerated Closure Operations. Equipment failures. If an LOW or ENRAF fails, then tank farms will be out of compliance with environmental monitoring requirements requiring alternative monitoring procedures that are more labor intensive. If sampling equipment breaks or fails requiring redesign and reprocurement/fabrication, then delays and added costs may result. If a major equipment failure occurs, requiring unbudgeted repairs/replacements that substantially exceed planned day to day maintenance costs, then CH2M HILL costs will exceed its budget.	
12B	***Risk Narrative:*** *[further explanation, if warranted]*	
Schedule Information		
21	***Regulatory Drivers:***	
22*	***Milestones:***	
28*	***Earliest Date Required:*** *[month, year]*	
29*	***Latest Date Required:*** *[month, year]*	
13B	***Schedule Explanation:*** This would be put into operation as soon as available, and would be beneficial until the end of the Safe Storage function.	
30	***Technology Insertion Point:*** ☐ New ☐ Existing Code: Official Date:	
Additional Points of Contact (POC)		
34	***Contractor End User POCs:*** David Braun, CH2M HILL, 509-373-6799, Fax: 509-373-9889 david_j_braun@rl.gov	
35	***DOE End User POCs:*** Mike Royack, (509) 376-4420, Michael_j_royack@rl.gov	
36*	***Other Contacts:*** *[name, organization, telephone, fax, email]*	

Office of River Protection
Technology Opportunity Statement

General Reference Information		**DEFERRED**
2*	***Assigned Tracking Number:*** WT129	
1*	***Title:*** Spray-on Shielding	
3*	***Summary:*** During manned deactivation operations, lead blankets or sheets are used as radiation shielding. Light foam type shielding (encapsulated lead beads) is available and flexible (with Radishield), but attaching it is not always easy. Operations could be eased if a method for spraying the foam shielding directly on the hot spots could be devised.	
38new	***Principal Contact:*** John W. Hobbs, CH2M HILL, 509-373-8676, Fax: 509-373-0181, john_hobbs@rl.gov	
Technology Opportunity Description		
8A*	***Project:*** X Safe Storage – Operations and Maintenance ☐ Safe Storage – Life Extension ☐ Waste Retrieval and Transfer – Waste Inventory Properties ☐ Waste Retrieval and Transfer – Equipment ☐ Closure ☐ Disposal	
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW03 Work Breakdown Structure (WBS) No.: 5.7.1	
12A	***Problem Description:*** During manned deactivation operations, lead blankets or sheets are used. Light foam type shielding (encapsulated lead beads) is available and flexible (with Radishield), but attaching it is not always easy. Operations could be eased if a method for spraying the foam shielding directly on the hot spots could be devised. Adaptation of commercial product needs to be evaluated.	
9A*	***Priority:*** ☐ HIGH Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction X MEDIUM Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction ☐ LOW Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation	
9B*	***Priority***	

Schedule Impact	☐ HIGH ☐ MED ☐ LOW	Needed to meet PBIs Needed to meet mission targets (2033 closure) Can improve mission targets or no schedule impact
Cost Savings	☐ HIGH ☐ MED ☐ LOW	>$1B total life-cycle savings >$100M but <$1B total life-cycle savings <$100M total life-cycle savings
Implementation Cost/Schedule	☐ HIGH ☐ MED ☐ LOW	<$10M and <2 yrs. >$10M and <2 yrs or <$10M and > 2 yrs. >$10M and > 2yrs. or significant technical risk

	Baseline Risk Reduction	☐ HIGH The baseline technical solution has not be proven at large scale or on actual radioactive waste. ☐ MED The baseline technical solution has been demonstrated at large scale but not implemented in radioactive perations. ☐ LOW The baseline technical solution has been implemented at Hanford.
Cost Information		
17A*	***Current Baseline Cost:*** $	
17B	***Estimated Cost Impact:*** $	
18*	***Cost Impact Explanation:*** A cost benefit analysis is needed. Currently, one day of shielding application is required for two-day typical jobs.	
Risk Information		
37 new	***Risk Identifier:*** ☒ CR-011 ☐ New ***Risk Statement:*** Radiation & Contamination CR-011 If unplanned radiological exposures or releases occur while contaminated equipment is being removed, then installation of retrieval equipment and subsequent feed delivery operations may be delayed. If spray-on shielding is not available, then the deactivation projects may loose an opportunity to become more effective, and meet aggressive commitments. Adequate attention to worker safety enables sustained HLW feed delivery and accelerated SST retrieval	
12B	***Risk Narrative:*** Issues have been resolved for mission work currently defined. The baseline strategy is to avoid work in highly contaminated pit. If highly contaminated pits must be accessed in the future or pits with planned work scope are more contaminated than previously thought, this solution may be more safe and cost-effective than existing methods.	
Schedule Information		
21	***Regulatory Drivers:***	
22*	***Milestones:***	
28*	***Earliest Date Required:*** *[month, year]*	
29*	***Latest Date Required:*** *[month, year]*	
13B	***Schedule Explanation:*** This would be put into operation as soon as available, and would be beneficial until the end of the Safe Storage function.	
30	***Technology Insertion Point:*** ☐ New ☐ Existing Code: _____ Official Date: _____	

Additional Points of Contact (POC)	
34	***Contractor End User POCs:*** John W. Hobbs, CH2M HILL, (509) 372-8676, Fax: 509-373-0181, John_Hobbs@rl.gov
35	***DOE End User POCs:*** *[name, organization, telephone, fax, email]*
36*	***Other Contacts:*** Roger Bauer, CH2M HILL, 509-376-5908, Fax: 509-373-4238 roger_e_bauer@rl.gov

Office of River Protection
Technology Opportunity Statement

General Reference Information			**CLOSED**
2*	***Assigned Tracking Number:*** WT130		
1*	***Title:*** Asbestos Encapsulation for Insulation Removal		
3*	***Summary:*** An on-the-spot asbestos encapsulation method that would allow facility deactivation workers to remove asbestos insulation (pipe and all) in high-dose areas could save time, worker dose exposure, and cost by avoiding the need to set up glove bags (ALARA) or treating the whole room as an asbestos area.		
38new	***Principal Contact:*** John W. Hobbs, CH2M HILL, (509) 372-8676, Fax: 509-373-0181, John_Hobbs@rl.gov		
Technology Opportunity Description			
8A*	***Project:*** ☐ Safe Storage – Operations and Maintenance X Safe Storage – Life Extension ☐ Waste Retrieval and Transfer – Waste Inventory Properties ☐ Waste Retrieval and Transfer – Equipment ☐ Closure ☐ Disposal		
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW03 Work Breakdown Structure (WBS) No.: 5.7.2		
12A	***Problem Description:*** An on-the-spot asbestos encapsulation method that would allow facility deactivation workers to remove asbestos insulation (pipe and all) in high-dose areas could save time, worker dose exposure, and cost by avoiding the need to set up glove bags (ALARA) or treating the whole room as an asbestos area. Solutions need to be identified and evaluated. *Note: During the FY2003 update, asbestos encapsulation was viewed as not justifying resources, since current technologies are acceptable and the scale of asbestos removal planned would not result in any measurable return on the investment that would be required.*		
9A*	***Priority:*** ☐ HIGH Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction ☐ MEDIUM Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction X LOW Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation		
9B	***Priority***		
	Schedule Impact	☐ HIGH ☐ MED ☐ LOW	Needed to meet PBIs Needed to meet mission targets (2033 closure) Can improve mission targets or no schedule impact
	Cost Savings	☐ HIGH ☐ MED ☐ LOW	>$1B total life-cycle savings >$100M but <$1B total life-cycle savings <$100M total life-cycle savings

	Implementation Cost/Schedule	☐ HIGH <$10M and <2 yrs. ☐ MED >$10M and <2 yrs or <$10M and > 2 yrs. ☐ LOW >$10M and > 2yrs. or significant technical risk
	Baseline Risk Reduction	☐ HIGH The baseline technical solution has not be proven at large scale or on actual radioactive waste. ☐ MED The baseline technical solution has been demonstrated at large scale but not implemented in radioactive operations. ☐ LOW The baseline technical solution has been implemented at Hanford.
Cost Information		
17A*	***Current Baseline Cost:*** $	
17B	***Estimated Cost Impact:*** $	
18*	***Cost Impact Explanation:*** A cost benefit analysis is needed. Typically, the time to setup the glove bag is twice the time needed to actually remove asbestos insulation.	
Risk Information		
37 new	***Risk Identifier:*** ☐ CR- [e.g., CR-047] ☒New ***Risk Statement:*** If an asbestos encapsulation method for insulation removal is not implemented, then the Facility Deactivation Projects will miss an opportunity of efficiency increase that will be necessary to accommodate high work loads in SST retrieval, Waste Feed Delivery, and Accelerated Closure Operations.	
12B	***Risk Narrative:*** *[further explanation, if warranted]*	
Schedule Information		
21	***Regulatory Drivers:***	
22*	***Milestones:***	
28*	***Earliest Date Required:*** *[month, year]*	
29*	***Latest Date Required:*** *[month, year]*	
13B	***Schedule Explanation:*** This will be put into operation as soon as available, and will be beneficial until the end of the Safe Storage function.	
30	***Technology Insertion Point:*** ☐ New ☐ Existing Code: _____ Official Date: _____	
Additional Points of Contact (POC)		
34	***Contractor End User POCs:*** John W. Hobbs, CH2M HILL, (509) 372-8676, Fax: 509-373-0181, John_Hobbs@rl.gov	
35	***DOE End User POCs:*** *[name, organization, telephone, fax, email]*	
36*	***Other Contacts:*** *[name, organization, telephone, fax, email]*	

Office of River Protection
Technology Opportunity Statement

General Reference Information	**DEFERRED**
2*	***Assigned Tracking Number:*** WT131
1*	***Title:*** Contamination Lock-Down Surface Coating
3*	***Summary:*** Facility deactivation activities often generate significant airborne contamination, which requires the erection of tents and work in mask. Polyurea has been applied to prevent airborne contamination and avoid the need to work with masks, but its application is a relatively heavy operation, and its high mechanical resistance hinders operations such as nozzle disconnection, etc. Sugar water coating is currently used in tank farm pits, but it is not sturdy enough, and it attracts ants. Other materials that would provide a "lighter" coating of 90-95% of horizontal surfaces, easily "pealed" could significantly ease operations, especially if applied using a fogging process.
38new	***Principal Contact:*** John W. Hobbs, CH2M HILL, (509) 372-8676, Fax: 509-373-0181, John_Hobbs@rl.gov
Technology Opportunity Description	
8A*	***Project:*** ☐ Safe Storage – Operations and Maintenance X Safe Storage – Life Extension ☐ Waste Retrieval and Transfer – Waste Inventory Properties ☐ Waste Retrieval and Transfer – Equipment ☐ Closure ☐ Disposal
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW03 Work Breakdown Structure (WBS) No.: 5.7.2
12A	***Problem Description:*** Facility deactivation activities often generate significant airborne contamination, which requires the erection of tents and work in mask. Polyurea has been applied to prevent airborne contamination and avoid the need to work with masks, but its application is a relatively heavy operation, and its high mechanical resistance hinders operations such as nozzle disconnection, etc. Sugar water coating is currently used in tank farm pits, but it is not sturdy enough, and it attracts ants. Other materials that would provide a "lighter" coating of 90-95% of horizontal surfaces, easily "pealed" could significantly ease operations, especially if applied using a fogging process. Potential solutions need to be identified and evaluated.
9*	***Priority:*** X HIGH Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction ☐ MEDIUM Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction ☐ LOW Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation
Cost Information	
17A*	***Current Baseline Cost:*** $
17B	***Estimated Cost Impact:*** $

18*	***Cost Impact Explanation:*** A cost benefit analysis is needed. The avoidance of work with mask could be a significant cost reduction.
Risk Information	
37 new	***Risk Identifier:*** ☒ CR-011 ☒ New ***Risk Statement:*** Radiation & Contamination CR-011 If unplanned radiological exposures or releases occur while contaminated equipment is being removed, then installation of retrieval equipment and subsequent feed delivery operations may be delayed. If an efficient contamination lock-down method is not implemented, then the Facility Deactivation Projects will miss an opportunity of efficiency increase that will be necessary to accommodate high work loads in SST retrieval, Waste Feed Delivery, and Accelerated Closure Operations.
12B	***Risk Narrative:*** Issues have been resolved for mission work currently defined. The baseline strategy is to avoid work in highly contaminated pits. If highly contaminated pits must be accessed in the future or pits with planned work scope are more contaminated than previously thought, this solution may be more safe and cost-effective than existing methods.
Schedule Information	
21	***Regulatory Drivers:***
22*	***Milestones:***
28*	***Earliest Date Required:*** *[month, year]*
29*	***Latest Date Required:*** *[month, year]*
13B	***Schedule Explanation:*** This will be put into operation as soon as available, and will be beneficial until the end of the Safe Storage function.
30	***Technology Insertion Point:*** ☐ New ☐ Existing Code: Official Date:
Additional Points of Contact (POC)	
34	***Contractor End User POCs:*** John W. Hobbs, CH2M HILL, (509) 372-8676, Fax: 509-373-0181, John_Hobbs@rl.gov
35	***DOE End User POCs:*** *[name, organization, telephone, fax, email]*
36*	***Other Contacts:*** *[name, organization, telephone, fax, email]*

Office of River Protection
Technology Opportunity Statement

General Reference Information		**CLOSED**
2*	***Assigned Tracking Number:*** WT132	
1*	***Title*:** Deactivate Inactive Systems in DST/SSTs	
3*	***Summary:*** The upcoming deactivation of inactive systems in DSTs and SSTs will offer technology opportunities. The generation of Functions and Requirements in FY03 will allow better definition of these opportunities.	
38new	***Principal Contact:*** Kathleen Tollefson, CH2M HILL, 509-373-9120, Fax: 509-373-7606 kathleen_s_tollefson@rl.gov	
Technology Opportunity Description		
8A*	***Project:*** ☐ Safe Storage – Operations and Maintenance X Safe Storage – Life Extension ☐ Waste Retrieval and Transfer – Waste Inventory Properties ☐ Waste Retrieval and Transfer – Equipment ☐ Closure ☐ Disposal	
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW03 Work Breakdown Structure (WBS) No.: 5.7.2	
12A	***Problem Description:*** Deactivations will take place from FY03 until FY08. POC stated work completed with baseline funding to end in FY03.	
9A*	***Priority:*** ☐ HIGH Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction ☐ MEDIUM Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction ☐ LOW Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation	
9B	***Priority***	
	Schedule Impact	☐ HIGH Needed to meet PBIs ☐ MED Needed to meet mission targets (2033 closure) ☐ LOW Can improve mission targets or no schedule impact
	Cost Savings	☐ HIGH >$1B total life-cycle savings ☐ MED >$100M but <$1B total life-cycle savings ☐ LOW <$100M total life-cycle savings
	Implementation Cost/Schedule	☐ HIGH <$10M and <2 yrs. ☐ MED >$10M and <2 yrs or <$10M and > 2 yrs. ☐ LOW >$10M and > 2yrs. or significant technical risk

	Baseline Risk Reduction	☐ HIGH The baseline technical solution has not be proven at large scale or on actual radioactive waste. ☐ MED The baseline technical solution has been demonstrated at large scale but not implemented in radioactive operations. ☐ LOW The baseline technical solution has been implemented at Hanford.
Cost Information		
17A*	***Current Baseline Cost:*** $	
17B	***Estimated Cost Impact:*** $	
18*	***Cost Impact Explanation:*** TBD	
Risk Information		
37 new	***Risk Identifier:*** ☐ CR- [e.g., CR-047] ☐ New ***Risk Statement:*** *TBD*	
12B	***Risk Narrative:*** *[further explanation, if warranted]*	
Schedule Information		
21	***Regulatory Drivers:***	
22*	***Milestones:***	
28*	***Earliest Date Required:*** *[month, year]*	
29*	***Latest Date Required:*** *[month, year]*	
13B	***Schedule Explanation:*** TBD	
30	***Technology Insertion Point:*** ☐ New ☐ Existing _____ Code: _____ Official Date:	
Additional Points of Contact (POC)		
34	***Contractor End User POCs:*** Kathleen Tollefson, CH2M HILL, 509-373-9120, Fax: 509-373-7606, kathleen_s_tollefson@rl.gov	
35	***DOE End User POCs:*** *[name, organization, telephone, fax, email]*	
36*	***Other Contacts:*** *[name, organization, telephone, fax, email]*	

Office of River Protection
Technology Opportunity Statement

General Reference Information	**ACTIVE**
2*	***Assigned Tracking Number:*** WT133
1*	***Title:*** Improved DST Integrity NDE Tools: Electromagnetic Acoustic Transducer (EMAT)
3*	***Summary:*** The current Ultrasonic Testing NDE method is slow: only 1% of the tank surface is covered in 4 months at a cost of $600K. The small fraction of the surface may lead to representativity concerns. EMAT would be a complementary technique to rapidly screen larger surfaces (10-12%) and identify areas of primary concern, and would allow to access rough surfaces. This Technical Opportunity Statement addresses Tough Technical Problem # 18: Need for DST tank integrity inspection higher up in the tank than CH2M HILL has done previously, as CH2M HILL plans to fill the DSTs to the curvature leading into the dome. The need is for ultrasonic scan and/or other inspection tools. POC is Jim Honeyman. This Technical Opportunity Statement addresses Tough Technical Problem #23: Potential improvements for ultrasonic testing of DST knuckles, POC is Doug Larsen.
38new	***Principal Contact:*** Jim Castleberry, CH2M HILL, 509-373-5011, Fax: 509-373-7606, jim_l_castleberry@rl.gov
Technology Opportunity Description	
8A*	***Project:*** ☐ Safe Storage – Operations and Maintenance X Safe Storage – Life Extension ☐ Waste Retrieval and Transfer – Waste Inventory Properties ☐ Waste Retrieval and Transfer – Equipment ☐ Closure ☐ Disposal
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW03 Work Breakdown Structure (WBS) No.: 5.7.2
12A	***Problem Description:*** The current Ultrasonic Testing NDE method is slow: only 1% of the tank surface is covered in 4 months at a cost of $600K. The small fraction of the surface may lead to representativity concerns. EMAT would be a complementary technique to rapidly screen larger surfaces (10-12%) and identify areas of primary concern, and would allow to access rough surfaces. EMAT could complete a tank inspection in about one week. Funding is needed to implement. *Note: The Center for Nondestructive Evaluation at Iowa State University was awarded EM-50 funds in FY03 for NDE demonstration at Hanford.*

9*	***Priority:*** X HIGH Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction ☐ MEDIUM Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction ☐ LOW Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation		
9*	***Priority:***		
	Schedule Impact	☒ HIGH ☐ MED ☐ LOW	Needed to meet PBIs Needed to meet mission targets (2033 closure) Can improve mission targets or no schedule impact
	Cost Savings	☐ HIGH ☒ MED ☐ LOW	>$1B total life-cycle savings >$100M but <$1B total life-cycle savings <$100M total life-cycle savings
	Implementation Cost/Schedule	☒ HIGH ☐ MED ☐ LOW	<$10M and <2 yrs. >$10M and <2 yrs or <$10M and > 2 yrs. >$10M and > 2yrs. or significant technical risk
	Baseline Risk Reduction	☒ HIGH The baseline technical solution has not been proven at large scale or on actual radioactive waste. ☐ MED The baseline technical solution has been demonstrated at large scale but not implemented in radioactive operations. ☐ LOW The baseline technical solution has been implemented at Hanford.	
Cost Information			
17A*	***Current Baseline Cost:*** $ The EMAT is a scanning tool covers more surface area and alerts CH2M HILL to problem areas. It would require $1 million to deploy it in a tank.		
17B	***Estimated Cost Impact:*** $		
18*	***Cost Impact Explanation:*** $1M to develop the technology and make ready for deployment; Lifecycle: $0.1M increase cost for UT examination, 3/UT examinations per year for the life the DST's Potential cost avoidance/saving not quantified.		
Risk Information			
37 new	***Risk Identifier:*** ☒ CR- RPP-CR-014, CR-070A ☐ New ***Risk Statement:*** If NDE tools that cover larger surfaces of the DSTs are not implemented, then the representativity of the measurement may be questionable. If a DST fails before the end of the RPP mission, then a tank space shortfall may occur (Technical Risk List) DST integrity and space saving initiatives must be successful to avoid replanning of the TFC baseline strategy (including possible tank sequencing adjustments and potential construction of new tanks) and support accomplishment of accelerated cleanup initiatives.		
12B	***Risk Narrative:*** *[further explanation, if warranted]*		

Schedule Information	
21	***Regulatory Drivers:*** Completion of the physical examinations of the DSTs is required by WAC commitment and as a prerequisite for obtaining Resource Conservation and Recovery Act (RCRA) B permit status for continued operation of the DST system. Washington Administrative Code 173-303-640(2)(c)(v) requires a physical examination or leak test as a part of an integrity assessment program.
22*	***Milestones:***
28*	***Earliest Date Required:*** *[month, year]*
29*	***Latest Date Required:*** *[month, year]*
13B	***Schedule Explanation:*** This will be put into operation as soon as available, and will be beneficial until the end of the Safe Storage function.
30	***Technology Insertion Point:*** ☐ New ☐ Existing Code: _____ Official Date: _____
Additional Points of Contact (POC)	
34	***Contractor End User POCs:*** Jim Castleberry, CH2M HILL, (509) 373-5011, Fax: 509-373-7606 Jim_l_castleberry@rl.gov; Gary Duncan, CH2M HILL (509) 376-6008, F (509) 372-0065, gary_p_duncan@rl.gov; C.E. (Chris) Jensen, CH2M HILL, (509) 373-5058, chris_e_jensen@rl.gov; Wes Bryan CH2M HILL (509) 373-9740, F (509) 3720065, wes_bryan@rl.gov
35	***DOE End User POCs:*** Vic Callahan, (509) 373-9880, victor_l_callahan@rl.gov
36*	***Other Contacts:*** Jim Honeyman, CH2M HILL, (509) 376-740; james_o_jim_honeyman@rl.gov; Doug Larsen, CH2M HILL, (509) 373-5995, douglas_c_larsen@rl.gov

Office of River Protection
Technology Opportunity Statement

General Reference Information		ACTIVE
2*	***Assigned Tracking Number:*** WT134	
1*	***Title:*** DST Instrument Gauge Upgrades	
3*	***Summary:*** The upcoming AZ Tank Farm Upgrades, and subsequent tank farm upgrades, will offer opportunities for implementing enhanced systems, as opposed to like-for-like replacements of older generation systems. Systems to be upgraded include leak detectors, liquid level gauges, etc. The generation of Functions and Requirements in FY03 will allow better definition of these opportunities.	
38new	***Principal Contact:*** Kathleen Tollefson, CH2M HILL, 509-373-9120, Fax: 509-373-7606 kathleen_s_tollefson@rl.gov	
Technology Opportunity Description		
8A*	***Project:*** ☐ Safe Storage – Operations and Maintenance X Safe Storage – Life Extension ☐ Waste Retrieval and Transfer – Waste Inventory Properties ☐ Waste Retrieval and Transfer – Equipment ☐ Closure ☐ Disposal	
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW03 Work Breakdown Structure (WBS) No.: 5.7.2	
12A	***Problem Description:***	
9* old	***Priority:*** ☐ HIGH Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction X MEDIUM Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction ☐ LOW Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation	
9* new	***Priority***	
	Schedule Impact	☐ HIGH Needed to meet PBIs ☒ MED Needed to meet mission targets (2033 closure) ☐ LOW Can improve mission targets or no schedule impact
	Cost Savings	☐ HIGH >$1B total life-cycle savings ☐ MED >$100M but <$1B total life-cycle savings ☒ LOW $100M total life-cycle savings
	Implementation Cost/Schedule	☒ HIGH <$10M and <2 yrs. ☐ MED >$10M and <2 yrs or <$10M and > 2 yrs. ☐ LOW >$10M and > 2yrs. or significant technical risk

	Baseline Risk Reduction	☐ HIGH The baseline technical solution has not been proven at large scale or on actual radioactive waste. ☒ MED The baseline technical solution has been demonstrated at large scale but not implemented in radioactive operations. ☐ LOW The baseline technical solution has been implemented at Hanford.
Cost Information		
17A*	***Current Baseline Cost:*** $	
17B	***Estimated Cost Impact:*** $	
18*	***Cost Impact Explanation:*** TBD	
Risk Information		
37 new	***Risk Identifier:*** ☒ *RPP-CR-014, CR-070A* ☐ *New* ***Risk Statement:*** DST integrity and space saving initiatives must be successful to avoid replanning of the TFC baseline strategy (including possible tank sequencing adjustments and potential construction of new tanks) and support accomplishment of accelerated cleanup initiatives.	
12B	***Risk Narrative:*** *[further explanation, if warranted]*	
Schedule Information		
21	***Regulatory Drivers:***	
22*	***Milestones:***	
28*	***Earliest Date Required:*** *[month, year]*	
29*	***Latest Date Required:*** *[month, year]*	
13B	***Schedule Explanation:*** Upgrades will take place from FY03 until FY08	
30	***Technology Insertion Point:*** ☐ New ☐ Existing Code: Official Date:	
Additional Points of Contact (POC)		
34	***Contractor End User POCs:*** Kathleen Tollefson, CH2M HILL, 509-373-9120, Fax: 509-373-7606 kathleen_s_tollefson@rl.gov	
35	***DOE End User POCs:*** *[name, organization, telephone, fax, email]*	
36*	***Other Contacts:*** *[name, organization, telephone, fax, email]*	

Office of River Protection
Technology Opportunity Statement

General Reference Information		CLOSED FOR SSTs/DEFERRED FOR DSTs
2*	***Assigned Tracking Number:*** WT135	
1*	***Title:*** Response to Potential Line Leak	
3*	***Summary:*** Cost effective leak detection methods must be able to detect, quantify, and locate waste leakage from waste transfer lines quickly to minimize the impact to the environment. Approaches must be readily available to allow operations to continue. This opportunity may also support RL-WT026 / RL-WT027 and RL-WT-106, DST Transfer Piping NDE Tools.	
38new	***Principal Contact:*** Warren Thompson, CH2M HILL, 509-372-8053, Fax: 509-373-4095, warren_t_thompson@rl.gov	
Technology Opportunity Description		
8A*	***Project:*** ☐ Safe Storage – Operations and Maintenance ☐ Safe Storage – Life Extension ☐ Waste Retrieval and Transfer – Waste Inventory Properties X Waste Retrieval and Transfer – Equipment ☐ Closure ☐ Disposal	
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW04 Work Breakdown Structure (WBS) No.: 5.08.02 (primary), 5.08.05 (secondary)	
12A	***Problem Description:*** NEED INFO	
9a*	***Priority:*** ☐ HIGH Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction X MEDIUM Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction ☐ LOW Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation	
9b	***Prioirity***	

	Schedule Impact	☐ HIGH ☐ MED ☐ LOW	Needed to meet PBIs Needed to meet mission targets (2033 closure) no schedule impact or can improve mission targets (<2033 closure).
	Cost Savings	☐ HIGH ☐ MED ☐ LOW	>$1B total life-cycle savings >$100M but <$1B total life-cycle savings <$100M total life-cycle savings
	Implementation Cost/Schedule	☐ HIGH ☐ MED ☐ LOW	<$10M and <2 yrs. >$10M and <2 yrs or <$10M and > 2 yrs. >$10M and > 2yrs. or significant technical risk

	Baseline Risk Reduction	☐ HIGH ☐ MED ☐ LOW	The baseline technical solution has not been proven at large scale or on actual radioactive waste. The baseline technical solution has been demonstrated at large scale but not implemented in radioactive operations. The baseline technical solution has been implemented at Hanford.
Cost Information			
17A*	***Current Baseline Cost:*** $		
17B	***Estimated Cost Impact:*** $		
18*	***Cost Impact Explanation:*** Costs of delays and costs of cleanup are likely to dominate.		
Risk Information			
37 new	***Risk Identifier:*** ☐ CR-_____ [e.g., CR-047] ☐ New ***Risk Statement:*** If an existing underground transfer line begins to leak, there is likely to be a significant delay before an alternate transfer line is available to continue the desired waste transfer. 40 CFR 265.196 (e) and WAC 173-303-640 (7) (e) requires that a direct buried leaking transfer line be repaired and equipped with secondary containment before it can be returned to service. There are also the likely costs of cleanup.		
12B	***Risk Narrative:*** *[further explanation, if warranted]*		
Schedule Information			
21	***Regulatory Drivers:*** 40 CFR 265.193, 40 CFR 265.196, WAC 173-303-640 (4), WAC 173-303-640 (7)		
22*	***Milestones:*** DST System Integrity Assessment Report, 3/31/2006		
28*	***Earliest Date Required:*** *[month, year]*		
29*	***Latest Date Required:*** *[month, year]*		
13B	***Schedule Explanation:***		
30	***Technology Insertion Point:*** ☐ New ☐ Existing Code: Official Date: TPA and PBI milestones are in place for Interim Stabilization and certain SST retrievals in the next few years. CH2M HILL has a goal of 40 tanks being retrieved and interim closed by 9/30/2006 (PBI-3). CH2M HILL has a goal of retrieval and processing TRU and LLW waste by 9/30/06 (PBI-4). Generally, milestones for waste feed delivery to the Waste Treatment Plant begin in the 2006-2007 timeframe and DST transfers and other SST retrievals continue at least until 2018. All of these transfers will be through new or existing underground transfer lines or through above ground hose-in-hose lines. To meet the requirements of 40 CFR 265 and WAC 173-303-640, leak detection methods must be in-place for all transfers.		
Additional Points of Contact (POC)			
34	***Contractor End User POCs:*** *[name, organization, telephone, fax, email]*		
35	***DOE End User POCs:*** *[name, organization, telephone, fax, email]*		
36*	***Other Contacts:*** *[name, organization, telephone, fax, email]*		

Office of River Protection

Technology Opportunity Statement

General Reference Information	INACTIVE
2*	***Assigned Tracking Number:*** WT136
1*	***Title:*** Installation of New Risers in SSTs (Single Shell Tanks)
3*	***Summary:*** Retrieval equipment may require 32" risers in more SSTs. For closure activity support, new smaller diameter risers (8-12 inch dia.) positioned around the perimeter of the tank to optimize grout placement could be less expensive than removing equipment to gain access for tank fill, would allow relaxing constructability requirements (flow distance) for grout fill design, and would promote displacement of residual waste towards center of tank for improved long term performance, similar to strategy employed at SRS and INEL. This includes tough technical problems #5 for a simple way to quickly and efficiently install a new riser in an existing SST, and #6 for a means for installing fill-holes in the tanks for quick and dirty filling of tanks after retrieval is complete.
38new	***Principal Contact:*** John Schofield, CH2M HILL, 509-373-2245, Fax: 509-372-2862, John_S_Schofield@rl.gov
Technology Opportunity Description	
8A*	***Project:*** ☐ Safe Storage – Operations and Maintenance ☐ Safe Storage – Life Extension ☐ Waste Retrieval and Transfer – Waste Inventory Properties X Waste Retrieval and Transfer – Equipment X Closure ☐ Disposal
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW04 Work Breakdown Structure (WBS) No.: 5.08.05
12A	***Problem Description:*** Risers penetrating the tank domes provide access to the tanks. Existing risers vary in diameter from 4 inches to 42 inches. For 4 of 5 tanks scheduled for closure in FY04 (C-106 and C-200s), equipment removal to permit access for tank fill is required and planned. Potential access problems for other tanks scheduled for interim closure in FY04-FY06 have not been evaluated. Availability of new riser technology by the end of FY04 would enhance ability to meet PBI-3 interim tank closure schedule for most of the 26-40 tanks scheduled for closure by the end of FY06. Tanks T-110 and T-111 are candidate tanks for additional risers to enable the LLW and TRU respectively to be retrieved with planned retrieval systems.
9a*	***Priority:*** X HIGH Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction ☐ MEDIUM Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction ☐ LOW Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation

9b	***Priority***		
	Schedule Impact	☐ HIGH ☐ MED ☐ LOW	Needed to meet PBIs Needed to meet mission targets (2033 closure) no schedule impact or can improve mission targets (<2033 closure).
	Cost Savings	☐ HIGH ☐ MED ☐ LOW	>$1B total life-cycle savings >$100M but <$1B total life-cycle savings <$100M total life-cycle savings
	Implementation Cost/Schedule	☐ HIGH ☐ MED ☐ LOW	<$10M and <2 yrs. >$10M and <2 yrs or <$10M and > 2 yrs. >$10M and > 2yrs. or significant technical risk
	Baseline Risk Reduction	☐ HIGH ☐ MED ☐ LOW	The baseline technical solution has not been proven at large scale or on actual radioactive waste. The baseline technical solution has been demonstrated at large scale but not implemented in radioactive operations. The baseline technical solution has been implemented at Hanford.
Cost Information			
17A*	***Current Baseline Cost:*** $		
17B	***Estimated Cost Impact:*** $		
18*	***Cost Impact Explanation:*** The draft engineering study prepared by Columbia Energy & Environmental Services (CEES-0034) shows cost of new risers is less than the cost of equipment removal.		
Risk Information			
37 new	***Risk Identifier:*** ☐ CR-_____ [e.g., CR-047] ☐ New ***Risk Statement:*** If retrieval equipment requires larger risers than exist in some SSTs, then new, larger risers (e.g., 32") will need to be installed in these tanks. For closure activities without new risers, placement conditions are prone to be different tank-by-tank, making it difficult to develop one-size-fits-all grout mix formulation. Removal of equipment to permit access is costly, and may involve higher worker exposure than a controlled method for installation of new risers.		
12B	***Risk Narrative:*** New riser construction for tank fill access is evaluated in draft engineering study CEES-0034. New riser construction may impose new Authorization Basis concerns, including potential reduction in dome-loading capacity due to cutting rebar. These concerns may be addressed by a structural analysis.		
Schedule Information			
21	***Regulatory Drivers:*** TPA for retrieval of all single shell tanks in 2018		
22*	***Milestones:*** Current plans call for retrieval and interim closure of up to 40 tanks by 9/30/06. TPA milestone to retrieve all single shell tanks in 2018		
28*	***Earliest Date Required:*** 2004 for T-110 and T-111 retrievals. Interim closure activities will commence in late FY03.		
29*	***Latest Date Required:*** 2017 for retrieval of SSTs and 2023 for closure of SSTs		
13B	***Schedule Explanation:*** T-110 and T-111are two tanks that are likely candidates for needing new		

	risers to permit retrieval of tank contents. Retrieval is scheduled for 2005 for these tanks. Retrieval of waste from SSTs is scheduled to be complete in 2018, and closure of SSTs by 2024.
30	***Technology Insertion Point:*** ☐ New ☐ Existing Code: Official Date:
Additional Points of Contact (POC)	
34	***Contractor End User POCs:*** Terry Hissong, CH2M HILL 509-372-0677, Fax 509-373-9093; t_l_terry_hissong@rl.gov
35	***DOE End User POCs:*** Roger Quintero, DOE-ORP, 509-373-0421, Fax: 509-373-1313, roger_a_quintero@rl.gov
36*	***Other Contacts:*** Julian Laurenz, CH2M HILL 509-372-9301, Fax: 509-372-9292, julian_e_laurenz@rl.gov

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Office of River Protection
Technology Opportunity Statement

General Reference Information	**INACTIVE**
2*	***Assigned Tracking Number*:** WT137
1*	***Title*:** Removal/Decontamination of In-Tank Equipment
3*	***Summary:*** Current method of disposal is to flush, cut-up and grout in boxes, and weld shut. Handling and disposal costs are high. This includes tough technical problem #13, which is a simple way to assay equipment planned to be removed from a tank prior to its removal. Currently, we get the item pulled, put into a burial box, then assayed.
38new	***Principal Contact:*** Warren Thompson, CH2M HILL, 509-372-8053, Fax 509-373-4095 warren_t_thompson@rl.gov
Technology Opportunity Description	
8A*	***Project:*** ☐ Safe Storage – Operations and Maintenance ☐ Safe Storage – Life Extension ☐ Waste Retrieval and Transfer – Waste Inventory Properties X Waste Retrieval and Transfer – Equipment ☐ Closure ☐ Disposal
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW04 Work Breakdown Structure (WBS) No.: 5.08.05
12A	***Problem Description:*** NEED INFO
9A	***Priority:*** ☐ HIGH Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction ☐ MEDIUM Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction X LOW Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation

9B	***Priority Matrix:***		
	Schedule Impact	☐ HIGH ☐ MED X LOW	Needed to meet PBIs Needed to meet mission targets (2033 closure) No schedule impact or can improve mission targets (<2033 closure).
	Cost Savings	☐ HIGH ☐ MED X LOW	>$1B total life-cycle savings >$100M but <$1B total life-cycle savings <$100M total life-cycle savings
	Implementation Cost/Schedule	☐ HIGH ☐ MED X LOW	<$10M and <2 yrs. >$10M and <2 yrs or <$10M and > 2 yrs. >$10M and > 2yrs. or significant technical risk
	Baseline Risk Reduction	☐ HIGH ☐ MED X LOW	The baseline technical solution has not been proven at large scale or on actual radioactive waste. The baseline technical solution has been demonstrated at large scale but not implemented in radioactive operations. The baseline technical solution has been implemented at Hanford.
Cost Information			
17A*	***Current Baseline Cost:*** $		
17B	***Estimated Cost Impact:*** $		
18*	***Cost Impact Explanation:*** Improvements to approaches to removal/decontamination and disposal of long-length contaminated equipment are needed to reduce handling and disposal costs.		
Risk Information			
37 new	***Risk Identifier:*** ☐ CR-_____ [e.g., CR-047] ☐ New ***Risk Statement:*** If contaminated equipment needs to be removed and decontaminated to permit required DST upgrades for Waste Feed Delivery and to achieve SST retrieval criteria, then cost effective approaches need to be available		
12B	***Risk Narrative:*** *[further explanation, if warranted]*		
Schedule Information			
21	***Regulatory Drivers:***		
22*	***Milestones:***		
28*	***Earliest Date Required:*** *[month, year]*		
29*	***Latest Date Required:*** *[month, year]*		
13B	***Schedule Explanation:***		
30	***Technology Insertion Point:*** ☐ New ☐ Existing Code: Official Date: PBI-2 identifies the Phase I upgrades in the AY/AZ/AW Tank Farms and AN Tank Farm Upgrades needing to be done by 9/30/03. Additional completions will be identified in the Waste Feed Delivery Project Implementation Plan (IP).		

Additional Points of Contact (POC)	
34	***Contractor End User POCs:*** Warren Thompson, CH2M HILL, 509-372-8053, Fax: 509-373-4095 warren_t_thompson@rl.gov
35	***DOE End User POCs:*** C. S. (Cathy) Louie, DOE-ORP, 509-376-6834, F/509-373-0628, catherine_s_louie@rl.gov
36*	***Other Contacts:*** *[name, organization, telephone, fax, email]*

Office of River Protection
Technology Opportunity Statement

General Reference Information	**ACTIVE**
2*	***Assigned Tracking Number:*** WT138
1*	***Title:*** Physical Behavior of Sludge Wastes
3*	***Summary:*** Provide additional physical, and hydrodynamic information to guide the retrieval and delivery of Hanford tank sludge wastes. This includes tough technical problem #3 for pumping slurries. Up to the present, we have focused on pumping liquids and brines; soon we will also be pumping slurries. (Ralph Wilson)
38new	***Principal Contact:*** Larry Julyk, CH2M HILL, 509-376-4608, F/509-372-1608, larry_j_julyk@rl.gov
Technology Opportunity Description	
8A*	***Project:*** ☐ Safe Storage – Operations and Maintenance ☐ Safe Storage – Life Extension ☒ Waste Retrieval and Transfer – Waste Inventory Properties ☐ Waste Retrieval and Transfer – Equipment ☐ Closure ☐ Disposal
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW04 Work Breakdown Structure (WBS) No.: 5.8.2
12A	***Problem Description:*** Waste slurries must be transported and treated with minimum cost and delay. To this end, the transfer and treatment equipment must be designed correctly, and the operating plans must be accurate. Successful design and operation both rely on accurate knowledge of the physical properties of the wastes to be treated. DNFSB "reported" that CH2M HILL current design basis was insufficient and that additional information on particle size and density was necessary to justify the design pressure. The concern mainly arises over the size and density of large particles that are most likely to settle and cause "plugging". **Needs related to physical properties of sludge:** Information about the physical properties of sludge wastes is incomplete. Knowledge of particle size distribution and particle density is required for the design of waste transfer systems (pipes and pumps) and to determine whether transfers of slurries can be completed as planned. Although some particle size distribution measurements have been made, the densities of the particles in the wastes are unknown. Furthermore, the role of particle agglomeration is only beginning to come to light. Quantitative information about the effect of turbulence, ionic strength, temperature, and other processing variables on agglomeration would be useful in designing and performing slurry transfers. The information could also be used in the future to select tank cleanup methods, including high velocity fluid shear-based technologies, for example. **Needs related to sludge transport:** Additional work is advisable to determine the transportability of Hanford sludge wastes. The model used to estimate the required transport

velocity and to predict the head pressure that will be developed has been adapted from other industries and has not been qualified on Hanford slurries. Tests to demonstrate the minimum required transport velocity for Hanford slurries would be beneficial. The transport model should be extended to incorporate theory associated with agglomeration and de-agglomeration.

In FY2003 CH2M Hill convened a Slurry Transport Expert Panel (STEP) as a means to address DNFSB concerns. The expert panel prepared a list of 18 recommendations to improve the pipeline design and procedures to assure that plugging didn't occur. RPP-13651 is the final report of the expert panel. An action plan to address the panel's recommendations was prepared and submitted to ORP.

Despite pipeline plugging over many years at Hanford, the technologies for removing plugs are still not well developed. Although it should be possible, through adequate planning, to avoid plugging of lines during delivery of the wastes to the waste treatment plant, having reliable methods for removing sediments from pipelines can benefit the projects by reducing the need for excessive conservatism. Additional and advanced technologies for unplugging pipelines should be demonstrated and characterized to improve overall project efficiency.

Similar needs: WT-126 addresses development of pipeline unplugging and plug location technology.

9A ***Priority:***

☐ HIGH Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction

☒ MEDIUM Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction

☐ LOW Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation

9B ***Priority Matrix:***

Schedule Impact	☐ HIGH X MED ☐ LOW	Needed to meet PBIs Needed to meet mission targets (2033 closure) no schedule impact or can improve mission targets (<2033 closure).
Cost Savings	☐ HIGH ☐ MED X LOW	>$1B total life-cycle savings >$100M but <$1B total life-cycle savings <$100M total life-cycle savings
Implementation Cost/Schedule	X HIGH ☐ MED ☐ LOW	<$10M and <2 yrs. >$10M and <2 yrs or <$10M and > 2 yrs. >$10M and > 2yrs. or significant technical risk
Baseline Risk Reduction	X HIGH ☐ MED ☐ LOW	*The baseline technical solution has not been proven at large scale or on actual radioactive waste.* The baseline technical solution has been demonstrated at large scale but not implemented in radioactive operations. The baseline technical solution has been implemented at Hanford.

Cost Information

17A* ***Current Baseline Cost:*** $no costs assumed for pluggage.

17B ***Estimated Cost Impact:*** Pluggage avoidance: $48M ($2M/yr for 2005-2028)

18*	***Cost Impact Explanation:*** The pluggage avoidance estimate is based on an estimate of two plugs per year and an estimate of $1M to remove the plug and recover from its effects. This does not include additional costs that that could be incurred to schedule slippage. The number of plugs that occur each year is extremely variable, depending on the types of operations being conducted and the frequency of each (experience factor).
Risk Information	
37 new	***Risk Identifier:*** ☐ CR-131, 323, 624a ***Risk Statement:*** If all of the credible potential plugging scenarios are not sufficiently mitigated then over-conservative transfer designs must be assumed to assure that lines do not plug. If the waste chemistry or properties are different than planned, then new safety analysis and systems may be required. If lines plug then the line will not be available to support the WFD mission.
12B	***Risk Narrative:*** DNFSB "reported" that CH2M HILL current design basis was insufficient and that additional information on particle size and density was necessary to justify the design pressure. The concern mainly arises over the size and density of large particles that are most likely to settle and cause "plugging".
Schedule Information	
21	***Regulatory Drivers:*** Tri-Party Agreement (waste feed delivery); DNFSB Sept. 2002 letter to EM-1
22*	***Milestones:*** Supports technical basis of TPA milestone M-45-02 "Submit annual updates to SST retrieval sequence document," due at the end of each fiscal year.
28*	***Earliest Date Required:*** 2003
29*	***Latest Date Required:*** 2020
13B	***Schedule Explanation:***
30	***Technology Insertion Point:*** ☐ New ☐ Existing Code: _____ Official Date: _____
Additional Points of Contact (POC)	
34	***Contractor End User POCs:*** Mark Knight, CH2M HILL, 509-373-1199, F/509-372-1608, mark_a_knight@rl.gov D.A. (Dan) Reynolds, CH2M HILL, 509-373-3115, F/509-373-4641 daniel_a_reynolds@rl.gov
35	***DOE End User POCs:*** James F. Thompson, Jr, Office of River Protection, (509) 373-9757, james_f_jr_thompson@rl.gov; Roger Quintero, DOE-ORP, 509-373-0421, Fax: 509-373-1313, roger_a_quintero@rl.gov
36*	***Other Contacts:*** K.A. (Ken) Gasper, CH2M HILL, 509-373-1948, fax 509-373-9093, kenneth_a_ken_gasper@rl.gov N.W. (Nicholas) Kirch, CH2M HILL, 509-373-2380, fax 509-372-0065, nicholas_w_kirch@rl.gov

Office of River Protection
Technology Opportunity Statement

General Reference Information	**ACTIVE**
2*	***Assigned Tracking Number:*** WT139
1*	***Title:*** Best-Basis Inventory Improvements
3*	***Summary:*** This opportunity reflects benefits and actions to improve the accuracy and quality of the Best Basis Inventory. Opportunities for improvement and specific actions were identified during October 2001 and March2002 BBI workshops. The BBI system was also reviewed by a CH2M Hill self assessment team and by ORP in FY'03. The ORP review identified four "Findings" and ten "Observations". The "Findings" were judged to be fixable and resolution of the "Findings" required before ORP would approve the Documented Safety Analysis (DSA). The "Findings" have been entered into the corrective actions management system
38new	***Principal Contact:*** Jim Field, CH2M HILL 509-376-3753, F (509) 373-4641, Jim_G_Field@rl.gov
Technology Opportunity Description	
8A*	***Project:*** ☐ Safe Storage – Operations and Maintenance ☐ Safe Storage – Life Extension X Waste Retrieval and Transfer – Waste Inventory Properties ☐ Waste Retrieval and Transfer – Equipment ☐ Closure ☐ Disposal
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW04 Work Breakdown Structure (WBS) No.: 5.8.2 and 5.8.5
12A	***Problem Description:*** The Best Basis Inventory (BBI) is used to estimate the amount and composition of radioactive waste in the tanks. The inventory for some tanks is based upon significant sampling, but the inventory of other tanks is based upon process history and a model to predict the composition of waste types in the tanks. For tanks without significant sample characterization the potential errors in estimated inventory can be significant. The BBI is also used to track inventory changes from inter-tank transfers so errors in tank inventory can arise even for tanks with significant sample history as retrieval and closure operations transfer contents throughout the tank farms. Four activities have been identified to improve the BBI: 1. Define levels of uncertainty in current BBI 2. Improve Hanford Defined Waste (HDW) model estimates to incorporate revised global radionuclide inventory estimates and improve estimates for partitioning of species during plant and tank farm operations. 3. Optimize BBI work process 4. Incorporate ICD and others A FY'03 ORP assessment of the BBI identified the following four "Findings" of deficiency: • Estimation of bounding source term for DSA based on current BBI values is incomplete • Inadequate interface definition and control between BBI generator and end-users • Processes for derivation of templates and adjustment of data were not clearly described. • BBI application data and tools were not maintained as "record material".

	Resolutions to these findings have been nearly completed as of 4th qtr. FY'03.
9A	***Overall Priority:*** X HIGH Large cost benefit, short-term implementation needed to achieve benefits, easy to implement, high-risk reduction. Potential HIGH benefit if BBI improvements result in less sampling or cost reductions in WTP design or operation. ☐ MEDIUM Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction ☐ LOW Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation
9B	***Priority Matrix:***

Schedule Impact	☐ HIGH ☐ MED X LOW	Needed to meet PBIs Needed to meet mission targets (2033 closure) no schedule impact or can improve mission targets (<2033 closure).
Cost Savings	☐ HIGH X MED ☐ LOW	>$1B total life-cycle savings >$100M but <$1B total life-cycle savings <$100M total life-cycle savings
Implementation Cost/Schedule	X HIGH ☐ MED ☐ LOW	<$10M and <2 yrs. >$10M and <2 yrs or <$10M and > 2 yrs. >$10M and > 2yrs. or significant technical risk
Baseline Risk Reduction	☐ HIGH ☐ MED X LOW	*The baseline technical solution has not been proven at large scale or on actual radioactive waste.* The baseline technical solution has been demonstrated at large scale but not implemented in radioactive operations. The baseline technical solution has been implemented at Hanford.

Cost Information	
17A*	***Current Baseline Cost:*** The alternative to using BBI data for tank contents is to sample the tanks. Core samples are $750K-$1M per sample. The yearly cost to maintain and improve the BBI system and update the BBI inventory for 40 tanks per quarter is <$1.0M. Improving the HDW model is one of the costs to improve the system. The initiative includes updating the model using new information, and estimating HDW model uncertainty.
17B	***Estimated Cost Impact:*** $40M sampling costs avoided by 2007.
18*	***Cost Impact Explanation:*** Closure plans currently estimate that five samples will need to be withdrawn from each tank to ascertain its contents for closure. If BBI were more accurate then closure plans may proceed with fewer samples (3 or 4). At a cost of $1M/sample for forty tanks to be "interim" closed by 2007, BBI improvements could save $40M.

Risk Information	
37 new	***Risk Identifier:*** ☐ CR-_____ [e.g., CR-047] x New ***Risk Statement:*** If the BBI inventory is significantly off then waste feed may be out of specification and returned to the tank farm or the tank farm will have to increase sampling to ascertain feed composition. If the ORP BBI Assessment Findings are not resolved the Documented Safety Basis will not be approved.
12B	***Risk Narrative:***
Schedule Information	
21	***Regulatory Drivers: NA***
22*	***Milestones:*** NA
28*	***Earliest Date Required:*** 1/30/03 (Many actions already completed)
29*	***Latest Date Required:*** 2004 to support accelerated retrievals and tank interim closures.
13B	***Schedule Explanation:*** Inventory information used for planning and decision making for tank closure, waste feed delivery, waste treatment plant, interim stabilization and safety.
30	***Technology Insertion Point:*** ☐ New x Existing Code: Official Date:
Additional Points of Contact (POC)	
34	***Contractor End User POCs:*** Nick W. Kirch, CH2M HILL, 509-373-2380, F/509-376-1788, Nicholas_W_Nick_Kirch@rl.gov
35	***DOE End User POCs:*** Cathy Louie, DOE-ORP, 509-376-6834, Fax: 509-373-0628, catherine_s_louie@rl.gov
36*	***Other Contacts:*** K.A. (Ken) Gasper, CH2M HILL, 509-373-1948, FAX: 509-373-9093, kenneth_a_ken_gasper@rl.gov

Office of River Protection
Technology Opportunity Statement

General Reference Information	**ACTIVE**
2*	***Assigned Tracking Number:*** WT140
1*	***Title:*** Post-Closure Monitoring
3*	***Summary:*** Technology is needed to support post-closure monitoring of waste left in place, contamination in soils beneath RPP facilities, and better understanding of leach rates. DOE has issued post closure monitoring guidance for DOE Order 435.1. This is expected to apply to interim closure as well. Monitoring wells are $1 million per well including measurements. If requirements for post closure monitoring must be met with monitoring wells, the costs will be unacceptable.
38new	***Principal Contact:*** Fred Mann, CH2M HILL, 509-373-3978, Fax: 509-373-3974, Frederick_M_Mann@rl.gov; Frank Anderson, CH2M HILL, 509-373-3971, Fax: 509-373-3974, frank_j_anderson@rl.gov
Technology Opportunity Description	
8A*	***Project:*** ☐ Safe Storage – Operations and Maintenance ☐ Safe Storage – Life Extension ☐ Waste Retrieval and Transfer – Waste Inventory Properties ☐ Waste Retrieval and Transfer – Equipment X Closure ☐ Disposal
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW04 *Work Breakdown Structure (WBS) No.: 5.8.5*
12A	***Problem Description:*** From a SST retrieval and closure perspective, it will be difficult to demonstrate that retrieval goals and closure requirements are met without capabilities for cost effective post-closure monitoring. There are three distinct zones beneath the tanks that are of distinct interest: 0-20 feet, 20 - 80 feet, and 80 - 300 feet. In the first zone, penetrations will be by cone penetrometer or other direct push technology. Retrieved samples from the first zone will be obtained from excavation or from cone penetrometer pushes. Some of these non-gamma emitters can be inferred from analog measurements using electrical resistivity techniques. Electrical conductance or resistance can be monitored using tomographic methods to obtain three-dimensional images of the subsurface. Other methods, including more standard geophysical resistivity monitoring, might also be applicable and in some cases electromagnetic induction techniques might be deployable at selected waste sites (at areas of low metal content). Where even moderate salt concentrations slightly above background are present in the subsurface, these methods may prove to be reliable in capturing the shape and movement of the subsurface. Penetrations into the second zone will be done by cone penetrometer, new borehole, or existing steel-encased boreholes. The size of samples from the second zone will vary depending upon the method of retrieval (ranging from 50 grams to nearly continuous core up to 4 inches in diameter). Penetrations in the deepest zone can only be done with steel-encased boreholes. *There are* relatively few boreholes extend below 120 feet.

	Monitoring wells combined with periodic multi-spectral gamma logging surveys identify the presence of certain radionuclides that are high-energy gamma emitters, such as cobalt-60. Other radioactive contaminants, such as strontium-90 and uranium, are beta- and alpha particle emitters cannot be detected with surface remote detection because of matrix interference of the overlying soils.
9a*	***Priority:*** ☐ HIGH Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction ☐ MEDIUM Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction X LOW Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation
9b*	***Priorities***

Schedule Impact	☐ HIGH ☐ MED x LOW	Needed to meet PBIs Needed to meet mission targets (2033 closure) Can improve mission targets or no schedule impact
Cost Savings	☐ HIGH ☐ MED x LOW	>$1B total life-cycle savings >$100M but <$1B total life-cycle savings <$100M total life-cycle savings
Implementation Cost/Schedule	☐ HIGH x MED ☐ LOW	<$10M and <2 yrs. >$10M and <2 yrs or <$10M and > 2 yrs. >$10M and > 2yrs. or significant technical risk
Baseline Risk Reduction	☐ HIGH x MED ☐ LOW	The baseline technical solution has not been proven at large scale or on actual radioactive waste. The baseline technical solution has been demonstrated at large scale, but not implemented in radioactive operations. The baseline technical solution has been implemented at Hanford.

Cost Information	
17A*	***Current Baseline Cost:*** Borehole, cone penetrometer, cased wells and test pits are used to gain access to the subsurface. A sensitive hyper-pure germanium gamma detector adapted for borehole use gathers radiation spectrums as it is lowered through a casing. Soil samples from the drill cuttings are sent to laboratories for analyses. Monitoring wells are $1 million per well including measurements.
17B	***Estimated Cost Impact:*** $
18*	***Cost Impact Explanation:*** Substantial cost savings could result if site characterization activities can be performed without installing monitoring wells and the need to conduct full-suite laboratory analyses on soil samples.
Risk Information	
37 new	***Risk Identifier:*** ☐ CR-_____ [e.g., CR-047] ☐ New **Risk Statement:** If requirements for post closure monitoring must be met with monitoring wells, the costs will be unacceptable.

12B	***Risk Narrative:*** Continued use of current methods that includes costly boring, labor-intensive sampling, and laboratory analysis. From a SST retrieval and closure perspective, it will be difficult to demonstrate that retrieval goals and closure requirements are met without capabilities for cost effective post-closure monitoring.
Schedule Information	
21	***Regulatory***
22*	**Milestones**
28*	**Earliest Date Required:**
29*	**Latest Date Required:**
13B	***Schedule Explanation:*** PBI-3 requires interim closure of M-45 milestone (S-112, S-102, C-104), C-106, 4 low risk/volume, and additional high risk SSTs, individual tank farms, and 244-AR vault by 9/30/2006.
	Technology Insertion Point: ☐ New ☐ Existing Code: Official Date:
Additional Points of Contact (POC)	
34	***Contractor End User POCs:*** Ron Calmus, CH2M HILL, (509) 372-3385; F/509-372-2862; ronald_b_calmus@rl.gov
35	***DOE End User POCs:*** Bob Lober, ORP, (509) 373-7949, Robert_w_lober@rl.gov Rob Yasek, DOE-ORP, 509-372-1270, Fax: 509-373-9140, Robert_M_Yasek@rl.gov
36*	***Other Contacts:*** K.A. (Ken) Gasper, CH2M HILL, 509-373-1948, FAX: 509-373-9093, kenneth_a_ken_gasper@rl.gov

Office of River Protection
Technology Opportunity Statement

General Reference Information	**ACTIVE**
2*	***Assigned Tracking Number:*** WT141
1*	***Title:*** Development and Demonstration of Bulk Vitrification Treatment Technology
3*	***Summary:*** For DOE to meet its accelerated goals to complete retrieval and treatment of Hanford tank waste by 2028 the capacity of the Waste Treatment Plant (WTP) to treat waste must be supplemented. One approach to supplement the WTP capacity is to employ supplemental technologies to treat tank waste containing approximately 50,000 MT of sodium*. One potential supplemental technology to treat the waste is to immobilize pretreated (Cs and TRU solids removed) waste by means of bulk vitrification. Bulk vitrification is mature and several implementation options exist. Bulk vitrification is an in-container vitrification process where the container along with its content of vitrified waste can be disposed in a LAW burial ground. The process consists of drying the waste, a mixing step, and an in-container vitrification step. The drying unit blends process soil (silicates) with the waste and removes water through evaporation. The remaining process soil is then mixed with the evaporated soil/waste stream and delivered to the vitrification container. A temporary off-gas hood is placed over the container and electrodes inserted. Power is applied to the electrodes to melt the waste/soil mixture. After cooling, the resulting vitrified product is sent to a disposal site. *Sodium salts (primarily sodium nitrate, nitrite, carbonate, and hydroxide) make up the vast majority of material in the tank waste. Other cations are also in the waste including aluminum and potassium. The waste includes radionuclides, principally cesium-137, technetium-99, strontium-90, and transuranic elements. Other radionuclides will also be present at lower concentrations. The supplemental treatment will process all the other components (anions and cations) in the waste along with the sodium.
38new	***Principal Contact:*** Dennis Hamilton, CH2M HILL, (509) 376-2423; Fax (509) 376-6399, dennis_w_Hamilton@rl.gov
Technology Opportunity Description	
8A*	***Project:*** ☐ Safe Storage – Operations and Maintenance ☐ Safe Storage – Life Extension ☐ Waste Retrieval and Transfer – Waste Inventory Properties ☐ Waste Retrieval and Transfer – Equipment ☐ Closure ☐ Disposal X Supplemental Treatment
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW13 Work Breakdown Structure (WBS) No.: 5.9
12A	***Problem Description:*** Vitrification was selected from among many potential waste forms because it was considered to be a mature technology. However, a bulk vitrification process has not been used before for treating Hanford tank wastes, and a bulk vitrification process would differ in many respects from the joule-heated melter process that is used in the WTP. A number of issues have been identified that need testing data to make a final decision abut this process and

	waste form. Complete data to assess, demonstrate, and deploy bulk vitrification for supplemental treatment of SST requires three phases. Phase I—Laboratory data to establish the waste form performance. Retention of waste constituents – Primary constituents of concern include Tc, I, Cl, F, and S. Constituents in a vitrified waste form have very low diffusion rates, and constituent release is predominantly controlled by the dissolution rate of the vitrified material, which is highly dependent on leaching conditions. Waste loading – It is desirable to place as much of the solid waste mass as possible into the smallest volume of material. Waste loading is an important measure when tied to waste form performance in terms of constituent retention. Bulk Vitrification has scale-up issues, including Sulfur Partitioning – At large-scale, the effects of sulfur on off-gas composition and product quality need to be understood. The quantity and composition of sulfur released to the off-gas needs to be determined. Melt Homogeneity – Processing anomalies that do not exist at smaller scale may manifest themselves at larger scale. A sampling and analysis plan should be developed that will provide a level of confidence that all portions of the product pass the requisite leach tests. Off-Gas Treatment – Off-gas sampling should be planned to characterize and quantify the composition of the off-gas to collect pertinent design data for effective off-gas treatment and emissions abatement relative to permitting the field-scale process and developing the material balance and flow. A conceptual design of a vitrification facility is necessary to estimate the life-cycle costs of this Supplemental Treatment option for comparison to other options. Phase II—Full-scale hot demonstration— testing is necessary to establish parameters for full scale equipment design and also validate that the product performance matches the laboratory predictions. Phase III— Deployment - This phase completes final design, fabrication, and installation; provides for facility testing; and completes all readiness activities. This phase also includes integrated system testing that provides final validation that the process, product, and equipment will perform as expected and that also validates the bases for permitting and operation. This phase also involves a commissioning period by the design/build contractor to verify operational performance criteria.
9A*	***Priority:*** X HIGH Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction ☐ MEDIUM Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction ☐ LOW Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation
9B	**Priorities**

	Schedule Impact	X HIGH	Needed to meet PBIs
		☐ MED	Needed to meet mission targets (2033 closure)
		☐ LOW	Can improve mission targets or no schedule impact
	Cost Savings	X HIGH	>$1B total life-cycle savings
		☐ MED	>$100M but <$1B total life-cycle savings
		☐ LOW	<$100M total life-cycle savings
	Implementation Cost/Schedule	X HIGH	<$10M and <2 yrs.
		☐ MED	>$10M and <2 yrs or <$10M and > 2 yrs.
		☐ LOW	>$10M and > 2yrs. or significant technical risk
	Baseline Risk Reduction	☐ HIGH	The baseline technical solution has not been proven at large scale or on actual radioactive waste.
		X MED	The baseline technical solution has been demonstrated at large scale but not implemented in radioactive operations.
		☐ LOW	The baseline technical solution has been implemented at Hanford.

Cost Information	
17A*	***Current Baseline Cost:***
17B	***Estimated Cost Impact:***
18*	***Cost Impact Explanation:***
Risk Information	
37 new	***Risk Identifier:*** ☐ CR-_____ [e.g., CR-047] ☐ New ***Risk Statement:***
12B	***Risk Narrative:***
Schedule Information	
21	***Regulatory Drivers:*** 1/2005 submit LAW supplemental treatment technologies report to Ecology (TPA-M-62-08); 1/2006 submit final Hanford tank waste treatment baseline to Ecology (TPA-M-62-11) [both milestones per TPA Change Number M-62-03-02]
22*	***Milestones:*** 9/2006 supplemental treatment deployed and operating to treat at least 100,000 gallons of waste.
28*	**Earliest Date Required:** 8/2006 to deploy and process 100,000 gallons. Earlier deployment can process more
29*	**Latest Date Required:**
13B	***Schedule Explanation:*** The sooner supplemental technologies can be deployed and operated reduces the required throughput capacity.
U	***Technology Insertion Point:*** ☐ New ☐ Existing Code: _____ Official Date: _____ Technology Insertion Point(s): N/A

Additional Points of Contact (POC)	
34	***Contractor End User POCs:*** Rick Raymond, CH2M HILL, 509-372-8767, Fax: 509-376-6399, richard_e_raymond@rl.gov
35	***DOE End User POCs:*** B.M. (Billie) Mauss, ORP, 509-373-9876, F/509-372-2781, billie_m_mauss@rl.gov
36*	***Other Contacts:*** K.A. (Ken) Gasper, CH2M HILL, 509-373-1948, FAX: 509-373-9093, kenneth_a_ken_gasper@rl.gov

Office of River Protection
Technology Opportunity Statement

General Reference Information	**ACTIVE**
2*	***Assigned Tracking Number:*** WT142
1*	***Title:*** Cast Stone
3*	***Summary:*** For DOE to meet its accelerated goals to complete retrieval and treatment of Hanford tank waste by 2028 the capacity of the Waste Treatment Plant (WTP) to treat waste must be supplemented. One approach to supplement the WTP capacity is to employ supplemental technologies to treat tank waste containing approximately 36,000 MT of sodium*. One potential supplemental technology to treat the waste is to immobilize pretreated (Cs and TRU solids removed) waste as cast stone. Cast stone may be used for the primary waste or secondary waste immobilization. The cast stone process is mature and many formulation options exist. To determine whether cast stone is an environmentally acceptable and economic choice firm data on the constituent retention and waste loading must be established for salt cake waste from 68 SSTs. From there, the cost to implement the technology may be estimated from conceptual designs. Improvements to standard cementitious formulations are desirable to improve the waste loading and reduce the contaminant release. *Sodium salts (primarily sodium nitrate, nitrite, carbonate, and hydroxide) make up the vast majority of material in the tank waste. Other cations are also in the waste including aluminum and potassium. The waste includes radionuclides, principally cesium-137, technetium-99, strontium-90, and transuranic elements. Other radionuclides will also be present at lower concentrations. The supplemental treatment will process all the other components (anions and cations) in the waste along with the sodium.
38new	***Principal Contact:*** K.A. (Ken) Gasper, CH2M HILL, 509-373-1948, FAX: 509-373-9093, kenneth_a_ken_gasper@rl.gov
Technology Opportunity Description	
8A*	***Project:*** ☐ Safe Storage – Operations and Maintenance ☐ Safe Storage – Life Extension ☐ Waste Retrieval and Transfer – Waste Inventory Properties ☐ Waste Retrieval and Transfer – Equipment ☐ Closure ☐ Disposal X Supplemental Treatment
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW13 Work Breakdown Structure (WBS) No.: 5.09.02
12A	***Problem Description:*** Complete data to assess, demonstrate, and deploy the cast stone process for supplemental treatment of SST in two phases. Phase I—Laboratory data to establish the waste form performance. The waste form performance is mainly determined by the release rate of contaminants of concern (nitrate, nitrite, Cr, Tc, U, and I) and the waste loading. The waste loading is the major determinant on the amount of

	Immobilized Low Activity Waste (ILAW) product that will be disposed and hence the land area and cost for disposal. Testing on simulants should be satisfactory for the bulk of testing. However, the major contaminant of concern is Tc, for which no good surrogate exists. A suitable amount of simulant testing would have to include Tc (spiked) to quantify the release rates of Tc, especially if special Tc specific binders were included in the formulation to improve the retention of Tc. Some testing on actual waste samples will also be necessary to validate that the simulants represent actual waste behavior. The curing of the laboratory test samples needs to be controlled to represent the range of time/temperature conditions that would exist in a larger scale grout pour. For example, the center of the pour can reach high temperatures due to the heat release from hydration during the set, while the outer edges of the pour are near ambient conditions. Temperature and time-at-temperature can affect the hydration of the cast stone. A conceptual design of a cast stone facility is necessary to estimate the life-cycle costs of this Supplemental Treatment option for comparison to other options. Phase II—Full-scale hot demonstration— testing is necessary to establish parameters for full scale equipment design and also validate that the product performance matches the laboratory predictions. Phase III— Deployment - This phase completes final design, fabrication, and installation; provides for facility testing; and completes all readiness activities. This phase also includes integrated system testing that provides final validation that the process, product, and equipment will perform as expected and that also validates the bases for permitting and operation. This phase also involves a commissioning period by the design/build contractor to verify operational performance criteria.
9A*	***Priority:*** X HIGH — Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction ☐ MEDIUM — Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction ☐ LOW — Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation
9B	**Priorities**

Schedule Impact	X HIGH	Needed to meet PBIs
	☐ MED	Needed to meet mission targets (2033 closure)
	☐ LOW	Can improve mission targets or no schedule impact
Cost Savings	X HIGH	>$1B total life-cycle savings
	☐ MED	>$100M but <$1B total life-cycle savings
	☐ LOW	<$100M total life-cycle savings
Implementation Cost/Schedule	X HIGH	<$10M and <2 yrs.
	☐ MED	>$10M and <2 yrs or <$10M and > 2 yrs.
	☐ LOW	>$10M and > 2yrs. or significant technical risk

	Baseline Risk Reduction	☐ HIGH	*The baseline technical solution has not been proven at large scale or on actual radioactive waste.*
		X MED	The baseline technical solution has been demonstrated at large scale but not implemented in radioactive operations.
		☐ LOW	The baseline technical solution has been implemented at Hanford.
Cost Information			
17A*	***Current Baseline Cost:*** Costs to complete the Hanford waste treatment mission by 2028 include building a second WTP at a cost of ~$1billion.		
17B	***Estimated Cost Impact:*** $		
18*	***Cost Impact Explanation:*** CH2M HILL PBI impact--$800K for each 100,000 gallons of tank waste retrieved and processed as LAW.		
Risk Information			
37 new	***Risk Identifier:*** ☐ CR-_____ [e.g., CR-047] ☐ New ***Risk Statement:*** If alternative supplemental treatments cannot be developed and permitted ORP cannot complete its mission within TPA milestones without building a second WTP at enormous cost.		
12B	***Risk Narrative:***		
Schedule Information			
21	***Regulatory Drivers:*** 1/2005 submit LAW supplemental treatment technologies report to Ecology (TPA-M-62-08); 1/2006 submit final Hanford tank waste treatment baseline to Ecology (TPA-M-62-11) [both milestones per TPA Change Number M-62-03-02]		
22*	***Milestones:*** 9/2006 supplemental treatment deployed and operating to treat at least 100,000 gallons of waste.		
28*	***Earliest Date Required:*** 8/2006 to deploy and process 100,000 gallons. Earlier deployment can process more		
29*	***Latest Date Required:***		
13B	***Schedule Explanation:*** The sooner supplemental technologies can be deployed and operated reduces the required throughput capacity.		
30	***Technology Insertion Point:*** ☐ New ☐ Existing Code: _____ Official Date: _____		
Additional Points of Contact (POC)			
34	***Contractor End User POCs:*** Rick Raymond, CH2M HILL, 509-372-8767, Fax: 509-376-6399, richard_e_raymond@rl.gov		
35	***DOE End User POCs:*** B.M. (Billie) Mauss, ORP, 509-373-9876, F/509-372-2781, billie_m_mauss@rl.gov		
36*	***Other Contacts:*** K.A. (Ken) Gasper, CH2M HILL, 509-373-1948, FAX: 509-373-9093, kenneth_a_ken_gasper@rl.gov		

Office of River Protection
Technology Opportunity Statement

General Reference Information	**DEFERRED**
2*	***Assigned Tracking Number:*** WT143
1*	***Title:*** Tank Waste Denitration
3*	***Summary:*** For DOE to meet its accelerated goals to complete retrieval and treatment of Hanford tank waste by 2028 the capacity of the Waste Treatment Plant (WTP) to treat waste must be increased. One approach to increase the WTP capacity is to employ supplemental technologies to treat tank waste containing 15,000-25,000 MT of sodium*. The bulk of the sodium is as nitrate or nitrite, which are concerns for ground water protection. Some of the supplemental technology options such as bulk vitrification produce a waste form that no longer contains nitrate/nitrite, but creates an off-gas that may be high in NOx, which eventually (depending upon the gas treatment system) must be disposed as a secondary waste high in nitrate. Other supplemental technology options such as cast stone produce waste forms that are high in mobile nitrate. The other supplemental technology option, steam reforming, mainly reduces nitrate in the reactor to form nitrogen and the only NOx generated is due to incomplete reaction. Nitrate is a concern for ground water protection and regulators would much rather store a waste form that doesn't contain nitrate than try to protect the groundwater with engineering controls on the disposal site. A denitration technology that could reduce nitrate/nitrite w/o generating a similarly undesirable secondary waste would be a valuable technology addition to cast stone or even vitrification off-gas secondary wastes. *Sodium salts (primarily sodium nitrate, nitrite, carbonate, and hydroxide) make up the vast majority of material in the tank waste. Other cations are also in the waste including aluminum and potassium. The supplemental treatment will process all the other components (anions and cations) in the waste along with the sodium.
38new	***Principal Contact:*** Michael E. Johnson, CH2M HILL, 509-372-3628, Fax: 509-376-1788, michael_e_johnson@rl.gov
Technology Opportunity Description	
8A*	***Project:*** ☐ Safe Storage – Operations and Maintenance ☐ Safe Storage – Life Extension ☐ Waste Retrieval and Transfer – Waste Inventory Properties ☐ Waste Retrieval and Transfer – Equipment ☐ Closure ☐ Disposal X Supplemental Treatment
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW13 Work Breakdown Structure (WBS) No.: 5.9
12A	***Problem Description:*** There are many denitration technologies. Most utilize an elevated temperature and a carbon reductant to reduce the nitrate to nitrogen while oxidizing the carbon. The reactions are very temperature sensitive and exothermic which raises the potential for the reaction to go autocatalytic and create explosive conditions. Control of the system is simpler if the reaction is initiated by high temperature and controlled by limitations of the reductant or the nitrate. Steam reforming is such a high temperature denitration. However, high temperature

	systems are generally costly and create off-gas issues. Lower temperature systems are desirable. There is evidence that small amounts of organics are destroyed during evaporation of high nitrate Hanford wastes. It is presumed that the organic destruction is coming from oxidation of organics by the nitrate, but the rates are too slow to significantly denitrate the waste. Catalysts to enhance those reactions may be possible, but are not a currently available technology. Active metal denitration is one lower temperature denitration system that presents promise. The basic concept has been developed in the laboratory but much is yet unknown. Other chemical denitration systems, such as denitration using heterogeneous catalysts are even less developed. Denitration may also be accomplished electrochemically and has been demonstrated at Savannah River. The process utilizes a membrane electrochemical cell. The decomposed nitrate leaves as NOx (primarily) NO_2 with small amounts of reduced nitrogen, NH_3, and some N_2. Complete data to assess, demonstrate, and deploy denitration for supplemental treatment of SST requires three phases. Phase I— Laboratory Studies—Develop a process flow sheet that defines the fate of the waste materials and especially the contaminants of concern and added reactants. Effects of the ranges of tank constituents and reactants on the process chemistry would also need to be determined. Special concern would need to be paid to the process control, and safety and generation of potentially explosive conditions. A conceptual design of a denitration facility is necessary to estimate the life-cycle costs of this Supplemental Treatment option for comparison to or addition to other options. Phase II—Pilot plant demonstration—Pilot plant testing would be necessary to establish parameters for full scale equipment design and also validate that the product performance matches the laboratory predictions. Phase III—Deployment—provides final validation that the process, product, and equipment will perform as expected and validate the bases for permitting and operation. Related Technology Opportunities—WT-142 Containerized Cast Stone is the only Supplemental Treatment option that would significantly benefit from a denitration technology. A denitration option cannot be selected to affect the selection of the preferred Supplemental Treatment alternative(s). The priority of this Technology Opportunity depends greatly upon the results of the Supplemental Treatment downselection and the reasons.
9A	***Priority:*** ☐ HIGH Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction ☐ MEDIUM Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction X LOW Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation
9*	**Priority Matrix:**
	Schedule Impact ☐ HIGH Needed to meet PBIs ☐ MED Needed to meet mission targets (2033 closure) X LOW Can improve mission targets or no schedule impact

	Cost Savings	☐ HIGH >$1B total life-cycle savings X MED >$100M but <$1B total life-cycle savings ☐ LOW <$100M total life-cycle savings
	Implementation Cost/Schedule	☐ HIGH <$10M and <2 yrs. ☐ MED >$10M and <2 yrs or <$10M and > 2 yrs. X LOW >$10M and > 2yrs. or significant technical risk
	Baseline Risk Reduction	☐ HIGH *The baseline technical solution has not been proven at large scale or on actual radioactive waste.* X MED The baseline technical solution has been demonstrated at large scale but not implemented in radioactive operations. ☐ LOW The baseline technical solution has been implemented at Hanford.
Cost Information		
17A*	***Current Baseline Cost:*** $ NA—There is no current baseline for denitration. An applicable baseline would be to select a Supplemental Treatment that does not need denitration . Denitration would make Cast Stone a more attractive Supplemental Treatment option.	
17B	***Estimated Cost Impact:*** $	
18*	***Cost Impact Explanation:***	
Risk Information		
37 new	***Risk Identifier:*** ☐ CR- [e.g., CR-047] ☐ New ***Risk Statement:*** If a practical cost-effective denitration technology could be uncovered then additional cost effective treatment options could be exercised.	
12B	***Risk Narrative:*** *[further explanation, if warranted]*	
Schedule Information		
21	***Regulatory Drivers:***	
22*	***Milestones:***	
28*	***Earliest Date Required:*** 2005 to implement a supplemental waste treatment	
29*	***Latest Date Required:*** 2010	
13B	***Schedule Explanation:*** The 'Earliest Date Required' is considered as the time to implement and impact the current tank contractor performance. The 'Latest Date Required' is considered as the time when the final decision to expand the WTP must be made.	
30	***Technology Insertion Point:*** ☐ New ☐ Existing Code: _____ Official Date: _____	

Additional Points of Contact (POC)	
34	***Contractor End User POCs:*** Richard E. (Rick) Raymond, CH2M HILL, 509-372-8767,:richard_e_raymond@rl.gov
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Office of River Protection
Technology Opportunity Statement

General Reference Information	ACTIVE
2*	***Assigned Tracking Number:*** WT144
1*	***Title:*** Fractional Crystallization
3*	***Summary:*** For DOE to meet its accelerated goals to complete retrieval and treatment of Hanford tank waste by 2028 the capacity to treat waste must be increased beyond that planned for the Waste Treatment Plant (WTP). The approach now under evaluation to provide this additional capacity is by employing supplemental technologies to treat salt cake tank waste containing 15,000-25,000 MT of sodium*. One potential supplemental technology to treat the waste is to separate bulk solids from hazardous waste constituents and key radionuclides by means of fractional crystallization in conjunction with the selective dissolution involved in the retrieval by sluicing. *Sodium salts (primarily sodium nitrate, nitrite, carbonate, and hydroxide) make up the vast majority of material in the salt cake tank waste. Related Technical Opportunity Statements WT-146—Sulfate removal—fractional crystallization is one technology option to accomplish sulfate removal. It may be used alone or in combination with other pretreatment steps such as selective dissolution and precipitation of a sulfate compound. WT-152—Supplemental Pretreatment Technologies-- fractional crystallization may be used alone or in combination with other pretreatment steps such as selective dissolution during retrieval to separate Cs-137, Technetium-99, nitrates and nitrites, all of which favor staying in the liquid phase compared to some of the other sodium salts which crystallize more readily. WT-152 does not specify the specific technology to be employed.
38new	***Principal Contact*** : Kayle D. Boomer, CH2M HILL, 509-372-3629, Fax: 509-376-1788, kayle_d_boomer@rl.gov
Technology Opportunity Description	
8A*	***Project:*** ☐ Safe Storage – Operations and Maintenance ☐ Safe Storage – Life Extension ☐ Waste Retrieval and Transfer – Waste Inventory Properties ☐ Waste Retrieval and Transfer – Equipment ☐ Closure ☐ Disposal X Supplemental Treatment
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW13 Work Breakdown Structure (WBS) No.: 5.9
12A	***Problem Description:*** An acid-side crystallization process (aka. "Clean salt") was specifically considered during the technology options workshops in 2002, but not selected as one of the technologies to pursue as part of the Supplemental Treatments Program. The process involved fairly difficult equipment and didn't provide by itself a waste form that could be disposed directly. What the workshop did not consider was utilizing this process in conjunction with selective dissolution (See Technology Opportunity Statement WT152) to achieve effective

	separation of much of the sodium salts (e.g. sodium sulfate, sodium phosphate, sodium carbonate, and sodium silicates) from the nitrate/nitrite rich solution. The former could be crystallized, washed and sent to supplemental treatment immobilization facilities directly. This avoids sending that material to double shell tanks (DSTs) and helps the DST tank space problem. Furthermore, this material no longer needs to be sent to the WTP for immobilization and therefore helps the WTP ILAW capacity limitations. The technology opportunity is to determine whether alkaline-side fractional crystallization used alone or along with other pretreatment processes can provide cost-effective feed to a supplemental treatment immobilization process and determine a suitable immobilization process while avoiding the need for major infrastructure additions or upgrades. The first step is to conduct an engineering evaluation of a plausible process flow sheet. If that proves attractive, then a rapid development program would be needed to validate the engineering assumptions, test, and deploy the technology. Phase I—Complete "quick" engineering assessment and devise conceptual process flow sheet. If the "quick" assessment and a suitable validating assessment indicate the concept is attractive, then proceed with Phase II. Phase II--Laboratory data associated with the efficiency in fractional crystallization and associated crystal washing as well as the composition of the alkaline-side solids are needed. Two categories of feeds need to be considered: (1) those coming from the SST saltcake waste retrieval (considering the composition variation from start to finish) and (2) candidate DST supernate feed. The washed crystallized product must be immobilized and the waste form tested. The waste form performance is mainly determined by the release rate of contaminants of concern (nitrate, nitrite, Cr, Cs, Tc, U, and I) and the waste loading. The waste loading is the major determinant on the amount of Immobilized Low Activity Waste (ILAW) product that will be disposed and hence the land area and cost for disposal. A conceptual design of a fractional crystallization facility or use of existing capability is necessary to estimate the life-cycle costs of this Supplemental Treatment option for comparison to other options. Phase III-Scale-up tests—pilot-scale tests of the washing and immobilization process steps must be conducted for a range of waste compositions. Parameters for full-scale design determined. Phase IV—Deployment—provides final validation that the process, product, and equipment will perform as expected and validate the bases for permitting and operation.
9A	***Priority:*** X HIGH — Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction ☐ MEDIUM — Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction ☐ LOW — Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation

9B	***Priority***		
	Schedule Impact	X HIGH ☐ MED ☐ LOW	Needed to meet PBIs (may be needed prior to immobilizing some retrieved saltcake wastes from SSTs with some supplemental treatment alternatives, e.g., lack of double shell tank space availability may limit retrieval of some single shell tank saltcake waste unless this technology is deployed) Needed to meet mission targets (2033 closure) no schedule impact or can improve mission targets (<2033 closure).
	Cost Savings	X HIGH ☐ MED ☐ LOW	>$1B total life-cycle savings >$100M but <$1B total life-cycle savings <$100M total life-cycle savings
	Implementation Cost/Schedule	☐ HIGH X MED ☐ LOW	<$10M and <2 yrs. >$10M and <2 yrs or <$10M and > 2 yrs. >$10M and > 2yrs. or significant technical risk
	Baseline Risk Reduction	X HIGH ☐ MED ☐ LOW	The baseline technical solution has not been proven at large scale or on actual radioactive waste. The baseline technical solution has been demonstrated at large scale but not implemented in radioactive operations. The baseline technical solution has been implemented at Hanford.
Cost Information			
17A*	***Current Baseline Cost:***		
17B	***Estimated Cost Impact:*** This work together with the Supplemental Treatment activities described in WT-152—Supplemental Pretreatment Technologies and WT-146—Sulfate removal enables the currently planned WTP operation to be reduced from 2034 to 2026.		
18*	***Cost Impact Explanation:*** The Hanford Mission Acceleration employs supplemental treatment in combination with the WTP to process all of the waste by 2028. To complete this processing by 2028 will require immobilizing almost 3000 MT Na/yr. However, the pretreatment facility in the WTP is sized to process 2200 MT Na/yr (River Protection Project System Plan, ORP-11242, Revision 0, December 2002), which would limit the amount of waste that could be immobilized and delay completing waste processing 6 yrs., to 2034. To meet a target completion of 2028 and save the 6 years, pretreatment capacity to treat medium curies salt must also be provided. At a WTP operating cost of $600 M/year, a reduction of 6 years in WTP operation results in a cost savings of $3.6 billion. The sulfate removal further reduces the duration of WTP operation by 2 years with a cost savings of an additional $1.2 billion, for a total of $4.8 billion. During the period 2007-2011 before the WTP pretreatment facility is on-line, the only low curie salt (<.05Ci/L) material available for supplemental treatment immobilization is the approximately 5000 MT Na waste contain in about 35 single shell tanks. To realize the full benefits of supplemental treatment immobilization, capacity to process medium-curie salt must be provided. This requires additional supplemental pretreatment capacity, and selective dissolution is envisioned as the most cost effective approach for attaining this added capacity.		

Risk Information	
37 new	***Risk Identifier:*** ☐ CR-_____ [e.g., CR-047] ☐ New ***Risk Statement:*** If SST retrieval volume is significantly greater than estimated, then insufficient DST space will be available.
12B	***Risk Narrative:*** If retrieval of the salt cake waste exceeds 2 M gallon for S-112 and a similar problem with retrieval of S-102, then availability of DST becomes a constraint on further retrieval of salt cake waste from SSTs until some of the DST supernate is processed. Evaporation/fractional crystallization allows some of the DST waste to be removed and concentrated, creating available DST space. Fractional crystallization in conjunction with selective dissolution and supplemental treatment immobilization will reduce the amount of retrieved salt cake waste that must go to DSTs.
Schedule Information	
21	***Regulatory Drivers:*** Any immobilized waste produced by supplemental treatment must meet performance requirements agreed upon by ORP and WA Dept of Ecology for Land Disposal. Supplemental treatment is needed to meet the TPA milestones for SST retrieval complete by 2018 and treatment completed by 2028.
22*	***Milestones:*** Baseline case: 9/2006 supplemental treatment deployed and operated to retrieve at least 250,000 gallons of waste. In addition, up to 26 SSTs interim closed (including achieving retrieval) by 9/2005 (and 40 by 9/2006); to support this 9.4 million gallons of additional usable DST space must be gained. In the longer term, there are TPA milestones for SST retrieval to complete by 2018 and treatment completed by 2028, which cannot be met with the existing WTP capacity unless supplemental treatment is deployed and operated.
28*	**Earliest Date Required:** For supplemental treatment 8/2006 to deploy and process 250,000 gallons. Earlier deployment can process more. For making DST space available: SST retrieval could be rate limited by 9/2004 because of limited availability of DST space.
29*	**Latest Date Required:** 2010, (WTP expansion decision)
13B	***Schedule Explanation:*** The sooner supplemental technologies can be deployed and operated reduces the required throughput WTP capacity needed to complete processing by 2028. The sooner demands on DST space by SST retrieval can be minimized, the less the constraint on SST retrieval, helping to enable the retrieval of 26 tanks by 9/2005 and 40 tanks by 9/2006. This is also a part of achieving retrieval of all SST waste by 2018.
U	***Technology Insertion Point:*** ☐ New ☐ Existing Code: _____ Official Date: _____ Technology Insertion Point(s): N/A

Additional Points of Contact (POC)	
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35	***DOE End User POCs:*** Billie Mauss, ORP, 509-373-5113, Fax 509-373-1313, billie_m_mauss@rl.gov; James F. Thompson, Jr, Office of River Protection, 509-373-9757, james_f_jr_thompson@rl.gov
36*	***Other Contacts:*** K.A. (Ken) Gasper, CH2M HILL, 509-373-1948, Fax 509-373-9093, kenneth_a_ken_gasper@rl.gov W. Blaine Barton, CH2M HILL, 509-376-5118, Fax 509-373-4641, w_b_blaine_barton@rl.gov D.L. (Dan) Herting, CH2M HILL, 509-372-2532, Fax 509-373-2843, daniel_l_herting@rl.gov Stewart Mackay, CH2M HILL, 509-372-3634; Fax: 509-372-3983; stewart_m_mackay@rl.gov Kayle D. Boomer, CH2M HILL, 509-372-3629; Fax: 509-376-1788; kayle_d_boomer@rl.gov

Office of River Protection
Technology Opportunity Statement

General Reference Information	**DEFERRED**
2*	***Assigned Tracking Number:*** WT145
1*	***Title:*** Qualify Steam Reforming Process for LAW Treatment
3*	***Summary:*** For DOE to meet its accelerated goals to complete retrieval and treatment of Hanford tank waste by 2028 the capacity of the Waste Treatment Plant (WTP) to treat waste must be supplemented. One approach to supplement the WTP capacity is to employ supplemental technologies to treat tank waste containing approximately 50,000 MT of sodium*. One potential supplemental technology to treat the waste is to immobilize pretreated (Cs and TRU solids removed) waste by means of steam reforming. Steam reforming utilizes a high-temperature fluidized bed to destroy nitrates and organic compounds, with the help of additives, to incorporate radioisotopes together with the non-radioactive chemical (e.g. aluminum, sodium, sulfate, and fluorine), in a granular material that can be placed in containers or grouted. Qualification of the steam reformer mineral waste form for LAW needs further determination of the types of crystal structures that are formed under different process conditions and how contaminants of concern are retained in the waste form. *Sodium salts (primarily sodium nitrate, nitrite, carbonate, and hydroxide) make up the vast majority of material in the tank waste. Other cations are also in the waste including aluminum and potassium. The waste includes radionuclides, principally cesium-137, technetium-99, strontium-90, and transuranic elements. Other radionuclides will also be present at lower concentrations. The supplemental treatment will process all the other components (anions and cations) in the waste along with the sodium.
38new	***Principal Contact:*** Michael E. Johnson, CH2M HILL, 509-372-3628, Fax: 509-376-1788, michael_e_johnson@rl.gov
Technology Opportunity Description	
8A*	***Project:*** ☐ Safe Storage – Operations and Maintenance ☐ Safe Storage – Life Extension ☐ Waste Retrieval and Transfer – Waste Inventory Properties ☐ Waste Retrieval and Transfer – Equipment ☐ Closure ☐ Disposal X Supplemental Treatment
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW13 Work Breakdown Structure (WBS) No.: 5.09.02
12A	***Problem Description:*** DOE has identified steam reforming for a variety of pretreatment and immobilization applications at the Hanford Site and at other DOE sites. Prepare Pre-Conceptual Engineering and Cost Study (completed 02/2003)

	• Ensure that conceptual design, schedule and cost estimate is capable of treating 18,000 gallons per month of dissolved saltcake waste at a nominal sodium concentration of 4.48M. • A revised pre-conceptual study was completed in July 2003 for a system capable of processing a net of 10-gpm (432,000-gallons per month) of dissolved saltcake waste at a nominal sodium concentration of 5M. Laboratory data to establish the waste form performance. • Retention of waste constituents – As with other recommended technologies, this flow sheet and product must be evaluated against regulatory analysis and performance assessment requirements. • Waste loading – It is desirable to place as much of the solid waste mass as possible into the smallest volume of material. Waste loading is an important measure when tied to waste form performance in terms of constituent retention. Safety – Steam reforming results in the presence of hydrogen and carbon monoxide, as well as carbon and iron powders being present simultaneously in the fluidized bed vessel. The main process vessel is designed to be explosion proof. Analysis of the process to assess how far downstream (or upstream) process equipment would need to be explosion proof will need further analysis for application in a DOE environment. Real waste testing – No real waste tests have been performed with this process. Additionally, there are related concerns regarding the representative nature of a smaller-scale hot test versus a large-scale spiked test. Pilot plant demonstration—Pilot plant testing would be necessary to establish parameters for full-scale equipment design and also validate that the product performance matches the laboratory predictions. Included in the pilot plant demonstration is the effect of varying process conditions (e.g., waste feed variability) on off-gas treatment efficiency and on waste form performance. Deployment— This phase completes final design, fabrication, and installation; provides for facility testing; and completes all readiness activities. This phase also includes integrated system testing that provides final validation that the process, product, and equipment will perform as expected and that also validates the bases for permitting and operation. This phase also involves a commissioning period by the design/build contractor to verify operational performance criteria.
9A*	***Priority:*** X HIGH — Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction ☐ MEDIUM — Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction ☐ LOW — Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation

9B	***Priorities***		
	Schedule Impact	X HIGH	Needed to meet PBIs
		☐ MED	Needed to meet mission targets (2033 closure)
		☐ LOW	Can improve mission targets or no schedule impact
	Cost Savings	☐ HIGH	>$1B total life-cycle savings
		X MED	>$100M but <$1B total life-cycle savings
		☐ LOW	<$100M total life-cycle savings
	Implementation Cost/Schedule	☐ HIGH	<$10M and <2 yrs.
		X MED	>$10M and <2 yrs or <$10M and > 2 yrs.
		☐ LOW	>$10M and > 2yrs. or significant technical risk
	Baseline Risk Reduction	☐ HIGH	The baseline technical solution has not been proven at large scale or on actual radioactive waste.
		X MED	The baseline technical solution has been demonstrated at large scale but not implemented in radioactive operations.
		☐ LOW	The baseline technical solution has been implemented at Hanford.
Cost Information			
17A*	***Current Baseline Cost:***		
17B	***Estimated Cost Impact:***		
18*	***Cost Impact Explanation:***		
Risk Information			
37 new	***Risk Identifier:*** ☐ CR-_____ [e.g., CR-047] ☐ New ***Risk Statement:*** • If stakeholders do not accept the selected treatment path, then successful disposition of tank waste will not be achieved by 2006. • If stakeholders do accept treatment other than WTP, then completion of treatment by 2028 will not be achieved. • If no LAW treatment/immobilization technology performs as hoped, the net savings relative to WTP may not be provable.		
12B	***Risk Narrative:***		
Schedule Information			
21	***Regulatory Drivers:*** 1/2005 submit LAW supplemental treatment technologies report to Ecology (TPA-M-62-08); 1/2006 submit final Hanford tank waste treatment baseline to Ecology (TPA-M-62-11) [both milestones per TPA Change Number M-62-03-02]		

22*	***Milestones:***
28*	**Earliest Date Required:**
29*	**Latest Date Required:**
13B	***Schedule Explanation:***
U	***Technology Insertion Point:*** ☐ New ☐ Existing Code: _____ Official Date: _____ Technology Insertion Point(s): N/A
Additional Points of Contact (POC)	
34	***Contractor End User POCs:*** Rick Raymond, CH2M HILL, 509-372-8767, Fax: 509-376-6399, richard_e_raymond@rl.gov
35	***DOE End User POCs:*** B.M. (Billie) Mauss, ORP, 509-373-9876, F/509-372-2781, billie_m_mauss@rl.gov
36*	***Other Contacts:*** K.A. (Ken) Gasper, CH2M HILL, 509-373-1948, F/509-373-9093, kenneth_a_ken_gasper@rl.gov

Office of River Protection
Technology Opportunity Statement

General Reference Information	**ACTIVE**
2*	***Assigned Tracking Number:*** WT146
1*	***Title:*** Sulfate Removal
3*	***Summary:*** High concentrations of sulfate in the low activity waste (LAW) feed solutions present problems for the current WTP baseline LAW vitrification process using joule-heated melters. These problems can lead to a reduction in waste incorporated in the ILAW glass. Without sulfate removal on the saltcake waste fraction contained in 68 SSTs, the WTP will produce 205,000 m^3 of ILAW. With sulfate removal the waste loading can be increased so as to produce only 150,600 m^3. Sulfate limitations increase the ILAW production by 36%. Additionally, preliminary testing of the LAW vitrification system indicated that a separate molten sulfur layer would form in the melter at the maximum sulfate-to-sodium mole ratio in the LAW solutions. This molten sulfur layer is highly corrosive to melter components. A sulfate process to remove sulfate from the LAW that requires vitrification in the WTP would save significant cost and shorten the mission. The sulfate removal process is not proposed for use on waste that is provided as feed to the other recommended supplemental technologies: ex situ bulk vitrification, cast stone, or steam reforming. Processing of sulfate by these other treatment processes is not anticipated to be an issue. There are likely many different sulfate separations scenarios. An acid-side precipitation of sulfate is one consideration. This is based on a process previously used to separate Sr by sulfate precipitation (ARH-2973, Sulfate Precipitation Flowsheet for Purification of Crude Strontium Product from B Plant Solvent Extraction, January 1974). Other processes such as a crystallization process, the burkeite process, developed in theory by Cogema or a broader application of fractional crystallization using existing Hanford infrastructure (242-A evaporator) may also be worthy of analysis.
38new	***Principal Contact:*** Kayle D. Boomer, CH2M HILL, 509-372-3629, Fax: 509-376-1788, kayle_d_boomer@rl.gov
Technology Opportunity Description	
8A*	***Project:*** ☐ Safe Storage – Operations and Maintenance ☐ Safe Storage – Life Extension ☐ Waste Retrieval and Transfer – Waste Inventory Properties ☐ Waste Retrieval and Transfer – Equipment ☐ Closure ☐ Disposal X Supplemental Treatment
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW13 Work Breakdown Structure (WBS) No.: 5.9

12A	***Problem Description:*** Complete data to assess, demonstrate, and deploy a sulfate separation technology for supplemental treatment of SST requires three phases. Phase I—Laboratory Studies—Develop a process flow sheet that defines the fate of the waste materials and especially the contaminants of concern. Effects of the ranges of tank constituents on the process chemistry would also need to be determined. A strategy for the disposal of the sulfate waste product would need to be developed. Does the product need additional immobilization or can the product be packaged and disposed directly? Disposal pathways for secondary products (if any) would also need to be developed. A process that involved acidification of the waste would generate off gas, which would need to be characterized and the secondary wastes disposed. Potential operational issues such as foaming would need to be investigated. If the sulfate waste product required further immobilization such as incorporation in grout, a conceptual design of a grout facility is necessary to estimate the life-cycle costs of this Supplemental Treatment option for comparison to other options. Phase II—Pilot plant demonstration—Pilot plant testing would be necessary to establish parameters for full scale equipment design and also validate that the product performance matches the laboratory predictions. Phase III—Deployment—provides final validation that the process, product, and equipment will perform as expected and validate the bases for permitting and operation
9A	***Priority:*** ☐ HIGH — Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction ☐ MEDIUM — Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction X LOW — Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation
9B	***Priorities:***

Schedule Impact	☐ HIGH X MED ☐ LOW	Needed to meet PBIs Needed to meet mission targets (2033 closure) no schedule impact or can improve mission targets (<2033 closure).
Cost Savings	X HIGH ☐ MED ☐ LOW	>$1B total life-cycle savings >$100M but <$1B total life-cycle savings <$100M total life-cycle savings
Implementation Cost/Schedule	☐ HIGH ☐ MED X LOW	<$10M and <2 yrs. >$10M and <2 yrs or <$10M and > 2 yrs. >$10M and > 2yrs. or significant technical risk
Baseline Risk Reduction	☐ HIGH ☐ MED X LOW	The baseline technical solution has not been proven at large scale or on actual radioactive waste. The baseline technical solution has been demonstrated at large scale but not implemented in radioactive operations. The baseline technical solution has been implemented at Hanford.

Cost Information

17A*	***Current Baseline Cost:*** There is no current baseline cost for sulfate separation. The current baseline is to vitrify all the LAW into ILAW. The presence of sulfate increases that vitrification volume ~36% for the 68 SSTs.
17B	***Estimated Cost Impact:*** $
18*	***Cost Impact Explanation:*** Cost impact for sulfate separation is a cost avoidance, from lower ILAW volume.
Risk Information	
37 new	***Risk Identifier:*** ☐ CR-_____ [e.g., CR-047] ☐ New ***Risk Statement:*** If a sulfate separation technology is not developed or another treatment technology employed to process the high sulfate waste then significantly more glass will need to be processed through the WTP taking longer time and increasing cost.
12B	***Risk Narrative:*** *[further explanation, if warranted]*
Schedule Information	
21	***Regulatory Drivers:***
22*	***Milestones:***
28*	***Earliest Date Required:*** 2008 (start up of WTP)
29*	***Latest Date Required:***
13B	***Schedule Explanation:***
30	***Technology Insertion Point:*** ☐ New ☐ Existing Code: _____ Official Date: _____
Additional Points of Contact (POC)	
34	***Contractor End User POCs:*** Rick Raymond, CH2M HILL, 509-372-8767, Fax: 509-376-6399, richard_e_raymond@rl.gov
35	***DOE End User POCs:*** B.M. (Billie) Mauss, ORP, 509-373-9876, F/509-372-2781, billie_m_mauss@rl.gov; Rob Yasek, 509-372-1270, robert_m_yasek@rl.gov; Diane Clark, ORP, 509-376-7557, diane_l_clark@rl.gov
36*	***Other Contacts:*** K.A. (Ken) Gasper, CH2M HILL, 509-373-1948, FAX: 509-373-9093, kenneth_a_ken_gasper@rl.gov Stewart Mackay, CH2M HILL 509-372-3634, F/509-372-3983, stewart_m_mackay@rl.gov Michael E. Johnson, CH2M HILL, 509-372-3628, Fax: 509-376-1788, michael_e_johnson@rl.gov

Office of River Protection
Technology Opportunity Statement

General Reference Information	**ACTIVE**
2*	***Assigned Tracking Number:*** WT147
1*	***Title:*** TRU Treatment Technology
3*	***Summary:*** For DOE to meet its accelerated goals to complete retrieval and treatment of Hanford tank waste by 2028 the capacity of the Waste Treatment Plant (WTP) to treat waste must be increased. TRU immobilization represents a supplemental way to treat 12 tanks (9 SSTs and 3 DSTs) without sending waste to the WTP. The resulting TRU solids would be treated (e.g., dewatered), containerized, and shipped to the WIPP. In the case of TRU in DSTs, a separate facility would be required to separate much of the liquid and soluble radionuclides from the solids through washing. The criteria for treatment and containerization of the TRU solids are driven by the WIPP waste acceptance criteria. CH2M HILL issued a Market Survey on October 28, 2002 to request information about equipment and/or systems that can perform the necessary operations for two types of TRU wastes: waste that can be "contact handled" and waste that need to be "remote handled". Additional technologies that were not identified by this market survey may be available.
38new	***Principal Contact:*** Rick Tedeschi, CH2M HILL, 509-376-6018, Fax: 509-3739093, allan_r_rick_tedesche@rl.gov
Technology Opportunity Description	
8A*	***Project:*** ☐ Safe Storage – Operations and Maintenance ☐ Safe Storage – Life Extension ☐ Waste Retrieval and Transfer – Waste Inventory Properties ☐ Waste Retrieval and Transfer – Equipment ☐ Closure ☐ Disposal X Supplemental Treatment
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW13 Work Breakdown Structure (WBS) No.: 5.09.02
12A	***Problem Description:*** Complete data to assess, demonstrate, and deploy TRU removal for supplemental treatment requires three phases. Phase I— The main discriminators are the ability to verify the validity of the flowsheet with simulant tests and relevant experience with remote-handled facilities and equipment design. Treatment and immobilization of the TRU tank wastes include solid-liquid separation, washing of the TRU waste to remove soluble salts and Cs, and immobilization of the washed waste by means of vitrification, grout or phosphate-bonded ceramic, or by means of low temperature drying. The following list outlines important performance parameters: • Good separation efficiency to allow 1) production of contact-handled TRU waste (<200 mrem/hr at package surface) and 2) sufficient basis to designate the washed solids as transuranic waste. • Efficient waste loading (waste packages that do not exceed any of the WIPP waste acceptance criteria for radioactive constituents. • Waste packages that meet all other WIPP waste acceptance criteria.

	A conceptual design of a TRU removal facility is necessary to estimate the life-cycle costs of this Supplemental Treatment option for comparison to other options. Phase II—Pilot plant demonstration—Pilot plant testing would be necessary to establish parameters for full scale equipment design and also validate that the product performance matches the laboratory predictions. Phase III—Deployment—provides final validation that the process, product, and equipment will perform as expected and validate the bases for permitting and operation.
9*	***Priority:*** X HIGH — Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction ☐ MEDIUM — Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction ☐ LOW — Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation
9B	***Priorities:***

Schedule Impact	☐ HIGH ☐ MED ☐ LOW	Needed to meet PBIs Needed to meet mission targets (2033 closure) No schedule impact or can improve mission targets (<2033 closure).
Cost Savings	☐ HIGH ☐ MED ☐ LOW	>$1B total life-cycle savings >$100M but <$1B total life-cycle savings <$100M total life-cycle savings
Implementation Cost/Schedule	☐ HIGH ☐ MED ☐ LOW	<$10M and <2 yrs. >$10M and <2 yrs or <$10M and > 2 yrs. >$10M and > 2yrs. or significant technical risk
Baseline Risk Reduction	☐ HIGH ☐ MED ☐ LOW	The baseline technical solution has not been proven at large scale or on actual radioactive waste. The baseline technical solution has been demonstrated at large scale but not implemented in radioactive operations. The baseline technical solution has been implemented at Hanford.

Cost Information	
17A*	***Current Baseline Cost:***
17B	***Estimated Cost Impact:***
18*	***Cost Impact Explanation:***

Risk Information	
37 new	***Risk Identifier:*** ☒ *RPP-CR-037* ☐ New ***Risk Statement:*** If field demonstrations of alternative treatment technologies, including TRU and LLW tank waste treatment, are unsuccessful (regulator disapproval, technology failure), then the TPA milestone for completing tank waste treatment is in jeopardy and additional costs and schedule delays may occur. Development and implementation of alternative LLW and TRU tank waste treatment capacity will allow the RPP to complete tank waste treatment in 2028 and support completion of the Hanford cleanup mission in 2035.
12B	***Risk Narrative:*** • If stakeholders do not accept the selected treatment path, then successful disposition of tank waste will not be achieved by 2006. • If stakeholders do not accept treatment other than WTP, then completion of treatment by 2028 will not be achieved. • If TRU treatment technology doesn't perform as expected, the net savings relative to WTP may not be provable.
Schedule Information	
21	***Regulatory Drivers:***
22*	***Milestones:*** 9/2006 supplemental treatment deployed and operated to retrieve and package at least 750,000 gallons of TRU waste.
28*	**Earliest Date Required:** 4/2004
29*	**Latest Date Required:**
13B	***Schedule Explanation:***
U	***Technology Insertion Point:*** ☐ New ☐ Existing Code: _____ Official Date: _____ Technology Insertion Point(s): N/A
Additional Points of Contact (POC)	
34	***Contractor End User POCs:*** Rick Tedeschi, CH2M HILL, 509-376-6018, Fax: 509-3739093, allan_r_rick_tedesche@rl.gov
35	***DOE End User POCs:*** Rob Yasek, ORP, (509) 372-1270, Robert_M_Yasek@rl.gov
36*	***Other Contacts:*** K.A. (Ken) Gasper, CH2M HILL, 509-373-1948, F/509-373-9093, kenneth_a_ken_gasper@rl.gov

Office of River Protection
Technology Opportunity Statement

General Reference Information	**ACTIVE**
2*	***Assigned Tracking Number:*** WT148
1*	***Title:*** Sluicing Enhancement and Cost Reduction
3*	***Summary:*** under the current Mission Acceleration Plan, the end of FY2006 will retrieve 26 to 40 SSTs. For SSTs that are not assumed to have leaked, and waste that is not intended for dry processing downstream, sluicing is the current baseline retrieval technology, and is considered as the most cost-effective option. Enhanced designs over past-practice sluicing are underway, with enhanced nozzles to break hard heels more effectively, and centrally located transfer pumps. However, the effectiveness of these improvements at achieving the 99% retrieval required by the Tri-Party Agreement is not known. In addition, budgets available by 2006 are limited, and significant cost reductions are needed from current sluicing project estimates. In order to ensure successful retrieval of 26 to 40 tanks within limited budgets by the end of FY2006, alternative technologies readily available or different implementation approaches of sluicing are needed as backups. The subject tanks vary in size and content: • 530 and 750 kgal tanks, 75 feet in diameter and 30-37 feet high, containing from 6 to 500 kgal of waste, • 1 Mgal tanks, 75 feet in diameter and 45 feet high, containing from 30 to 300 kgal of waste. Access in the tanks is through risers that vary in diameter from 4" to 42". The risers are often far from the tank center. Wastes are expected to be mostly HLW.
38new	***Principal Contact:*** Warren Thompson, CH2M HILL, 509-372-8053, Fax: 509-373-4095, warren_t_thompson@rl.gov
Technology Opportunity Description	
8A*	***Project:*** ☐ Safe Storage – Operations and Maintenance ☐ Safe Storage – Life Extension ☐Waste Retrieval and Transfer – Waste Inventory Properties X Waste Retrieval and Transfer – Equipment ☐ Closure ☐ Disposal ☐ Supplemental Treatment
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW04 *Work Breakdown Structure (WBS) No.: 5.8.2 (primary), 5.8.5 (secondary)*
12A	***Problem Description:*** *See summary*

9a*	***Priority:***		
	X HIGH	Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction	
	☐ MEDIUM	Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction	
	☐ LOW	Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation	
9b	***Priority***		
	Schedule Impact	☐ HIGH	Needed to meet PBIs
		☐ MED	Needed to meet mission targets (2033 closure)
		☐ LOW	no schedule impact or can improve mission targets (<2033 closure).
	Cost Savings	☐ HIGH	>$1B total life-cycle savings
		☐ MED	>$100M but <$1B total life-cycle savings
		☐ LOW	<$100M total life-cycle savings
	Implementation Cost/Schedule	☐ HIGH	<$10M and <2 yrs.
		☐ MED	>$10M and <2 yrs or <$10M and > 2 yrs.
		☐ LOW	>$10M and > 2yrs. or significant technical risk
	Baseline Risk Reduction	☐ HIGH	The baseline technical solution has not been proven at large scale or on actual radioactive waste.
		☐ MED	The baseline technical solution has been demonstrated at large scale but not implemented in radioactive operations.
		☐ LOW	The baseline technical solution has been implemented at Hanford.
Cost Information			
17A*	***Current Baseline Cost:*** $ 10M-$15M per tank		
17B	***Estimated Cost Impact:*** $ TBD		
18*	***Cost Impact Explanation:*** Retrieval cost needs to be reduced to $2M to $3M per tank.		
Risk Information			
37 new	***Risk Identifier:*** ☐ CR-_____ [e.g., CR-047] ☐ New ***Risk Statement:*** If enhanced sluicing cannot achieve the extent of retrieval required by the Tri-Party Agreement, or if the cost of retrieval by sluicing cannot be reduced as much as needed, then retrieval schedule commitments will be missed and/or budget needs will exceed available funds.		
12B	**Risk Narrative:**		
Schedule Information			
21	***Regulatory Drivers:*** Tri-Party Agreement M-45 Series milestones.		
22*	***Milestones:***		
28*	***Earliest Date Required:*** September 2003		
29*	***Latest Date Required:*** September 2006		
13B	***Schedule Explanation:*** Performance-Based Incentive PBI-3 identifies SST retrieval and interim closure in accordance with M-45 milestones.		

30	***Technology Insertion Point:*** ☐ New ☐ Existing Code: Official Date: ***Technology Insertion Point(s):*** (M45 Series TPA milestones, as applicable) TIP No.:
Additional Points of Contact (POC)	
34	***Contractor End User POCs:*** Warren Thompson, CH2M HILL, 509-372-8053, Fax: 509-373-4095, warren_t_thompson@rl.gov Roger Bauer, CH2M HILL, 509 376-5908, F/509 373 6101 roger_e_bauer@rl.gov Carl Hanson, COGEMA Engineering, 509 376 4810, F/509 372 2862, carl_e_hanson@rl.gov
35	***DOE End User POCs:*** James F. Thompson, Jr, Office of River Protection, (509) 373-9757, james_f_jr_thompson@rl.gov; Roger Quintero, DOE-ORP, 509-373-0421, Fax: 509-373-1313, roger_a_quintero@rl.gov
36*	***Other Contacts:*** K.A. (Ken) Gasper, CH2M HILL, 509-373-1948, F/509-373-9093, kenneth_a_ken_gasper@rl.gov

Office of River Protection
Technology Opportunity Statement

General Reference Information	**ACTIVE**
2*	***Assigned Tracking Number:*** WT149
1*	***Title:*** Transport of SST Waste with Little Water
3*	***Summary:*** Single-Shell Tank (SST) wastes are currently relatively dry solids, as a result of Interim Stabilization Operations that have remove all pumpable liquids from the SSTs, in order to mitigate leakage risks. Between 26 and 40 SSTs are planned for retrieval by the end of FY06. A significant fraction of the tanks will be retrieved with minimal amounts of added water, for various reasons: • SSTs that are assumed to have leaked cannot receive significant amounts of water • Some sludge wastes will be dry processed, and therefore water addition for retrieval would complicate the processing • In order to avoid Double-Shell Tank (DST) storage space shortage, selected SSTs may be used for interim storage of retrieved SST waste, which precludes the addition of significant amounts of water to these wastes. Transfer of these wastes retrieved with minimal water addition will not be possible through the current liquid/slurry transfer system. Transfer systems readily available, and suitable for sludge/salts in dry and wet conditions are needed.
38new	***Principal Contact:*** Warren Thompson, CH2M HILL, 509-372-8053, Fax: 509-373-4095, warren_t_thompson@rl.gov
Technology Opportunity Description	
8A*	***Project:*** ☐ Safe Storage – Operations and Maintenance ☐ Safe Storage – Life Extension ☐ Waste Retrieval and Transfer – Waste Inventory Properties X Waste Retrieval and Transfer – Equipment ☐ Closure ☐ Disposal ☐ Supplemental Treatment
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW04 Work Breakdown Structure (WBS) No.: 5.8.5
12A	***Problem Description:*** See Summary
9a*	***Priority:*** X HIGH — Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction ☐ MEDIUM — Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction ☐ LOW — Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation

9b	***Priority***		
	Schedule Impact	☐ HIGH ☐ MED ☐ LOW	Needed to meet PBIs Needed to meet mission targets (2033 closure) no schedule impact or can improve mission targets (<2033 closure).
	Cost Savings	☐ HIGH ☐ MED ☐ LOW	>$1B total life-cycle savings >$100M but <$1B total life-cycle savings <$100M total life-cycle savings
	Implementation Cost/schedule	☐ HIGH ☐ MED ☐ LOW	<$10M and <2 yrs. >$10M and <2 yrs or <$10M and > 2 yrs. >$10M and > 2yrs. or significant technical risk
	Baseline Risk Reduction	☐ HIGH ☐ MED ☐ LOW	The baseline technical solution has not been proven at large scale or on actual radioactive waste. The baseline technical solution has been demonstrated at large scale but not implemented in radioactive operations. The baseline technical solution has been implemented at Hanford.
Cost Information			
17A*	***Current Baseline Cost:***		
17B	***Estimated Cost Impact:***		
18*	***Cost Impact Explanation:*** Potential cost savings would be from avoiding the addition of water for SST retrieval and transfer, and avoiding the corresponding evaporation or other water separation operations typically required as part of waste immobilization.		
Risk Information			
37 new	***Risk Identifier:*** ☐ CR-_____ [e.g., CR-047] ☐ New ***Risk Statement:*** If effective transport techniques for SST wastes retrieved with minimal water addition are not implemented, then shortages of DST storage space will result in SST retrieval delays.		
12B	***Risk Narrative:***		
Schedule Information			
21	***Regulatory Drivers:*** Tri-Party Agreement M-45 milestones.		
22*	***Milestones:***		
28*	***Earliest Date Required:*** - FY2003		
29*	***Latest Date Required:*** FY2006		
13B	***Schedule Explanation:*** Functional systems will first be useful if deployed prior to retrieval of waste from the SSTs, which may begin in FY 2003 to support Mission Acceleration.		
30	***Technology Insertion Point:*** ☐ New ☐ Existing Code: _____ Official Date _____ **Technology Insertion Point(s):**		

Additional Points of Contact (POC)	
34	***Contractor End User POCs:*** Warren Thompson, CH2M HILL, 509-372-8053, Fax: 509-373-4095, warren_t_thompson@rl.gov Terry Hissong, CH2M HILL 509 372 0677, F/509 373 9093, T_L_Hissong@rl.gov
35	***DOE End User POCs:*** James F. Thompson, Jr, Office of River Protection, (509) 373-9757, James_f_jr_thompson@rl.gov Roger Quintero, DOE-ORP, 509-373-0421, Fax: 509-373-1313, roger_a_quintero@rl.gov
36*	***Other Contacts:*** K.A. (Ken) Gasper, CH2M HILL, 509-373-1948, F/509-373-9093, kenneth_a_ken_gasper@rl.gov

Office of River Protection
Technology Opportunity Statement

General Reference Information	ACTIVE
2*	***Assigned Tracking Number:*** WT150
1*	***Title:*** Characterization of waste inventory in ancillary equipment
3*	***Summary:*** Decisions on ancillary equipment remediation as part of final tank farm closure will depend on estimated waste inventory and calculated risk consequences of residual waste in such equipment. Presently there are no methods or tools to develop reliable estimates of waste inventory in ancillary equipment. For the AX farm, an engineering study was conducted to estimate waste inventory in ancillary equipment (SESC-98-006, January 1998) for purposes of risk assessment and worker exposure calculations. No sampling or analysis was conducted to support this estimate. This includes tough technical problem #12, which is a capability for determining how much waste is in ancillary equipment (e.g., in the pipes).
38new	***Principal Contact:*** Ron Calmus, CH2M HILL, (509) 372-3385; F/509-372-2862; ronald_b_calmus@rl.gov
Technology Opportunity Description	
8A*	***Project:*** ☐ Safe Storage – Operations and Maintenance ☐ Safe Storage – Life Extension ☒ Waste Retrieval and Transfer – Waste Inventory Properties ☐ Waste Retrieval and Transfer – Equipment ☒ Closure ☐ Disposal
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW04 Work Breakdown Structure (WBS) No.: 5.8.5
12A	***Problem Description:*** Decisions on ancillary equipment remediation as part of final tank farm closure will depend on estimated waste inventory and calculated risk consequences of residual waste in such equipment. Presently there are no methods or tools to develop reliable estimates of waste inventory in ancillary equipment. Lack of ability to characterize waste inventory in ancillary equipment could result in excessive conservatism in estimating inventory and performing risk assessment. This overly conservative posture will directly contribute to higher costs for retrieval and closure. Estimates of waste inventory in ancillary equipment were made for AX farm, in SESC-98-006, January 1998. No sampling or analysis was conducted to support these estimates. Methods and equipment for ancillary equipment characterization may have been developed at other DOE sites, or for commercial purposes, but there has been no rigorous inquiry into what may have already been developed or used.

9a*	***Priority:***		
	☐ HIGH	Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction	
	☐ MEDIUM	Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction	
	☒ LOW	Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation *(Low Priority for Technology Opportunity; outside Contract period)*	
9b*	***Priorities***		
	Schedule Impact	☐ HIGH	Needed to meet PBIs
		x MED	Needed to meet mission targets (2033 closure)
		☐ LOW	Can improve mission targets or no schedule impact
	Cost Savings	☐ HIGH	>$1B total life-cycle savings
		☐ MED	>$100M but <$1B total life-cycle savings
		x LOW	<$100M total life-cycle savings
	Implementation Cost/Schedule	x HIGH	<$10M and <2 yrs.
		☐ MED	>$10M and <2 yrs or <$10M and > 2 yrs.
		☐ LOW	>$10M and > 2yrs. or significant technical risk
	Baseline Risk Reduction	x HIGH	The baseline technical solution has not been proven at large scale or on actual radioactive waste.
		☐ MED	The baseline technical solution has been demonstrated at large scale, but not implemented in radioactive operations.
		☐ LOW	The baseline technical solution has been implemented at Hanford.
Cost Information			
17A*	***Current Baseline Cost:*** $		
17B	***Estimated Cost Impact:***		
18*	***Cost Impact Explanation:*** Lack of ability to characterize waste inventory in ancillary equipment could result excessive conservation in inventory estimates and risk assessment, contributing to higher costs for retrieval and closure. No estimates are available for development of methods and equipment for characterizing waste in ancillary equipment.		
Risk Information			
37 new	***Risk Identifier:*** ☐ CR-_____ [e.g., CR-047] ☒ New ***Risk Statement:*** Lack of ability to characterize waste could lead to excessive conservation in inventory estimates for risk assessment. Worker risk associated with sampling ancillary equipment would need to be assessed as part of methods development or equipment development for ancillary equipment characterization.		
12B	***Risk Narrative:*** *[further explanation, if warranted]*		
Schedule Information			
21	***Regulatory Drivers:***		
22*	***Milestones:***		
28*	***Earliest Date Required:*** *Post-FY2006*		

29*	***Latest Date Required:*** *[month, year]*
13B	***Schedule Explanation:*** Tank farm closure could potentially involve remediation of ancillary equipment. This is not included in the scope of interim tank farm closure under PBI-3. Therefore, ancillary equipment characterization capability may not be needed for some years—post-FY 2006
30	***Technology Insertion Point:*** ☐ New ☐ Existing Code: Official Date:
Additional Points of Contact (POC)	
34	***Contractor End User POCs:*** W. Thompson, CH2M HILL, 509-372-8053, F/509-373-6101, warren_t_thompson@rl.gov
35	***DOE End User POCs:*** Bob Lober, DOE-ORP, 509-373-7949, Fax: 509-373-1313, robert_w_lober@rl.gov
36*	***Other Contacts:*** Frank Anderson, CH2M HILL, 509-373-3971, Fax: 509-373-3974, frank_j_anderson@rl.gov; Mike Connelly, CH2M HILL, 509-373-3981, Fax: 509-373-3974, michael_connelly@rl.gov K.A. (Ken) Gasper, CH2M HILL, 509-373-1948, FAX: 509-373-9093, kenneth_a_ken_gasper@rl.gov

Office of River Protection
Technology Opportunity Statement

General Reference Information	**ACTIVE**
2*	***Assigned Tracking Number:*** WT151-S
1*	***Title:*** Getter Materials for Tank Fill
3*	***Summary:*** Fundamental data is needed to improve understanding of the performance of getter materials added to tank fill materials that will reduce the release rate of contaminants. Understanding (1) how important contaminants interact with sequestering agents, (2) how sequestering agents perform in a cementitious tank fill matrix overlying waste residue (not homogeneously mixed with residual waste), and (3) the effects of aging on these binding properties may allow significant risk reduction by engineered barrier design, thus lessening reliance on waste retrieval.
38new	***Principal Contact:*** Julian Laurenz, CH2M HILL, 509-372-9301, F/509-372-9292, julian_e_laurenz@rl.gov
Technology Opportunity Description	
8A*	***Project:*** ☐ Safe Storage – Operations and Maintenance ☐ Safe Storage – Life Extension ☒ Waste Retrieval and Transfer – Waste Inventory Properties ☒ Waste Retrieval and Transfer – Equipment ☒ Closure ☒ Disposal
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW04 (primary), ORP-TW13 (secondary) Work Breakdown Structure (WBS) No.: 5.8.5 (primary), 5.9.4 (secondary)
12A	***Problem Description:*** Negatively charged elements and compounds (e.g. TcO_4^-, Se^-) are poorly sorbed on most materials under basic (pH > 7) conditions. Understanding (1) how important contaminants interact with sequestering agents, (2) how sequestering agents perform in a cementitious tank fill matrix overlying waste residue (not homogeneously mixed with residual waste), and (3) the effects of aging on these binding properties may allow significant risk reduction by engineered barrier design, thus lessening reliance on waste retrieval. Proposals have been received from national laboratories for continuing development of tin-treated hydroxyapatite and other sequestering agents, bench-scale and large-scale testing of grout mix designs with getters, desorption and aging tests, and testing effectiveness of tank fill with getters on actual simulating configuration expected in SSTs (fill overlying waste). If low-cost getter materials can be developed for use in waste disposal, then requirements on waste forms can be reduced, potentially saving hundreds of millions of dollars in the Hanford Immobilized Waste Disposal Program. The Savannah River Site uses FeS to trap technetium, and many disposal sites use concrete to trap uranium. There is a related science need for getter materials for outside the tanks. This science need also supports Technology Opportunity, "Reactive Barriers to Contaminant Migration" (WT061) because sequestering deployed as a permeable flow-through barrier would prevent the migration of contaminants beneath the tank farms and facilities. This need is described in Section 10.3.4 of the Office of River Protection Preliminary Integrated

	Technology Plan, DOE-ORP-2001-17, Rev 0.		
9a*	***Priority:*** ☐ HIGH — Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction ☒ MEDIUM — Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction *(Medium Priority for Science Opportunity)* ☐ LOW — Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation		
9b*	***Priorities***		
	Schedule	X HIGH ☐ MED ☐ LOW	Needed to meet PBIs Needed to meet mission targets (2033 closure) Can improve mission targets or no schedule impact
	Cost Savings	XHIGH ☐ MED ☐ LOW	>$1B total life-cycle savings >$100M but <$1B total life-cycle savings <$100M total life-cycle savings
	Implementation Cost/Schedule	☐ HIGH X MED ☐ LOW	<$10M and <2 yrs. >$10M and <2 yrs or <$10M and > 2 yrs. >$10M and > 2yrs. or significant technical risk
	Baseline Risk Reduction	X HIGH ☐ MED ☐ LOW	The baseline technical solution has not been proven at large scale or on actual radioactive waste. The baseline technical solution has been demonstrated at large scale but not implemented in radioactive operations. The baseline technical solution has been implemented at Hanford.
Cost Information			
17A*	***Current Baseline Cost:*** Indeterminate. The current strategy for closure of Hanford double and single-shell tanks does not include the use of sequestering agents. Although use of sequestering agents has been proposed for use in support of Environmental Restoration activities on the Hanford site, the technology has not been deployed at Hanford.		
17B	***Estimated Cost Impact:*** Lessen retrieval/closure requirements (~10^8 to 10^9 dollars); Less bounding assumptions on ILAW will allow higher waste loadings, which will accelerate schedule and reduce costs (~10^8 to ~10^9 dollars); Lower design requirements for the ILAW disposal facility (exceed 10^8 dollars); Estimated cost of getter/grout development is $2 to $4M, based on proposals from SNL, ORNL, SRTC, and PNNL. When allocated to 149 SSTs, this is < cost of retrieval to achieve the same risk reduction by removal of waste inventory.		

18*	***Cost Impact Explanation:*** The cost savings could be significant. With regard to the disposal facility, the cost savings resulting from lowering the design requirements could exceed several hundred million dollars. The cost saving associated with deployment of the getter material in the soil could approach several hundred million dollars depending on the inventory and distribution of contamination resulting from past and anticipated future leaks. Cost savings associated with deployment of getter materials in tank fill materials could be in the tens to hundreds of millions of dollars if more rigorous tank retrieval requirements or tank closure approaches can be avoided by taking advantage of getter materials in reducing release rate.
Risk Information	
37 new	***Risk Identifier:*** ☐ CR- [e.g., CR-047] ☒ New ***Risk Statement:*** If the regulators do not accept a subsurface barrier, the capping options will be rejected, thus requiring more expensive remediation methods.
12B	***Risk Narrative:*** If successful getter materials are not found, it will be difficult to assure the public that the DOE can mitigate adverse impact of leaving waste in the tanks (and their associated subsurface contamination) in place and (2) leaving immobilized waste in onsite ILAW disposal facilities. If efforts to improve engineered barrier designs and performance via addition of getters are not undertaken will be difficult to convince stakeholders and regulators (Ecology, NRC, DOE) that we have taken prudent steps to at least explore opportunities to reduce long term risk to human health and the environment. 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. More rigorous and expensive retrieval and closure methods may be required to achieve performance requirements.
Schedule Information	
21	***Regulatory Drivers:*** Performance assessments are required by DOE Order 5820.2A, soon to be revised and issued as DOE Order 435.1.
22*	***Milestones:*** Data Packages for 2005 ILAW PA (2004); Tank Farm RFI Report (2007); 200 Area RFI reports (through 2008)
28*	***Earliest Date Required:*** January 2002
29*	***Latest Date Required:*** December 2004
13B	***Schedule Explanation:*** For use during the maintenance phase of Hanford Immobilized Low-Activity Tank Waste Performance Assessments, such data and testing are needed by 2005 PBI-3 includes interim closure of M-45 high risk SSTs (S-112, S-102, C-104), C-106, 4 low risk/volume tanks, additional HLW tanks (>fee over and above 19), individual tank farms (> fee over and above 2), and 244-AR vault by 9/30/2006; To support interim closure of C-106, and C Farm 200-Series tanks in CY 2004, per PBI-3 item 2, grout/getter development is needed in FY03 for input to material specifications for procurement of a tank fill contractor in the 4th quarter of CY 2003. If getter development is delayed to FY04, it could still support interim closure of the remaining SSTs scheduled for closure in FY05 and later. However, it could potentially impact the FY04 SST closure schedule.

30	***Technology Insertion Point:*** ☐ New ☐ Existing Code: _____ Official Date: _____
Additional Points of Contact (POC)	
34	***Contractor End User POCs:*** Ron Calmus, CH2M HILL, (509) 372-3385; F/509-372-2862; ronald_b_calmus@rl.gov, F.M. (Fred) Mann, CH2M HILL, 509-373-3978, Fax: 509-373-3974, frederick_m_mann@rl.gov
35	***DOE End User POCs:*** P.E. (Phil) LaMont, DOE-ORP, 509-376-6117; F/509-372-1350, philip_e_lamont@rl.gov R.W. (Bob) Lober, DOE-ORP, 509-373-7949; F/509-373-1313; robert_w_lober@rl.gov Roger Quintero, DOE-ORP, 509-373-0421, Fax: 509-373-1313, roger_a_quintero@rl.gov
36*	***Other Contacts:*** Ron Calmus, CH2M HILL, (509) 372-3385; F/509-372-2862; ronald_b_calmus@rl.gov, K.A. (Ken) Gasper, CH2M HILL, 509-373-1948, F/509-373-9093, kenneth_a_ken_gasper@rl.gov

Office of River Protection
Technology Opportunity Statement

General Reference Information	ACTIVE
2*	***Assigned Tracking Number:*** WT152
1*	***Title:*** Supplemental Pretreatment Technologies
3*	***Summary:*** Removal of solids, and/or radionuclides, and/or readily leachable hazardous waste species will be required for some retrieved salt cake waste feeds for some or all supplemental immobilization technologies. Robust and innovative solutions are needed for the removal of ^{137}Cs, ^{99}Tc, nitrites and nitrates, and solids from saltcake waste streams. For DOE to meet its accelerated goals to complete retrieval and treatment of Hanford tank waste by 2028 the capacity to treat waste must be increased beyond that planned for the Waste Treatment Plant (WTP). The approach now under evaluation to provide this additional capacity is by employing supplemental technologies to treat salt cake tank waste containing 15,000-25,000 MT of sodium*. Some supplemental waste feed pretreatment capacity is required in addition to what will be available from WTP in order to meet the 2028 completion date. One potential supplemental technology to pretreat the waste is to separate bulk solids from hazardous waste constituents and key radionuclides by means of selective dissolution involved in the retrieval by sluicing perhaps in conjunction with fractional crystallization subsequently before supplemental treatment immobilization. *Sodium salts (primarily sodium nitrate, nitrite, carbonate, and hydroxide) make up the vast majority of material in the salt cake tank waste. Related Technical Opportunity Statements WT-144- Fractional Crystallization-- fractional crystallization is one technology option to accomplish separation of hazardous waste constituents and key radionuclides to support supplemental treatment immobilization and to support making additional double shell tank space available. WT-146—Sulfate removal— to accomplish sulfate removal from the salt cake waste to allow the WTP to operate with higher waste loading because of lower sulfate content feed being delivered to WTP. Sulfate removal may be accomplished one or a combination of pretreatment steps such as selective dissolution, fractional crystallization and precipitation of a sulfate compound.
38new	***Principal Contact:*** Kayle D. Boomer, CH2M HILL, 509-372-3629, Fax: 509-376-1788, kayle_d_boomer@rl.gov
Technology Opportunity Description	
8A*	***Project:*** ☐ Safe Storage – Operations and Maintenance ☐ Safe Storage – Life Extension ☐ Waste Retrieval and Transfer – Waste Inventory Properties ☐ Waste Retrieval and Transfer – Equipment ☐ Closure ☐ Disposal X Supplemental Treatment
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW13 Work Breakdown Structure (WBS) No.: 5.09.02

12A	***Problem Description:*** To identify, select and demonstrate a simple, cost effective pretreatment approach at the tank farms for reducing the radionuclide (particularly cesium-137 and technetium-99) and hazardous waste constituents (particularly nitrate and nitrite) of salt cake waste from 68 single shell tanks at Hanford destined for supplemental treatment, reducing the sulfate destined for the WTP, and allowing both treatment facilities to reduce the number of containers of low-activity waste that must be produced. The selected approach shall be compatible with the planned salt cake retrieval approaches and schedule. The selected approach shall also be compatible with feed requirements to the WTP and supplemental treatments that are being pursued (i.e., the results of the technology downselection in October 2003 from Bulk Vitrification, Steam Reforming and Cast Stone). The selected approach should not require major new facilities at the Hanford Tank Farms in order to fully implement. This project will have a high impact of worker safety by avoiding of sulfate accumulation in the WTP and its associated hazard to melter operation, and by reducing the dose level associated with the feed fed through supplemental treatment immobilization that has not gone through the WTP pretreatment facility. The River Protection Project commitment is the retrieval and treatment of all Hanford tank waste to be completed by 2028 with work safety ensured, with minimum impact to the environment, and in the most practical and cost effective manner. Some supplemental waste feed pretreatment capacity is required in addition to what will be available from WTP in order to meet the 2028 completion date. Solution to this problem will result in improved worker safety; schedule improvements, and cost savings. Diverting much of the sulfate, phosphate, and carbonate from the 68 salt cake containing single shell tanks, and the associated sodium from the WTP feed and sending it to supplemental treatment, reduces the total quantity of ILAW that needs to be produced by the WTP by more than 30%. That translates into savings in the operating cost of the WTP and some savings in the total quantity of waste that must be disposed (because the waste loading of the supplemental treatment process will also be higher than the WTP would have been with sulfate). The separation of cesium, technetium, nitrate and nitrite, from the sulfate, phosphate, and carbonates as well as silicates, zeolites and oxalates allows those latter constituents to be incorporated into a bulk vitrification, steam reforming, or cast stone formulations that would be highly leach resistant and readily suited for near surface disposal at a Hanford burial ground. Removal of the cesium ensures lower dose to workers of the resulting separated product for processing, transportation and disposal. Currently, the baseline plan is to retrieve salt cake waste in Hanford single shell tanks by sluicing for eventual transfer to either the WTP or to Supplemental Treatment Facilities. No attempt is planned to reduce the curie content of the liquid being retrieved from a given single shell tank (lowest curie content tanks may be retrieved first). No sulfate removal is incorporated into the baseline approach either in the WTP or Supplemental Treatment facilities. The waste loading at the WTP Immobilized Low Activity Waste Vitrification facility is reduced sufficiently to enable the melters to operate safely and cost effectively (e.g., without premature failure) and for the resulting waste form to meet all requirements.

9*	***Priorities:***		
	Schedule Impact	X HIGH ☐ MED ☐ LOW	Needed to meet PBIs (may be needed prior to immobilizing some retrieved saltcake wastes from SSTs with some supplemental treatment alternatives Needed to meet mission targets (2033 closure) no schedule impact or can improve mission targets (<2033 closure).
	Cost Savings	X HIGH ☐ MED ☐ LOW	>$1B total life-cycle savings >$100M but <$1B total life-cycle savings <$100M total life-cycle savings
	Implementation Cost/Schedule	☐ HIGH X MED ☐ LOW	<$10M and <2 yrs. >$10M and <2 yrs or <$10M and > 2 yrs. >$10M and > 2yrs. or significant technical risk
	Baseline Risk Reduction	X HIGH ☐ MED ☐ LOW	The baseline technical solution has not been proven at large scale or on actual radioactive waste. The baseline technical solution has been demonstrated at large scale but not implemented in radioactive operations. The baseline technical solution has been implemented at Hanford.
Cost Information			
17A*	***Current Baseline Cost:***		
17B	***Estimated Cost Impact:*** Up to 5$B		
18*	***Cost Impact Explanation:*** Allows medium curie feed from SST salt cake retrieval to be immobilized by supplemental treatment facilities before the WTP pretreatment facility is on-line, and also supplements WTP pretreatment facility when it is on line to shorten time to complete tank retrieval, treatment and closure. The Hanford Mission Acceleration employs supplemental treatment in combination with the WTP to process all of the waste by 2028. To complete this processing by 2028 will require immobilizing almost 3000 MT Na/yr. However, the pretreatment facility in the WTP is sized to process 2200 MT Na/yr (River Protection Project System Plan, ORP-11242, Revision 0, December 2002), which would limit the amount of waste that could be immobilized and delay completing waste processing 6 yrs., to 2034. To meet a target completion of 2028 and save the 6 years, pretreatment capacity to treat medium curies salt must also be provided. At a WTP operating cost of $600 M/year, a reduction of 6 years in WTP operation results in a cost savings of $3.6 billion. The sulfate removal further reduces the duration of WTP operation by 2 years with a cost savings of an additional $1.2 billion, for a total of $4.8 billion. During the period 2007-2011 before the WTP pretreatment facility is on-line, the only low curie salt (<.05Ci/L) material available for supplemental treatment immobilization is the approximately 5000 MT Na waste contain in about 35 single shell tanks. To realize the full benefits of supplemental treatment immobilization, capacity to process medium-curie salt must be provided. This requires additional supplemental pretreatment capacity, and selective dissolution (perhaps incorporating fractional crystallize as a subsequent step) is envisioned as the most cost effective approach for attaining this added capacity.		

Risk Information	
37 new	***Risk Identifier:*** ☒ **RPP-CR-037** ☐ New ***Risk Statement:*** Any immobilized waste produced by supplemental treatment must meet performance requirements agreed upon by ORP and WA Dept of Ecology for Land Disposal (e.g., "Good as Glass") Alternative TRU/LLW Treatment Technologies. If field demonstrations of alternative treatment technologies, including TRU and LLW tank waste treatment, are unsuccessful (regulator disapproval, technology failure), then the TPA milestone for completing tank waste treatment is in jeopardy and additional costs and schedule delays may occur. Development and implementation of alternative LLW and TRU tank waste treatment capacity will allow the RPP to complete tank waste treatment in 2028 and support completion of the Hanford cleanup mission in 2035.
12B	***Risk Narrative:*** • If stakeholders do not accept the selected treatment path, then successful disposition of tank waste will not be achieved by 2006. • If stakeholders do not accept treatment other than WTP, then completion of treatment by 2028 will not be achieved. • If waste streams are not pretreated, downstream use of supplemental technologies may be impacted.
Schedule Information	
21	***Regulatory Drivers:*** Any immobilized waste produced by supplemental treatment must meet performance requirements agreed upon by ORP and WA Dept of Ecology for Land Disposal. Supplemental pretreatment is needed to meet the TPA milestones for SST retrieval complete by 2018 and treatment completed by 2028 in a cost-effective mode.
22*	***Milestones*** Baseline case: 9/2006 supplemental treatment deployed and operated to retrieve at least 250,000 gallons of waste. In addition, up to 26 SSTs interim closed (including achieving retrieval) by 9/2005 (and 40 by 9/2006). In the longer term, there are TPA milestones f or SST retrieval complete by 2018 and treatment completed by 2028, which cannot be met with the existing WTP capacity unless supplemental pretreatment is deployed and operated.
28*	**Earliest Date Required:** For supplemental treatment 8/2006 to deploy and process 250,000 gallons. Earlier deployment can process more. For making DST space available: SST retrieval could be rate limited by 9/2004 because of limited availability of DST space. The River Protection Project is beginning the retrieval of salt cake waste from single shell tanks in the summer of 2003 (Tank S-112). Tanks S-102 and another S Farm tank are two of the several tanks to be retrieved early in FY2004. A total of 40 salt cake tanks are targeted for retrieval before the start of FY2007. Promising tank farm pretreatment approaches need to be evaluated so that the partitioning could be used with process monitoring (and verified with sample analysis) on at least one tank in FY 2005. (Incidentally, this partitioned waste may be immobilized with a small scale containerized cast stone or other advanced formulation supplemental treatment immobilization process for the sulfate, phosphate, carbonate, oxalate, silicate, zeolite rich secondary waste stream). Another need is to validate the instrumentation and develop the control parameters (instrument readings showing radionuclide and key constituents concentrations as a function of retrieved volume) on S-102 and another S Farm tank in FY 2004.
29*	**Latest Date Required:** 2010 (WTP expansion decision)

13B	***Schedule Explanation:*** See Cost Impact Explanation, Block 18 above.
U	***Technology Insertion Point:*** X☐ New ☐ Existing Code: Official Date: Technology Insertion Point(s): N/A
Additional Points of Contact (POC)	
34	***Contractor End User POCs:*** Rick Raymond, CH2M HILL, 509-372-8767, Fax: 509-376-6399, Richard_E_Raymond@rl.gov
35	***DOE End User POCs:*** B.M. (Billie) Mauss, ORP, 509-373-5113, F/509-373-1313, billie_m_mauss@rl.gov
36*	***Other Contacts:*** K.A. (Ken) Gasper, CH2M HILL, 509-373-1948, Fax: 509-373-9093, kenneth_a_ken_gasper@rl.gov W. Blaine Barton, CH2M HILL, 509-376-5118, Fax: 509-373-4641, w_b_blaine_barton@rl.gov Michael E. Johnson, CH2M HILL; 509-372-3628;Fax: 509-376-1788, michael_e_johnson@rl.gov D.L. (Dan) Herting, CH2M HILL, 509-372-2532, Fax: 509-373-2843, daniel_l_herting@rl.gov Stewart Mackay, CH2M HILL, 509-372-3634 Fax: 509-372-3983, stewart_m_mackay@rl.gov

Office of River Protection
Technology Opportunity Statement

General Reference Information	**DEFERRED**
2*	***Assigned Tracking Number:*** WT153
1*	***Title:*** Transport of Packaged and Bulk Waste
3*	***Summary:*** Given the limited existing infrastructure (e.g., piping) as well as a desire to avoid the cost of building new infrastructure to support supplemental treatment, identification of alternative methods of moving wastes feeds, treated wastes, and secondary wastes is worth consideration. One possibility to consider is to transport waste rather than mobilize it and transfer it in conventions ways, e.g., using pipes.
38new	***Principal Contact:*** Stewart Mackay, CH2M HILL, 509-372-3634 Fax: 509-372-3983, stewart_m_mackay@rl.gov
Technology Opportunity Description	
8A*	***Project:*** ☐ Safe Storage – Operations and Maintenance ☐ Safe Storage – Life Extension ☐ Waste Retrieval and Transfer – Waste Inventory Properties ☐ Waste Retrieval and Transfer – Equipment ☐ Closure ☐ Disposal X Supplemental Treatment
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW13 Work Breakdown Structure (WBS) No.: 5.09.02
12A	***Problem Description:*** The design and construction of new infrastructure in order to transport waste feeds, secondary wastes, etc. is costly and can reduce schedule flexibility, making it more difficult to accelerate schedule. In an attempt to avoid cost and increase schedule flexibility, alternative methods of moving waste should be considered. One possible approach is to transport waste (i.e., feed streams, secondary wastes streams, immobilized waste, etc.) to and from a treatment capability by means of truck and high integrity containers. Materials that would be considered for transport would include: • Radioactive and chemically hazardous liquids • Radioactive immobilized and/or containerized solids • Radioactive sludges (paste-like materials that don't pump well) The transportation systems must include loading and unloading systems as well as cleaning and considerations for reuse. Bulk quantities will be a few thousand gallons or more. The feasibility of transporting waste by truck rather than through more conventional means needs to be studied. Are there particular flow sheets, process steps or particular tanks where the use of transportation would make sense? What are the costs, risks and schedule impact of transporting waste versus designing, building, and using pipes?

9A*	***Priority:***		
	☐ HIGH	Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction	
	X MEDIUM	Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction	
	☐ LOW	Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation	
9B	***Priorities***		
	Schedule Impact	☐ HIGH	Needed to meet PBIs
		☐ MED	Needed to meet mission targets (2033 closure)
		X LOW	Can improve mission targets or no schedule impact
	Cost Savings	☐ HIGH	>$1B total life-cycle savings
		X MED	>$100M but <$1B total life-cycle savings
		☐ LOW	<$100M total life-cycle savings
	Implementation Cost/Schedule	☐ HIGH	<$10M and <2 yrs.
		X MED	>$10M and <2 yrs or <$10M and > 2 yrs.
		☐ LOW	>$10M and > 2yrs. or significant technical risk
	Baseline Risk Reduction	☐ HIGH	The baseline technical solution has not been proven at large scale or on actual radioactive waste.
		☐ MED	The baseline technical solution has been demonstrated at large scale but not implemented in radioactive operations.
		X LOW	The baseline technical solution has been implemented at Hanford.
Cost Information			
17A*	***Current Baseline Cost:***		
17B	***Estimated Cost Impact:***		
18*	***Cost Impact Explanation:***		
Risk Information			
37 new	***Risk Identifier:*** ☐ CR-_____ [e.g., CR-047] ☐ New ***Risk Statement:***		
12B	***Risk Narrative:*** • If stakeholders do not accept the selected treatment path, then successful disposition of tank waste will not be achieved by 2006. • If stakeholders do not accept treatment other than WTP, then completion of treatment by 2028 will not be achieved. • If waste streams are not pretreated, downstream use of supplemental technologies may be impacted.		

Schedule Information	
21	***Regulatory Drivers:***
22*	***Milestones***
28*	**Earliest Date Required:**
29*	**Latest Date Required:**)
13B	***Schedule Explanation:*** The sooner supplemental technologies can be deployed and operated reduces the required throughput capacity.
U	***Technology Insertion Point:*** ☐ New ☐ Existing Code: _____ Official Date: _____ Technology Insertion Point(s): N/A
Additional Points of Contact (POC)	
34	***Contractor End User POCs:*** Dennis Hamilton, CH2M HILL, 509-376-2423, Fax: 509-376-6399, dennis_w_hamilton@rl.gov
35	***DOE End User POCs:*** B.M. (Billie) Mauss, ORP, 509-373-9876, F/509-372-2781, billie_m_mauss@rl.gov
36*	***Other Contacts:*** K.A. (Ken) Gasper, CH2M HILL, 509-373-1948, F/509-373-9093, kenneth_a_ken_gasper@rl.gov

Office of River Protection
Technology Opportunity Statement

General Reference Information	DEFERRED
2*	***Assigned Tracking Number:*** WT154
1*	***Title:*** Alternative Waste Streams
3*	***Summary:*** For DOE to meet its accelerated goals to complete retrieval and treatment of Hanford tank waste by 2028 the capacity of the Waste Treatment Plant (WTP) to treat waste must be supplemented. One approach to supplement the WTP capacity is to employ supplemental technologies to treat tank waste containing 15,000-25,000 MT of sodium*. Three technology options are being evaluated to select a suitable supplemental to treat low activity waste (LAW) from 68 of the SSTs. Further scrutiny of the tank contents can identify volumes of waste that can be processed more rapidly and economically. For example, some tanks contain only waste that can be classified as TRU or LLW waste. Processing these wastes only requires retrieval and packaging for disposal. Still other opportunities may exist as wastes and individual tanks of waste are critically scrutinized with the intent of processing the waste as quickly as possible while maintaining protection of the public and the environment. *Sodium salts (primarily sodium nitrate, nitrite, carbonate, and hydroxide) make up the vast majority of material in the tank waste. Other cations are also in the waste including aluminum and potassium. The supplemental treatment will process all the other components (anions and cations) in the waste along with the sodium.
38new	***Principal Contact:*** Kayle Boomer, CH2M HILL, 372-3629, F/376-1788, Kayle_d_boomer@rl.gov
Technology Opportunity Description	
8A*	***Project:*** ☐ Safe Storage – Operations and Maintenance ☐ Safe Storage – Life Extension ☐ Waste Retrieval and Transfer – Waste Inventory Properties ☐ Waste Retrieval and Transfer – Equipment ☐ Closure ☐ Disposal X Supplemental Treatment
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW13 Work Breakdown Structure (WBS) No.: 5.9
12A	***Problem Description:*** To optimize economic and rapid processing of the tank waste, each tank, indeed each readily recoverable fraction of tank waste, needs to be considered for its most effective processing. Characteristics that could lead to more economical processing could include, but are not limited to: Waste history—Is the waste from a source other than high level waste (HLW) so that it may me processed more simply than HLW? Has there already been a separation such that its processing requirements can be simplified? Tc content—Technetium is the major contributor to long-term risk (through groundwater

	contamination). Wastes low in Tc may not require immobilization in a durable waste form or require immobilization at all. It is even conceivable, depending on concentration, that such wastes may not require treatment. Cs content—Waste low in Cs (an other gamma emitters) may not require shielding which would greatly reduce the costs for any processing facility (mobile or fixed). TRU content—Except wastes that can be classified as TRU waste and processed only as TRU, concentrations of TRU generally complicate waste processing. Wastes low in TRU may be processed more simply. Insoluble salts content—The bulk of the tank waste is highly soluble sodium nitrate/nitrite and direct disposal of these wastes, regardless of how clean (radioactively) they are would not be allowed. But significant portions of lesser soluble salts are also in the waste. Slurry retrieval techniques may retrieve significant amounts of undissolved waste with very low activity that could be disposed directly.
9A*	***Priority:*** ☐ HIGH — Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction X MEDIUM — Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction ☐ LOW — Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation
9B	***Priorities***
	Schedule Impact — ☐ HIGH Needed to meet PBIs ☐ MED Needed to meet mission targets (2033 closure) X LOW Can improve mission targets or no schedule impact
	Cost Savings — ☐ HIGH >$1B total life-cycle savings X MED >$100M but <$1B total life-cycle savings ☐ LOW <$100M total life-cycle savings
	Implementation Cost/Schedule — ☐ HIGH <$10M and <2 yrs. X MED >$10M and <2 yrs or <$10M and > 2 yrs. ☐ LOW >$10M and > 2yrs. or significant technical risk
	Baseline Risk Reduction — ☐ HIGH The baseline technical solution has not been proven at large scale or on actual radioactive waste. X MED The baseline technical solution has been demonstrated at large scale but not implemented in radioactive operations. ☐ LOW The baseline technical solution has been implemented at Hanford.
Cost Information	
17A*	***Current Baseline Cost:*** $
17B	***Estimated Cost Impact:*** $
18*	***Cost Impact Explanation:***
Risk Information	

37 new	***Risk Identifier:*** ☒ *RPP-CR-036* ☐ New ***Risk Statement:*** Availability of Supplemental LAW Treatment Capacity. If supplemental LAW treatment capability is not available (development, NEPA documentation, design, regulatory permits, and construction) in time to begin LAW treatment in 2010, then the TPA Milestone for completing tank waste treatment in 2028 is in jeopardy, and additional costs and schedule impacts will occur. Development and implementation of supplemental LAW treatment capacity will allow the RPP to complete tank waste treatment in 2028 and support completion of the Hanford cleanup mission in 2035.
12B	***Risk Narrative:***
Schedule Information	
21	***Regulatory Drivers:*** 1/2005 submit LAW supplemental treatment technologies report to Ecology (TPA-M-62-08); 1/2006 submit final Hanford tank waste treatment baseline to Ecology (TPA-M-62-11) [both milestones per TPA Change Number M-62-03-02]
22*	***Milestones:***
28*	***Earliest Date Required:*** 6/2005
29*	***Latest Date Required:*** 2010
13B	***Schedule Explanation:*** Identification of alternative waste streams for accelerated/economic treatment may impact the final treatment strategies for WTP and Supplemental Treatments to complete the Hanford mission. The window of opportunity for completing this work is open until the processes are finally selected and sized. Once the infrastructure is in place the ability to reduce costs is greatly diminished.
30	***Technology Insertion Point:*** ☐ New ☐ Existing Code: _____ Official Date: _____
Additional Points of Contact (POC)	
34	***Contractor End User POCs:*** Stewart Mackay, CH2M HILL, 509-372-3634 Fax: 509-372-3983, stewart_m_mackay@rl.gov; John Kristofzski, CH2M HILL, 373-4225, F/373-9093, john_g_kristofzski@rl.gov :
35	***DOE End User POCs:*** B.M. (Billie) Mauss, ORP, 509-373-9876, F/509-372-2781, billie_m_mauss@rl.gov
36*	***Other Contacts:*** K.A. (Ken) Gasper, CH2M HILL, 509-373-1948, F/509-373-9093, kenneth_a_ken_gasper@rl.gov

Office of River Protection
Technology Opportunity Statement

General Reference Information	**DEFERRED**
2*	***Assigned Tracking Number:*** WT155
1*	***Title*:** Alternative Glasses for Hanford
3*	***Summary:*** Borosilicate glass is the baseline waste form for immobilization of Hanford low activity waste (LAW) and high-level waste (HLW). Borosilicate glass, however, has limitations for some Hanford wastes that make it less desirable. For example sulfate and chromium are limiting components in LAW and HLW glass, respectively. Glasses that could eliminate these limitations and permit higher waste loadings w/o a significant decrease in waste form durability would be valuable alternatives for Hanford application.
38new	***Principal Contact:*** Kayle Boomer, CH2M HILL, 372-3629, F/376-1788, Kayle_d_boomer@rl.gov
Technology Opportunity Description	
8A*	***Project:*** ☐ Safe Storage – Operations and Maintenance ☐ Safe Storage – Life Extension ☐ Waste Retrieval and Transfer – Waste Inventory Properties ☐ Waste Retrieval and Transfer – Equipment ☐ Closure ☐ Disposal X Supplemental Treatments
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW13 Work Breakdown Structure (WBS) No.: 5.9
12A	***Problem Description:*** Borosilicate glass is the baseline waste form for immobilization of Hanford low activity waste (LAW) and high-level waste (HLW). Borosilicate glass, however, has limitations for some Hanford wastes that make it less desirable. For example sulfate and chromium are limiting components in LAW and HLW glass, respectively. Glasses that could eliminate these limitations and permit higher waste loadings without a significant decrease in waste form durability would be valuable alternatives for Hanford application. Some alternative glasses include (but are not limited to): Multiphase glasses: No multiphase borosilicate glass has been approved for the national repository. The waste acceptance criteria allow for multiphase waste forms, but each phase must be documented. Significant waste loading increases could be realized if multiphase glasses could be approved. The general concern for crystalline phases in glass is that the crystal phases may contain radionuclides and may not retain them over long periods of time. Data is needed to qualify multiphase glasses to proof their long-term performance. Aluminosilicate glasses: Aluminosilicate glasses are currently being investigated for application to LAW glass at Hanford. Although the glass doesn't have to be qualified for the repository, data is still needed to assess the waste form's long-term performance for LAW disposal at Hanford. Phosphate glasses: Sulfate is the primary limiting factor for Hanford low activity waste glass. Sulfate is only soluble in borosilicate glass at less that 1%. Iron phosphate glass can incorporate up to 5% sulfate in it glass. If iron phosphate glass was used for Hanford LAW, significantly

	higher waster loadings may be achievable. Also, due to the inherent low viscosity of iron phosphate glass melt rates are typically higher, further increasing the potential capacity of LAW melters. On the other hand, some phosphate glasses are known to be more corrosive to melter ceramics and electrodes. More information is needed to determine an overall cost benefit for large-scale implementation of iron phosphate glasses for Hanford LAW vitrification. The advantages of iron phosphate glass as a waste form are good chemical durability, buffering action of P in the leachate, low melting temperature (so low volatilization of radionuclides), and high solubility of some troublesome components in borosilicate glass, such as sulfate and chromium (not an issue for LAW). However, there are technical issues that must be clarified before the phosphate glasses can be adopted as a waste form: the effect of crystallization on chemical durability and radionuclides partitioning, refractory and electrode corrosion, large-scale process demonstration, waste-form qualification, etc.
9A*	***Priority:*** ☐ HIGH — Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction ☐ MEDIUM — Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction X LOW — Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation
9B	***Priorities***
	Schedule Impact — ☐ HIGH Needed to meet PBIs ☐ MED Needed to meet mission targets (2033 closure) X LOW Can improve mission targets or no schedule impact
	Cost Savings — X HIGH >$1B total life-cycle savings ☐ MED >$100M but <$1B total life-cycle savings ☐ LOW <$100M total life-cycle savings
	Implementation Cost/Schedule — ☐ HIGH <$10M and <2 yrs. ☐ MED >$10M and <2 yrs or <$10M and > 2 yrs. X LOW >$10M and > 2yrs. or significant technical risk
	Baseline Risk Reduction — ☐ HIGH The baseline technical solution has not been proven at large scale or on actual radioactive waste. ☐ MED The baseline technical solution has been demonstrated at large scale but not implemented in radioactive operations. X LOW The baseline technical solution has been implemented at Hanford.
Cost Information	
17A*	***Current Baseline Cost:*** $
17B	***Estimated Cost Impact:***
18*	***Cost Impact Explanation:*** High waste loadings achievable with iron phosphate glasses results in shorter time to complete the Hanford mission and significant life-cycle cost savings.

Risk Information	
37 new	***Risk Identifier:*** ☒ *RPP-CR-036* ☐ New ***Risk Statement:*** Availability of Supplemental LAW Treatment Capacity. If supplemental LAW treatment capability is not available (development, NEPA documentation, design, regulatory permits, and construction) in time to begin LAW treatment in 2010, then the TPA Milestone for completing tank waste treatment in 2028 is in jeopardy, and additional costs and schedule impacts will occur. Development and implementation of supplemental LAW treatment capacity will allow the RPP to complete tank waste treatment in 2028 and support completion of the Hanford cleanup mission in 2035.
12B	***Risk Narrative:*** *[further explanation, if warranted]*
Schedule Information	
21	***Regulatory Drivers: :*** 1/2005 submit LAW supplemental treatment technologies report to Ecology (TPA-M-62-08); 1/2006 submit final Hanford tank waste treatment baseline to Ecology (TPA-M-62-11) [both milestones per TPA Change Number M-62-03-02]
22*	***Milestones:***
28*	***Earliest Date Required:*** 2005
29*	***Latest Date Required:*** 2010
13B	***Schedule Explanation:*** The "Earliest Date" recognizes that phosphate glasses may be an option in bulk vitrification as a Supplemental Treatment. The "Latest Date Required" is based upon final selection of the LAW glass before final decisions to expand the WTP.
30	***Technology Insertion Point:*** ☐ New ☐ Existing Code: Official Date:
Additional Points of Contact (POC)	
34	***Contractor End User POCs:*** Rick Raymond, CH2M HILL, 509-372-8767, Fax: 509-376-6399, richard_e_raymond@rl.gov
35	***DOE End User POCs:*** Bill Hamel, ORP, (509) 373-1569; William_Hamel@rl.gov B.M. (Billie) Mauss, ORP, 509-373-9876, Fax: 509-372-2781, billie_m_@rl.gov
36*	***Other Contacts:*** K.A. (Ken) Gasper, CH2M HILL, 509-373-1948, F/509-373-9093, kenneth_a_ken_gasper@rl.gov

Office of River Protection
Technology Opportunity Statement

General Reference Information	**DEFERRED**
2*	***Assigned Tracking Number:*** WT156
1*	***Title*:** Re-use of Existing Facilities
3*	***Summary:*** As the Hanford River Protection Project (RPP) seeks to accelerate retrieving and processing radioactive tank waste one or more Supplemental Treatment options may be employed to treat 15,000 to 25,000 MT of sodium.* As process options are considered it is important to remember that the Hanford clean up will occur on a "brownfield" and not a "Greenfield". That is, the clean up process will be conducted at a site that already has a significant inventory of processing facilities and infrastructure, many of them unused. This "brownfield" situation presents a challenge to work around with new processing, but it can also present opportunities to fill some system requirements. When conceiving processes to accomplish Supplemental Treatments or resources to execute projects full consideration should be given to using existing resources to reduce cost and accelerate schedule. *Sodium salts (primarily sodium nitrate, nitrite, carbonate, and hydroxide) make up the vast majority of material in the tank waste. Other cations are also in the waste including aluminum and potassium. The waste includes radionuclides, principally cesium-137, technetium-99, strontium-90, and transuranic elements. Other radionuclides will also be present at lower concentrations. The supplemental treatment will process all the other components (anions and cations) in the waste along with the sodium.
38new	***Principal Contact:*** Stewart Mackay, CH2M HILL, 509-372-3634 Fax: 509-372-3983, stewart_m_mackay@rl.gov
Technology Opportunity Description	
8A*	***Project:*** ☐ Safe Storage – Operations and Maintenance ☐ Safe Storage – Life Extension ☐ Waste Retrieval and Transfer – Waste Inventory Properties ☐ Waste Retrieval and Transfer – Equipment ☐ Closure ☐ Disposal X Supplemental Treatment
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW13 Work Breakdown Structure (WBS) No.: 5.9
12A	***Problem Description:*** As RPP plans to accelerate the retrieval and treatment of Hanford radioactive tank waste many process and equipment options exist to retrieve waste for the Waste Treatment Plant (WTP) and supplement the WTP capacity. The systems will be installed into a "brownfield" situation with existing facilities and infrastructure. Existing facilities and infrastructure could provide to Hanford opportunities to reduce cost and schedule. For example, existing processing facilities that are now unused or only partially used may provide space, utilities, even permitting to house new processing equipment, or (even simpler) may provide temporary storage space for radioactive product as permanent disposal facilities are prepared. Below is a list of some (but not all) facilities that could be valuable assets for consideration in system and process conceptualization.

	T-Plant—Is currently being using as a decontamination facility and is also planned for storage of K-basin sludge. Could provide space for radioactive processing or storage space for immobilized waste or waste packages. B-Plant and PUREX—similar to T-Plant but currently closed. Large space for radioactive materials, staging or interim storage. U-Plant—particularly considered for long-term storage of some radioactive wastes. 242 Evaporator/Crystallizer—designed and operated as a crystallizer in its early use. Currently used only as an evaporator. Grout Facility—built as a remote operated process facility for bulk grouting of Hanford waste, but never used for hot waste operation. Could be used as remote processing area. Could be refurbished for full scale grouting operation. Refurbishing costs estimated to be $80M. Grout Disposal Facility (Vaults)—Four vaults designed for bulk grout pouring and permanent disposal could provide 4M gallons of disposal capacity for immobilized waste. Single-Shell Tanks—With a lot of tanks being retrieved and very limited DST space there is a great need for additional interim capacity to stage transfers and feed supplemental treatment processes. Building new storage tanks is cost-prohibitive. A short-term solution could be to use sound SSTs for interim staging. Their use may require extra leak detection capability and mitigation schemes. There are many other smaller buildings (facilities) with utilities that should be considered as processing/storage platforms for Supplemental treatments. Vendors of the Supplemental treatment technologies (e.g. bulk vitrification, containerized grout, steam reforming, etc.) will not be familiar with existing Hanford facilities so effective consideration to re-use existing facilities will require close interactions between the vendors and Hanford engineering staff as the vendors conceptualize and develop their processes. At that point, there remains enough flexibility in the process design to match the features of the facility. If the facility consideration is only conducted after final decisions on the process are made there is almost no chance the existing facility meets all the requirements.
9A*	***Priority:*** ☐ HIGH — Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction ☐ MEDIUM — Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction X LOW — Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation

9B	***Priorities***		
	Schedule Impact	☐ HIGH	Needed to meet PBIs
		☐ MED	Needed to meet mission targets (2033 closure)
		X LOW	Can improve mission targets or no schedule impact
	Cost Savings	☐ HIGH	>$1B total life-cycle savings
		X MED	>$100M but <$1B total life-cycle savings
		☐ LOW	<$100M total life-cycle savings
	Implementation Cost/Schedule	☐ HIGH	<$10M and <2 yrs.
		☐ MED	>$10M and <2 yrs or <$10M and > 2 yrs.
		X LOW	>$10M and > 2yrs. or significant technical risk
	Baseline Risk Reduction	☐ HIGH	The baseline technical solution has not been proven at large scale or on actual radioactive waste.
		☐ MED	The baseline technical solution has been demonstrated at large scale but not implemented in radioactive operations.
		X LOW	The baseline technical solution has been implemented at Hanford.
Cost Information			
17A*	***Current Baseline Cost:*** $		
17B	***Estimated Cost Impact:*** $		
18*	***Cost Impact Explanation:***		
Risk Information			
37 new	***Risk Identifier:*** ☒ *RPP-CR-036* ☐ New ***Risk Statement:*** Availability of Supplemental LAW Treatment Capacity. If supplemental LAW treatment capability is not available (development, NEPA documentation, design, regulatory permits, and construction) in time to begin LAW treatment in 2010, then the TPA Milestone for completing tank waste treatment in 2028 is in jeopardy, and additional costs and schedule impacts will occur. Development and implementation of supplemental LAW treatment capacity will allow the RPP to complete tank waste treatment in 2028 and support completion of the Hanford cleanup mission in 2035.		
12B	***Risk Narrative:*** *[further explanation, if warranted]*		
Schedule Information			
21	***Regulatory Drivers:*** 1/2005 submit LAW supplemental treatment technologies report to Ecology (TPA-M-62-08); 1/2006 submit final Hanford tank waste treatment baseline to Ecology (TPA-M-62-11) [both milestones per TPA Change Number M-62-03-02]		
22*	***Milestones:***		
28*	***Earliest Date Required:*** 6/2003		
29*	***Latest Date Required:*** 2010		
13B	***Schedule Explanation:*** Consideration to re-use existing facilities should begin as Supplemental Treatment vendors develop their conceptual designs (2003). All process options must be collected and evaluated before final decisions whether to build a second WTP (2010).		

30	***Technology Insertion Point:*** ☐ New ☐ Existing Code: _____ Official Date: _____
Additional Points of Contact (POC)	
34	***Contractor End User POCs:*** *[name, organization, telephone, fax, email]*
35	***DOE End User POCs:*** *[name, organization, telephone, fax, email]*
36*	***Other Contacts:*** K.A. (Ken) Gasper, CH2M HILL, 509-373-1948, F/509-373-9093, kenneth_a_ken_gasper@rl.gov

Office of River Protection
Technology Opportunity Statement

General Reference Information	ACTIVE
2*	***Assigned Tracking Number:*** WT157
1*	***Title:*** Strategy for Long-Term Performance Testing and Comparison of Performance For Different Waste Forms
3*	***Summary:*** The long-term performance of a final disposed waste form has a significant impact on the ability of a disposal system to maintain future exposures within acceptable limits. A primary challenge associated with modeling future exposures for thousands of years is that the modeling of the final waste form relies on short-term performance tests that last for only a few months. With the exception of borosilicate glasses, the existing short-term performance tests and/or the existing data are not adequate to perform technically defensible modeling and comparisons of the long-term performance of different waste forms. Hanford is currently investigating other technologies to supplement the low activity waste (LAW) treatment and immobilization capacity of the Waste Treatment Plant (WTP). The supplemental technologies being considered include bulk vitrification, steam reforming, and cast stone (containerized grout). These technologies will produce waste forms that are different from the borosilicate glass modeled in the Immobilized Low-Activity Waste (ILAW) Performance Assessment (PA). Hanford requires results from short-term tests that allow technically defensible modeling of the long-term performance of each waste form. These results must be generated from tests that are appropriate for the waste form and take into account the fundamental mechanism that controls the release of the contaminants and the Hanford specific environment. These tests will allow a comparison of the long-term performance of different potential final waste forms. A near term strategy must be developed that accomplishes two goals. First, the strategy must take the existing, incomplete, short-term performance test data and develop a selection methodology that reduces the risk of making incorrect early down selection decisions for the different waste forms. Second, the strategy must present the technical steps required to generate the data necessary to perform technically defensible modeling of the long-term waste performance of any selected waste form.
38new	***Principal Contact:*** F. M. (Fred) Mann, CH2M HILL, 509-373-3978, F/509-373-3974, frederick_M_Mann@rl.gov
Technology Opportunity Description	
8A*	***Project:*** ☐ Safe Storage – Operations and Maintenance ☐ Safe Storage – Life Extension ☐ Waste Retrieval and Transfer – Waste Inventory Properties ☐ Waste Retrieval and Transfer – Equipment ☐ Closure X Disposal X Supplemental Treatment
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW13 Work Breakdown Structure (WBS) No.: 5.9

12A	***Problem Description:*** The long-term performance of the final disposed waste form has a significant impact on the ability of a disposal system to maintain future exposures within acceptable limits. Modeling of the long-term exposure relies on input data derived from short-term waste form performance tests. Two main items are important in testing that leads to a technically defensible performance assessment. First, the fundamental mechanism that controls the release of the contaminants must be understood and the fundamental weathering or diagenesis (evolution) of the "matrix" of the waste form must be known and considered. Evolution of a waste form matrix from "fresh" to "weathered or aged" is an important consideration for all waste forms. Cementitious waste forms are also subject to additional ageing processes as the porewater chemistry and mineral assemblage in fresh and aged cement can vary significantly. Second, the test must supply input data that is relevant to modeling waste form behavior when exposed to the unsaturated flow conditions expected in Hanford soils. Thus, the paper *A Strategy to Conduct an Analysis of the Long-Term Performance of Low-Activity Glass in a Shallow Subsurface Disposal System at Hanford* (PNNL-11834, by B.P. McGrail, W.L. Ebert, D.H. Bacon, and D.M. Strachen, as revised for the *Hanford Immobilized Low-Activity Waste Performance Assessment: 2001 Version* (DOE/ORP-2000-24, Appendix E) should be modified to include the supplemental technologies being considered for tank waste disposal at the Hanford Site. Through extensive efforts, four tests, the Single Pass Flow Through (SPFT), Pressurized Unsaturated Flow (PUF), Vapor Hydration Test (VHT), and Product Consistency Test (PCT) have been developed that when properly combined allow a good understanding of how glasses will dissolve and release contaminants in Hanford vadose zone soils. The SPFT tests allow for rapid, accurate, and reproducible dissolution rates to be measured on materials with a minimum of experimental artifacts. Results from a series of SPFT tests give the forward reaction rate (dissolution rate) for glass as a function of temperature, pH and leachate composition. The PUF tests create an environment that better simulates the unsaturated flow conditions that exist in the Hanford vadose zone disposal sites. These two tests have been performed on a variety of different borosilicate glass formulations. The extensive database of information from these two tests for borosilicate glasses shows good internal consistency and supplies sufficient information to generate a long-term, waste form performance model that is technically defensible. This model has been used in the ILAW PA to determine contaminant release rate from the ILAW glass waste form. The VHT and PCT tests are used in combination to rapidly screen the relatively durability of borosilicate glasses and hence are most useful in product comparison and product acceptance roles. Hanford is currently investigating various technologies to supplement the LAW treatment and immobilization capacity of the Waste Treatment Plant (WTP). The supplemental technologies being considered include bulk vitrification, steam reforming, and containerized grout. These technologies will produce waste forms that are different from the borosilicate glass modeled in the ILAW PA. Hanford requires accelerated test results that allow technically defensible modeling of the long-term performance of each waste form. These test results must be generated from tests that are appropriate for the waste form and take into account the fundamental mechanism that controls the release of the contaminants. The new waste forms from bulk vitrification, steam reforming, and containerized grout each present unique technical challenges. The bulk vitrification waste form is an aluminosilicate glass. Like the ILAW borosilicate glasses, contaminants in an aluminosilicate glass have very low solid-state diffusion rates and contaminant release is predominantly controlled by the dissolution rate of the non-porous glass waste form. Because the fundamental mechanisms controlling the long-term durability of bulk vitrification waste forms should be similar to those for borosilicate glass, the test methods, approach, and methodology for modeling the long-term performance of this waste form can

follow the established example based in the current ILAW PA. A database for aluminosilicate glasses will need to be generated to provide sufficient information to generate a long-term waste form performance model that is technically defensible.

Steam reforming produces a granular waste form that is comprised of several different crystalline phases. The dissolution rates of the different crystalline phases along with the internal porosity of the individual granules are thought to play a role in controlling the rate of contaminant release. However, no standard waste form performance test has been established for this waste form. Based on preliminary work conducted at PNNL and SRTC, the SPFT, PUF, and PCT tests appear to be useful in collecting the necessary data for PA modeling. However, additional testing is required before the fundamental mechanism that controls the release of the contaminants is understood and technically defensible long-term modeling can be performed.

The waste form produced by the cast stone (containerized grout) technology is significantly different from the glass waste forms and the steam-reforming product. Newly prepared grout waste forms that have cured for a few months are porous and the pore space is filled with a high pH solution that results from hydration products of the cement (calcium silicate and calcium hydroxide). It is commonly assumed that contaminants in the high-pH pore solution diffuse to the surface of the waste form where they are leached by infiltrating water. Contaminant-specific diffusion coefficients are determined with the ANSI/ANS 16.1 test. This test consists of placing a sample of the grout waste form in demineralized water or in selected cases site specific groundwater/vadose zone porewater for specified lengths of time and fitting the data to an assumed diffusion model to generate a diffusion coefficient. Although the ANSI/ANS 16.1 leach test presents a method for comparing the performance of different newly prepared grout formulations, its use to assess the long-term performance of grout has numerous flaws. First, the assumption of diffusion-controlled release from grout is fundamentally flawed. Contaminants that form precipitates or strongly adsorb to the solid surfaces of the grout are controlled by solubility and/or sorption processes. Hence, the mechanism controlling their release rate is not diffusion-controlled mass transport. Second, pore solution chemistry and the pore structure of grouts are fundamentally time varying so diffusion coefficients measured over a few weeks time period have little relationship to grouts aged over thousands of years. The pore structure of the grout is affected by the curing process, which continues to form hydration products thereby improving the performance of the grout. Conversely, the high pH pore solution initially present in grouts will slowly be neutralized by the dissolved CO_2 present in infiltrating water and air-filled pores in the vadose zone at Hanford. This will cause the slow dissolution of some primary minerals (such as calcium silicate hydrate and portlandite) increasing the porosity and eventually increasing release rates. Also, mineral assemblages in grout evolve to more crystalline solids that have in general lower surface areas and possibly less tolerance for lattice substitutions of waste impurities. The effects of unsaturated flow conditions, other aging reactions, and grout matrix dissolution are also not adequately considered with a simple diffusional release model. Very little consideration has also been given to the potential effects of grouted waste on the physical and chemical properties of soils that underlie the ILAW facility. Reactive chemical transport simulations suggest that fingering convection may be enhanced as highly alkaline plumes disperse into the surrounding soil.

In summary, the current strategy for extrapolating short-term tests on borosilicate glasses to long-term performance results must be modified to include other waste forms under consideration. In addition, more testing of steam reforming products is required before the fundamental mechanism that controls the release of the contaminants is understood and technically defensible long-term modeling can be performed. Also, a much better understanding of the fundamental mechanisms controlling contaminant release rates from grout waste forms and a systems-level analysis of an

	ILAW disposal site with grouted waste is needed. Development of new accelerated tests that can account for grout aging and Hanford specific conditions is critically needed.
9a*	***Priority:*** X HIGH — Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction ☐ MEDIUM — Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction ☐ LOW — Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation
9b*	***Priorities***

Schedule Impact	x HIGH ☐ MED ☐ LOW	Needed to meet PBIs Needed to meet mission targets (2033 closure) Can improve mission targets or no schedule impact
Cost Savings	x HIGH ☐ MED ☐ LOW	>$1B total life-cycle savings >$100M but <$1B total life-cycle savings <$100M total life-cycle savings
Cost/Schedule	☐ HIGH x MED ☐ LOW	<$10M and <2 yrs. >$10M and <2 yrs or <$10M and > 2 yrs. >$10M and > 2yrs. or significant technical risk
Baseline Risk Reduction	x HIGH ☐ MED ☐ LOW	The baseline technical solution has not been proven at large scale or on actual radioactive waste. The baseline technical solution has been demonstrated at large scale, but not implemented in radioactive operations. The baseline technical solution has been implemented at Hanford.

Cost Information	
17A*	***Current Baseline Cost:*** Costs to complete the Hanford waste treatment mission by 2028 include building a second WTP at a cost of ~$1billion.
17B	***Estimated Cost Impact:*** $
18*	***Cost Impact Explanation:*** CH2M HILL PBI impact--$800K for each 100,000 gallons of tank waste retrieved and processed as LAW.
Risk Information	
37 new	***Risk Identifier:*** ☐ CR-_____ [e.g., CR-047] ☐ New ***Risk Statement:***
12B	***Risk Narrative:***
Schedule Information	
21	***Regulatory Drivers:***
22*	***Milestones:***
28*	***Earliest Date Required:***
29*	***Latest Date Required:***
13B	***Schedule Explanation:***

30	***Technology Insertion Point:*** ☐ New ☐ Existing Code: _____ Official Date: _____
Additional Points of Contact (POC)	
34	***Contractor End User POCs:*** F. M. (Fred) Mann, CH2M HILL, 509-373-3978, F/509-373-3974, frederick_m_mann@rl.gov
35	***DOE End User POCs:*** Phil LaMont, DOE-ORP, 509-376-6117, Fax: 509-373-0628, Philip_E_LaMont@rl.gov; Billie Mauss, DOE-ORP, 509-373-5113, Fax: 509-373-1313, billie_m_mauss@rl.gov
36*	***Other Contacts:*** K.A. (Ken) Gasper, CH2M HILL, 509-373-1948, F/509-373-9093, kenneth_a_ken_gasper@rl.gov J.G. (John) Kristofski, CH2M HILL, 509-373-4225, F/509-373-9093, john_g_gristofzski@rl.gov

Office of River Protection
Technology Opportunity Statement

General Reference Information		**ACTIVE**
2*	***Assigned Tracking Number:*** WT158	
1*	***Title:*** Tailored Disposal Systems	
3*	***Summary:*** Supplemental Treatment Technologies may not create a wasteform that is inherently as durable as borosilicate glass from the Waste Treatment Plant (WTP). Improvements to the disposal system may be a cost effective approach to reduce risk from less durable waste forms that derive from supplemental treatments.	
38new	***Principal Contact:*** Fred Mann, CH2M HILL, 373-3978 F/373-3974; frederick_m_mann@rl.gov	
Technology Opportunity Description		
8A*	***Project:*** ☐ Safe Storage – Operations and Maintenance ☐ Safe Storage – Life Extension ☐ Waste Retrieval and Transfer – Waste Inventory Properties ☐ Waste Retrieval and Transfer – Equipment ☐ Closure X Disposal X Supplemental Treatment	
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW13 Work Breakdown Structure (WBS) No.: 5.9	
12A	***Problem Description:*** Supplemental Treatment Technologies may not create a waste form that is inherently as durable as borosilicate glass from the Waste Treatment Plant (WTP). The acceptability of a supplemental treatment option may require that the disposal system be designed to reduce the release of contaminants of concern to the environment. Three Supplemental Treatment Options are currently being considered: Containerized Grout, Bulk Vitrification, and Steam Reforming. The grout process is expected to require the least initial capital investment, but is known to retain contaminants of concern (COCs) more poorly than borosilicate glass. For grout, nitrate is a special contaminant of concern. In the state of Washington contamination of the groundwater with nitrate above 10ppm (or nitrite >2ppm) is contrary to state law. Methods to mitigate the release of nitrate/nitrite to the ground water would make a containerized grout treatment option more attractive. Bulk vitrification and steam reforming decompose the nitrates and nitrites in the feed so nitrate/nitrite are not COCs for these treatment options. All of the treatment options will have to prove they retain RCRA metals and listed organics to within land disposal standards. However, it is not expected that disposal facilities for grout or bulk vitrified glass will have to include special design special features to mitigate release of RCRA metals or organics. The fate of RCRA metals in steam-reformed product is not sufficiently understood to be sure that all RCRA metals will be retained satisfactorily. The possibility exists that some RCRA metals will not enter the stable mineral forms but may enter less stable forms or create new unstable forms. The high temperatures of steam reformer processing will mostly likely destroy all organic contamination and, therefore, greatly reduce the likelihood that organics release would constrain acceptability of this waste form.	

	Retention of radionuclides for time periods far exceeding engineering or administrative controls (over 1,000years) is required by the code of Federal Regulations for radioactive wastes. Special concern is paid to technetium because of its long half-life and mobility in the environment. Disposal systems that provide long-term mitigation of technetium release are needed to reduce risk. Other radionuclides for which mitigating strategies would be valuable include iodine (for all technology options) and uranium (not needed for grout). There are many technology options that could be used to mitigate release of COCs, and multiple technologies may be employed in tandem to "tailor" a disposal system for optimal performance. Two of the general technical approaches are: Hydraulic barriers to prevent moisture (liquid or vapor) from contacting the waste form and transporting contaminants to the groundwater. Reactive systems to chemically prevent the release of COCs to the ground water. Systems to react nitrate or nitrite would be of interest for a containerized grout disposal facility. Special reactive systems to chemical bind contaminants (getters) are of special interest to mitigate Tc and lesser interest to mitigate I or U. There are multiple specific approaches within these general categories and still other technology approaches may be devised.
9a*	***Priority:*** X HIGH — Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction ☐ MEDIUM — Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction ☐ LOW — Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation
9b	***Priorities***

Schedule Impact	☐ HIGH x MED ☐ LOW	Needed to meet PBIs Needed to meet mission targets (2033 closure) Can improve mission targets or no schedule impact
Cost Savings	☐ HIGH x MED ☐ LOW	>$1B total life-cycle savings >$100M but <$1B total life-cycle savings <$100M total life-cycle savings
Implementation Cost/Schedule	x HIGH ☐ MED ☐ LOW	<$10M and <2 yrs. >$10M and <2 yrs or <$10M and > 2 yrs. >$10M and > 2yrs. or significant technical risk
Baseline Risk Reduction	x HIGH ☐ MED ☐ LOW	The baseline technical solution has not been proven at large scale or on actual radioactive waste. The baseline technical solution has been demonstrated at large scale but not implemented in radioactive operations. The baseline technical solution has been implemented at Hanford.

Cost Information

17A*	***Current Baseline Cost:*** $
17B	***Estimated Cost Impact:*** $
18*	***Cost Impact Explanation:***
Risk Information	
37 new	***Risk Identifier:*** ☐ CR- [e.g., CR-047] ☒ New ***Risk Statement:*** If the combined waste form/disposal system doesn't sufficiently retain contaminants of concern then the supplemental treatment cannot be used.
12B	***Risk Narrative:***
Schedule Information	
21	***Regulatory Drivers:*** WAC (groundwater protection), RCRA, CFR (radionuclides)
22*	***Milestones:*** Aug. 2003; disposal system enhancements must be identified and have demonstrated promise to be considered during technology down selection (most important for grout).
28*	***Earliest Date Required:*** Aug. 2003
29*	***Latest Date Required:*** 2010 (decision point for WTP expansion)
13B	***Schedule Explanation:***
30	***Technology Insertion Point:*** ☐ New ☐ Existing Code: _____ Official Date: _____
Additional Points of Contact (POC)	
34	***Contractor End User POCs:*** Fred Mann, CH2M HILL, 373-3978 F/373-3974; frederick_m_mann@rl.gov Danny Parker, CH2M HILL, 372-0766, F/372-1664, danny_l_parker@rl.gov
35	***DOE End User POCs:*** Phil LaMont, DOE-ORP, 509-376-6117, Fax: 509-372-1350, philip_e_lamont@rl.gov; Billie Mauss, DOE-ORP, 509-373-5113, Fax: 509-373-1313, billie_m_mauss@rl.gov
36*	***Other Contacts:*** K.A. (Ken) Gasper, CH2M HILL, 509-373-1948, F/509-373-9093, kenneth_a_ken_gasper@rl.gov

Office of River Protection
Technology Opportunity Statement

General Reference Information	**DEFERRED**
2*	***Assigned Tracking Number:*** WT159
1*	***Title:*** Remote Pit Cleanout and Riser Preparation
3*	***Summary:*** Methods need to be developed to reduce exposure, time and cost of preparing pits and risers for installation of retrieval and interim closure equipment. This Opportunity Statement is closely related to Technology Opportunities Statements WT021 Improve Pit Remote Operation Tools (Pit Viper) and WT137 Removal/Decontamination of In-Tank Equipment. Note: Hose-in-hose transfer lines with junction boxes on the surface are being used now instead of pits. The pit viper is felt to be expensive and difficult to deploy. Inspect tank risers was identified in FY03 as a tough technical problem (#4). Currently plug gauges are used that require crane crews and massive effort. Is there a hand-held tool that could be lowered into the riser that would determine (electronically compute) riser diameter, circularity, axis alignment, etc.? Currently we are lucky to get all required dimensions, etc. for one riser on a tank; we would like that info on several, or all, of the risers. (Roger Bauer). PNNL has successfully performed similar measurements for deployment of equipment at U-Plant to ensure that the equipment could fit through the existing openings below grade. There are several options, depending upon the exact requirements of inspection that could be deployed without the use of crane crews for quick measurements.
38new	***Principal Contact:*** Warren Thompson, CH2M HILL, 509-372-8053, Fax: 509-373-4095, warren_t_thompson@rl.gov
Technology Opportunity Description	
8A*	***Project:*** ☐ Safe Storage – Operations and Maintenance ☐ Safe Storage – Life Extension ☐ Waste Retrieval and Transfer – Waste Inventory Properties X Waste Retrieval and Transfer – Equipment ☐ Closure ☐ Disposal
8B*	***PBS No. or Other Project Identifier:*** Program Baseline Summary (PBS) No.: ORP-TW04 Work Breakdown Structure (WBS) No.: 5.08.05
12A	***Problem Description:*** Deployment of the retrieval technologies requires some degree of pit cleanout, equipment/debris removal, and/or riser preparation. The pits are contaminated, and some are deep. Current methods for working in pits rely on pole tools, mirrors, and other extended reach hand tools to perform pit activities. These methods are labor intensive, costly, and result in a high worker dose. A commercial off the shelf remote arm and deployment platform, called the Pit Viper was demonstrated in the tank farms (See Technology Opportunities Statement WT021, Improve Pit Remote Operation Tools). Other approaches and technologies are desired to fully implement the pit decontamination, equipment/debris removal, (See Technology Opportunities Statement WT137, Removal-Decontamination of In-Tank Equipment) and riser preparation (See Technology Opportunities Statement WT136, Installation of New Risers in SSTs). The latter deals only with installation of new risers, whereas there will be riser preparation activities needed are many more existing risers to adapt them for the installation of

	new retrieval equipment.		
9*	***Priority:*** ☐ HIGH Large cost benefit, short term implementation needed to achieve benefits, easy to implement, high risk reduction X MEDIUM Moderate cost benefit, near term implementation needed to achieve benefits, moderately easy to implement, moderate risk reduction ☐ LOW Low cost benefit, long term implementation acceptable, difficult to implement, low risk mitigation		
9B	***Priority***		
	Schedule Impact	☐ HIGH ☐ MED ☐ LOW	Needed to meet PBIs Needed to meet mission targets (2033 closure) Can improve mission targets or no schedule impact
	Cost Savings	☐ HIGH ☐ MED ☐ LOW	>$1B total life-cycle savings >$100M but <$1B total life-cycle savings <$100M total life-cycle savings
	Implementation Cost/Schedule	☐ HIGH ☐ MED ☐ LOW	<$10M and <2 yrs. >$10M and <2 yrs or <$10M and > 2 yrs. $10M and > 2yrs. or significant technical risk
	Baseline Risk Reduction	☐ HIGH ☐ MED ☐ LOW	The baseline technical solution has not be proven at large scale or on actual radioactive waste. The baseline technical solution has been demonstrated at large scale but not implemented in radioactive operations. The baseline technical solution has been implemented at Hanford.
Cost Information			
17A*	***Current Baseline Cost:*** $TBD Concerned Projects being identified		
17B	***Estimated Cost Impact:*** $TBD Path forward to be defined		
18*	***Cost Impact Explanation:***		
Risk Information			
37 new	***Risk Identifier:*** ☒ **RPP-CR-032** ☐ New ***Risk Statement:*** If remote pits cannot be sufficiently cleaned out or risers prepared, then alternate pits and/or risers may need to be used. If they are not available, then the desired retrieval and interim closure approaches and schedule may be more difficult or impossible to implement. Pit Condition RPP-CR-032. If the tank and pits are not acceptable for use, then design and construction activities will be impacted. If the pits cannot be cleaned to acceptable worker dose levels, then there may be cost increases and schedule delays.If pits (SY, S-12A, S-A, and S-C) are not acceptable for use, then design and construction activities will be impacted. If the pits to be upgraded are in worse physical condition than assumed, then additional repairs will be necessary resulting in increased construction costs and schedule delays.		
12B	***Risk Narrative:*** If the pit or riser can't be used because of contamination, or obsolete equipment in the way, then alternatives contingency plans may be expensive and time consuming, hindering CH2M HILL ability to achieve the aggressive schedule defined in the IMAP.		

Schedule Information	
21	***Regulatory Drivers:*** The W-314 upgrades are driven by the TPA M-43 milestones
22*	***Milestones:*** TPA M-43 milestones and the Mission Acceleration schedule identified in the Integrated Mission Acceleration Plan. For example: retrieval and interim closure of 26-40 SSTs by the end of FY 2006.
28*	***Earliest Date Required:*** FY03 for retrieval of C-106, U-107, S-102, S-112
29*	***Latest Date Required:*** FY05 for W-314, beyond for W-211, W-521 and SST retrieval Projects
13B	***Schedule Explanation:*** SST Retrievals are driven by RPP-13678, the Integrated Mission Acceleration Plan, to achieve the CH2M HILL contract modifications approved at the start of FY03.
30	***Technology Insertion Point:*** ☐ New ☐ Existing Code: Official Date:
Additional Points of Contact (POC)	
34	***Contractor End User POCs:*** Warren Thompson, CH2M HILL, 509-372-8053, Fax: 509-373-4095, warren_t_thompson@rl.gov
35	***DOE End User POCs*** Mike Royack, (509) 376-4420, michael_j_royack@rl.gov
36*	***Other Contacts:*** John Bailey, CH2M HILL Tel(509) 372-0045 Fax (509)372-2403 john_w_bailey@rl.gov; Dan Baide, CH2M HILL Tel(509) 376-3274 Fax (509)373-6101 daniel_g_daide@rl.gov

Appendix B

Active Technical Challenge Sheets

August 2003

Active Technical Challenge Area http://www.hanford.gov/chgcp/futureprocurement.cfm	**Title (Technology Opportunity Reference Document)**
Safe Storage – Life-Extension Project	Double-Shell Tank (DST) Non-Destructive Examination (NDE) Tools (WT133)
Retrieval and Transfer – Equipment (SST Retrieval)	Tank Leak Detection, Monitoring and Mitigation (LDMM) Systems (WT026, WT027)
Retrieval and Transfer – Equipment (SST Retrieval)	Installation of New Risers in SSTs (WT136) *
Closure	Post-Retrieval Evaluation: In-Situ Characterization (WT102) and Technology to Support Post-Retrieval Evaluation of SSTs (WT115)
Disposal	Strategy for Long-Term Performance Testing and Comparison of Performance for Different Waste Forms (WT157)
Disposal	Tailored Disposal Systems (WT158)

* This Technical Challenge Sheet is currently inactive.

CH2M HILL Hanford Group, Inc.
Technical Challenge Sheet

1. **CH2M HILL Technical Challenge Area:** Safe Storage-Life Extension Project

2. **Title:** Double Shell Tank (DST) Non-Destructive Examination (NDE) Tools

3. **CH2M HILL Points of Contact:**
   Ken Gasper (509) 373-1948, Fax: (509) 373-9093, kenneth_a_ken_gasper@rl.gov

4. **Description:**
   Compliance to *Washington Administrative Code* (WAC) 173-303-640(2) requires the assessment of existing dangerous waste tank system's integrity. This assessment must determine that the tank system is adequately designed and has sufficient structural strength and compatibility with the waste(s) to be stored or treated, to ensure that it will not collapse, rupture, or fail. In addition, Washington Department of Ecology Administrative Orders 00NWPKW-1250 and -1251 require that by March 31, 2006 an integrity assessment report for the Hanford Site Double-Shell Tank System be submitted that assesses the integrity of the 28 DSTs and their ancillary equipment. One need is for an NDE method to rapidly screen large tank surfaces (10 – 12%) to identify areas of primary concern, including access to rough surfaces.

This is not an RFI or RFP and there is no guarantee that it will result in a procurement.
It is the intent of CH2M HILL to share our potential needs with the vendors.

CH2M HILL Hanford Group, Inc.
Technical Challenge Sheet

1. **CH2M HILL Technical Challenge Area:** Retrieval and Transfer-Equipment (SST Retrieval)

2. **Title:** Tank Leak Detection, Monitoring and Mitigation (LDMM) Systems

3. **CH2M HILL Points of Contact:**
Ken Gasper (509) 373-1948, Fax: (509) 373-9093, kenneth_a_ken_gasper@rl.gov

4. **Description:**
Improvements may be needed in both in-tank and ex-tank leak detection methods for use while wastes are being retrieved and transferred from potentially leaking SSTs. Currently, mass balance calculations based on static liquid levels have a potential error factor equal to four- to eight-thousand gallons while dynamic mass balance methods for salt tanks can have uncertainties much larger and a stable static liquid surface is not available during the bulk of salt retrieval by modified sluicing. Furthermore, leaks must carry gamma-emitting waste to within one half to one meter of existing dry wells before they can be detected with high-resolution spectral gamma systems. Neutron moisture detectors require the plume to come within 150 cm of the dry wells. Both in-tank and ex-tank leak detection systems that improve on the capabilities of the current baseline approach are needed. The objective is to detect a minimum quantity of liquid escaping the containment of a waste tank in real time and monitor the amount lost so that appropriate mitigation measures can be implemented. The system must have a low probability of reporting as a leak some other anomalie (i.e., creating a false alarm). The tank farm areas are congested with underground utilities and pipelines, so instrumentation deployed deep in the ground must take into consideration the difficulty, expense and schedule impact of placing sensing probes. There are relatively few access ports (tank risers) available for deployment of sensors inside a tank. Leak detection technologies capable of utilizing the existing infrastructure of steel-cased dry wells are desirable. Six to eight drywells are located around each 75-ft diameter Single Shell Tank.

The site geology, although relatively uniform, contains lenses of silt and gravel that can affect the subsurface migration of tank waste leaks. Furthermore, geologic anomalies (e.g., clastic dikes) can exist further complicating the subsurface migration of tank waste leaks.

While dry wells extend around the immediate periphery of most SST's to depths ranging from 80 to 130 feet, there are no operating well structures that allow detection directly beneath the tanks to allowing detection of potential leaks moving vertically from the center of the tank.

Possible solutions are tracer, electrical, electromagnetic, seismic, radar, and other cost effective techniques capable of leak detection throughout the volume of soil surrounding a tank to enable early, reliable, and accurate leak detection. It is desirable for leak detection technologies to have a 95% probability of detection with no more than a 5% probability of false alarms. It is also desirable for leak detection technologies to be capable of using the existing infrastructure of steel-cased dry wells to minimize deployment costs. Better in-tank

leak detection methods are also important and could include spectral gamma detection techniques, pressure transducer technology, and other methods.

Mitigating systems that improve on the capabilities of the current baseline approach could be considered. The objective is to prevent, curb, or eliminate the possibility or extent of liquid waste leakage from underground storage tanks into the surrounding soils. If cost-benefit, risk-reduction, and alternatives evaluations of new in-tank and ex-tank mitigating technologies determine that deployment, implementation, and operation are feasible, then further evaluation should be pursued. Such evaluations may include bench- and field-scale demonstrations and testing. Example concepts that could be evaluated include retrieval methods and operating strategies that minimize the potential for leakage, leak point and potential leak point location, seek-and-seal devices and methods, administrative approaches that maximize the use and coordination of currently available tools and methods including such things as sheet pile barriers, close-coupled grout injection barriers, dry-air containment barriers, auxiliary pumping schemes, reactive zones/barriers, "stop-leak" formulations, waste mining strategies, and other approaches.

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CH2M HILL Hanford Group, Inc.
Technical Challenge Sheet

1. **CH2M HILL Technical Challenge Area:** Retrieval and Transfer – Equipment (SST Retrieval)

2. **Title:** Installation of New Risers in SSTs (Single-Shell Tanks)

3. **CH2M HILL Point of Contact:**
   Ken Gasper (509) 373-1948, Fax: (509) 373-9093, kenneth_A_Gasper@rl.gov

4. **Description:**
   Hanford stores radioactive waste in underground tanks 20 ft in diameter (55,000 gallon capacity) or 75 ft in diameter (530,000 – 1.3 million gallon capacity) that are buried 6 or more feet. Access to the top of these tanks is through risers (4-40 inch diameter pipes rising from the dome of the tank to the ground surface or to access pits). Retrieval equipment may require 32" diameter risers in more SSTs. For closure activity support, new smaller diameter risers (8-12 inch dia.) positioned around the perimeter of the tank to optimize grout placement could be less expensive than removing equipment to gain access for tank fill, would allow relaxing constructability requirements (flow distance) for grout fill design, and would promote displacement of residual waste towards center of tank for improved long term performance, similar to strategy employed at Savannah River Site (SRS) and Idaho National Environmental and Engineering Laboratory (INEEL).

   Risers penetrating the tank domes provide access to the tanks. Existing risers vary in diameter from 4 inches to 42 inches. For 4 of 5 tanks scheduled for closure in FY04 (C-106 and C-200s), equipment removal to permit access for tank fill is required and planned. Potential access problems for other tanks scheduled for interim closure in FY04-FY06 have not been evaluated. Availability of new riser technology by the end of FY04 would enhance ability to meet the interim tank closure schedule for most of the 26-40 tanks scheduled for closure by the end of FY06.

CH2M HILL Hanford Group, Inc.
Technical Challenge Sheet

1. **CH2M HILL Technical Challenge Area:** Closure

2. **Title:** Post-Retrieval Evaluation: In-Situ Characterization (WT102)
   Technology to Support Post-Retrieval Evaluation of SSTs (WT115)

3. **CH2M HILL Point of Contact:**
   Ken Gasper (509) 373-1948, Fax: (509) 373-9093, kenneth_a_ken_gasper@rl.gov

4. **Description:**
   A technology or methodology is needed to evaluate the volume of tank contents, before, during, and after retrieval and transfer, as well as the post-retrieval residual contents. Before and during retrieval, volume measurement supports mass balance. Post retrieval volume and content measurement supports demonstration of closure requirements. Currently, waste level measurement is used for mass balance. Alternative technologies would allow better measurement, especially once supernatant liquids have been removed, uncovering uneven solid surfaces. A related problem is measuring the volume of solids remaining in the tank with a small layer of water (e.g. transfer pipeline back flush water) setting on top of the solids.

   WT102:
   In-situ characterization technologies would support post-retrieval evaluations of residual waste, as well as contamination in soils beneath RPP facilities. It is also important to determine interstitial liquid volumes and associated inventories of contaminants of concern. In situ characterization could also be used to support evaluating ancillary piping and other equipment.

   Better in situ characterization techniques could have a high return on investment in terms of reduced sampling and analysis costs, and could potentially provide off-riser characterization data in support of retrieval, Leak Detection, Monitoring, and Mitigation (LDMM) system designs, and closure planning.

   A fundamental understanding of the true radionuclide source-term from tank residuals is needed to base sound cost/benefit/risk decisions regarding the extent of waste removal actually required from the tanks to meet site-wide groundwater protection standards. A better understanding of the presence and impact of complexants on contaminant mobility is also needed. Finally, methods to determine the release rate (i.e. leach rate) from any remaining residuals left in the tank at the completion of retrieval are needed to support interim closure decisions and path forward.

   WT115:
   In addition to measuring against closure requirements, the SST retrieval program's near term projects are tasked with improvement upon the baseline retrieval technology of past practice sluicing. The Tank Volume Measurement System (TVMS), formerly known as the upgraded Topographical Mapping System (TMS), could be used to develop waste retrieval efficiency

and cost profiles for the various alternative retrieval technologies. This will assist in out-year planning and address the challenges of funding the baseline scope.

A method of determining the volume of waste that is potentially cheaper than laser mapping (but most likely not as accurate) is stereo photographs. This may require videos from more than one location in the tank, but it is still possible to use the stereo concept to measure volume in piles.

Closure Projects need tools to evaluate/characterize contaminants of concern in the residuals left in the tank at the conclusion of retrieval to support closure planning and the design of engineered barrier systems to stabilize, isolate, and immobilize residual wastes to ensure protection of human health and the environment. An in situ measurement technique for characterizing mobile, long-lived, contaminants of concern in tank waste residuals avoids the turn-around times and costs associated with extracting samples and sending them to the laboratory for analyses. From a groundwater perspective, the key contaminants of concern include Technetium-99 and uranium. Other mobile, long-lived, contaminants of concern include Iodine-129, Selenium-79, and Carbon-14.

Other critical aspects of the residual waste characterization problem include the possible need for off-riser sampling capabilities to access waste piles that are not directly beneath sampling risers. This may necessitate interface with robotic crawlers and/or articulated masts to provide the access necessary for in situ residual waste characterization.

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It is the intent of CH2M HILL to share our potential needs with the vendors.

CH2M HILL Hanford Group, Inc.
Technical Challenge Sheet

1. **CH2M HILL Technical Challenge Area:** Disposal

2. **Title:** Strategy for Long-Term Performance Testing and Comparison of Performance for Different Waste Forms

3. **CH2M HILL Point of Contact:**
Ken Gasper (509) 373-1948, Fax: (509) 373-9093, kenneth_a_ken_gasper@rl.gov

4. **Description:**
As part of the Hanford Mission Acceleration, CH2M HILL is currently developing a strategy to predict long term performance of alternative waste forms based upon the results of short-term tests. The long-term performance of the final disposed waste form has a significant impact on the ability of a disposal system to control contaminant release within acceptable limits. Two main items are important in developing the strategy to model the long-term performance of a waste form into a technically defensible performance assessment.
   - The fundamental mechanism that controls the release of the contaminants must be understood, and the fundamental weathering or diagenesis (evolution) of the "matrix" of the waste form must be known and considered.
   - A test must supply input data that is relevant to modeling waste form behavior when exposed to the unsaturated flow conditions expected in Hanford soils.

Through extensive efforts, the mechanisms of contaminant release from borosilicate glass have been elucidated and tests developed that supply input for appropriate long-term performance assessment (see PNNL report, "A Strategy to Conduct an Analysis of the Long-Term Performance of Low-Activity Waste Glass in a Shallow Subsurface Disposal System at Hanford," PNNL-11834). However, a similar understanding is lacking for other waste forms being considered from treatments other than vitrification into borosilicate glass. The supplemental technologies being considered include bulk vitrification, steam reforming, and containerized grout. Hanford requires an understanding of the basic mechanisms that will govern contaminant release from these waste forms and accelerated test results that allow technically defensible modeling of their long-term performance. Modeling of each new waste form (bulk vitrification, steam reforming, and containerized grout) presents unique technical challenges.

Bulk Vitrification--The bulk vitrification waste form is an alumino-silicate glass. Like the ILAW borosilicate glasses, contaminants in an alumino-silicate glass have very low solid-state diffusion rates, and contaminant release is predominantly controlled by the dissolution rate of the non-porous glass waste form.

Steam Reforming--Steam reforming produces a granular waste form that is comprised of several different crystalline phases. The dissolution rates of the different crystalline phases along with the internal porosity of the individual granules are thought to play a role in controlling the rate of contaminant release. However, no standard waste form performance test has been established for this waste form. Based on preliminary work conducted at PNNL and SRTC, the SPFT, PUF, and PCT tests appear to be useful in collecting the necessary data

for PA modeling. However, additional testing is required before the fundamental mechanism that controls the release of the contaminants is understood and technically defensible long-term modeling can be performed.

Cast Stone--The waste form produced by the Cast Stone technology is significantly different from the glass waste forms and the steam-reformed product. It is commonly assumed that contaminants in the high-pH pore solution diffuse to the surface of the waste form where they are leached by infiltrating water. Short-term tests (e.g. ANSI/ANS 16.1 leach test) present a method for comparing the performance of different newly prepared grout formulations such as Cast Stone, but these may not be sufficient to assess the long-term performance of grout for Hanford.

In summary, the current strategy for extrapolating short-term tests on borosilicate glasses to long-term performance results must be modified to include other waste forms under consideration. In addition, more testing of steam reforming products is required before the fundamental mechanism that controls the release of the contaminants is understood and technically defensible long-term modeling can be performed. Also, a much better understanding of the fundamental mechanisms controlling contaminant release rates from grout waste forms and a systems-level analysis of an immobilized low-activity waste (ILAW) Hanford disposal site with grouted waste is needed. Development of new accelerated tests that can account for grout aging and Hanford specific conditions is critically needed.

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It is the intent of CH2M HILL to share our potential needs with the vendors.

CH2M HILL Hanford Group, Inc.
Technical Challenge Sheet

1. **CH2M HILL Technical Challenge Area:** Disposal

2. **Title:** Tailored Disposal Systems

3. **CH2M HILL Point of Contact:**
Ken Gasper (509) 373-1948, Fax: (509) 373-9093, kenneth_a_ken_gasper@rl.gov

4. **Description:**
Supplemental Treatment Technologies may not create a waste form that is inherently as durable as borosilicate glass from the Waste Treatment Plant (WTP). The acceptability of a supplemental treatment option may require that the disposal system be designed to reduce the release of contaminants of concern to the environment.

Three Supplemental Treatment Options are currently being considered: Cast Stone, Bulk Vitrification, and Steam Reforming. The grout process is expected to require the least initial capital investment, but is known to retain contaminants of concern (COCs) less than borosilicate glass. For grout, nitrate is a special contaminant of concern. In the State of Washington contamination of the groundwater with nitrate above 10ppm (or nitrite >2ppm) is contrary to state law. Methods to mitigate the release of nitrate/nitrite to the ground water would make a containerized grout treatment option more attractive.

Bulk vitrification and steam reforming decompose the nitrates and nitrites in the feed so nitrate/nitrite are not COCs for these treatment options. All of the treatment options will have to prove they retain RCRA metals and listed organics to within land disposal standards.

Retention of radionuclides for time periods far exceeding engineering or administrative controls (over 1,000 years) is required by the Code of Federal Regulations for radioactive wastes. Special concern is paid to technetium because of its long half-life and mobility in the environment. Disposal systems that provide long-term mitigation of technetium release are needed to reduce risk. Other radionuclides for which mitigating strategies would be valuable include iodine (for all technology options) and uranium (not needed for grout).

There are many technology options that could be used to mitigate release of COCs, and multiple technologies may be employed in tandem to "tailor" a disposal system for optimal performance. Two of the general technical approaches are: 1) hydraulic barriers to prevent moisture (liquid or vapor) from contacting the waste form and transporting contaminants to the groundwater, and 2) reactive systems to chemically prevent the release of COCs to the ground water.

Systems to react or chemically bind nitrate or nitrite would be of interest for a containerized grout disposal facility. Special reactive systems to chemically bind contaminants (getters) are of special interest to mitigate Tc and, with lesser interest, to mitigate I or U. There are multiple specific approaches within these general categories that could be employed, and still other technology approaches may be devised. However, any practical enhancement to the

disposal system must be compatible with the designs of Hanford disposal systems being considered.

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Appendix C

Technology-related Excerpts from the

CH2M HILL Risk Management Register (1/23/03)

Technology-Related Risks from the CH2M HILL Risk Management Register (1/23/03)

RPP Critical Risk List #	RPP Critical Risk List Topic	TFC Risk Title Topic	TFC Risk Title	Risk Statement	Related TFC Risk(s)	Past Risk Event Number	Risk Owner	Risk Likelihood (VH,H,M,L,VL)	Residual Risk Likelihood	Additional Notes
RPP-CR-032; RPP-CR-014	SST Retrieval Needs RPP-CR-032; DST Space Availability RPP-CR-014	Jacking Technology	Jacking Technology	If no technology exists for retrieving deep sludge tanks and if installation of the mixer pump at the appropriate depth is hampered by high sludge levels, then major cost and schedule delays may be realized as new technology is developed.	N/A	160.S50[RE03]	Ed Martinen	M	M	Mitigation Type Activity. The jacking technology has been designed. This risk applies to AY Farm.
	SST Retrieval Needs RPP-CR-032; DST Space Availability RPP-CR-014	Retrieval Systems	SST Retrieval Technology	If SST retrieval system pilot projects prove unsuccessful, then alternate technologies will be needed with very little time for transitioning to new or old technologies, thus causing potential delays in the SST closure project. Also, this could eventually impact the WFD to WTP if a backup waste feed source is needed to meet waste feed delivery requirements.	C104_RE-9, C104_RE-10, C104_RE-11, 720,724, 300.J29-02, PP041-1, S-102 [RE26], 632	CR-064	Ryan Dodd	L	L	A. C-104: goal = perrform a technology demo to retrieve 99% (260 kgal) of sludg. This waste contains roughly 89 kg Pu & will be transferred to DST system. Robotic, crawler-based confined sluicing & articulated mast systems are planned as an alternative to "past practice" sluicing to minimize leakage potential during retrieval. This system has not been demo in Hanford tanks. B. S-102: goal = perform an initial retrieval of mixed saltcake & sludge wastes & transfer roughly 490 curies of mobile, long lived contaminants of concern to the DST system. The goal is to retrieve 99% (487 kgal) of the tank contents using an AEAT power fluidics mixing & pumping system as alternative to "past practice" sluicing to min. leakage potential during retrieval ops. Retrieval system has not been demo in Hanford tanks. C. S-112: goal = perform technology demo of saltcake retrieval methods & transfer roughly 550 curies of mobile, long lived contaminants of concern to the DST system. The goal is to retrieve 99% (518 kgal) of the tank contents using a low-volume, density gradient saltcake dissolution system
	SST Retrieval Needs RPP-CR-032; DST Space Availability RPP-CR-014	Equipment failures	MRS Equipment Fails During Qualification Testing	If MRS equipment fails during qualification testing, then redesign, modification, or replacement could be required.	N/A	C104_RE-15	Keith Carpenter	L	VL	Original Risk: Max-assumes rework of multiple system. Mitigation: 3 SMEs for 4d.
	SST Retrieval Needs RPP-CR-032; DST Space Availability RPP-CR-014	AOP Compliance	Tank Farm Air-borne Hazard	If a tank farm event requires the use of respiratory protection in the farm (e.g., organic vapor release), then construction, testing, and retrieval operations could be impacted, adding to cost and schedule duration.	664	C104_RE-48	Keith Carpenter	L	L	Original Risk: MIN – 1 day downtime x 50 workers @$75/hr. ML – 2 weeks downtime for investigation MAX = ML plus inefficiency from working in masks. Residual Risk: same as original risk, due to potential events from other tank farm operations.
	SST Retrieval Needs RPP-CR-032; DST Space Availability RPP-CR-014	Riser Availability	POR-008 does not operate as designed or is not available	If PR-008 is not available or is not functional, then significant cost and schedule delays could occur.	PP010-02, PP010-03, PP017-02, 100.S56-01, S-112[RE12], S-112[RE39], S-102 [RE15]	C104_RE-53	Keith Carpenter	L	VL	Original Risk: MIN – Minor modification ML – Design, procure new exhauster MAX – same as ML. Residual Risk: Likelihood decreased, but consequences remain same as original.
	SST Retrieval Needs RPP-CR-032; DST Space Availability RPP-CR-014	Retrieval Systems - MRS	MRS Technical Approach Inadequate	If selected MRS technology fails to meet performance requirements, then TPA milestones may be missed (03G&H).	CR-064	C104_RE-9	Keith Carpenter	L	VL	Original Risk: Min-assumes project support in re-negotiation of milestones, ML - assumes fines and re-negotiation of milestones (with continuation of work). Max-assumes fines, new system (stop work). Mitigation: Test Plan 10 Full Time Equivalents(FTEs) for 1 wk (10K)
	SST Retrieval Needs RPP-CR-032; DST Space Availability RPP-CR-014	Line Plugging	Transfer Flow Rate Deficiency and Solid Precipitation	If the transfer line plugs, then transfer ceases and adversely impacts schedule and the ability to accomplish the S-102 mission.	TRM-10, TRM-14, C104_RE-57, TRM-12	S-102 [RE28]	Mark Sturges	L	M	
	SST Retrieval Needs RPP-CR-032; DST Space Availability RPP-CR-014	Riser Availability	Risers Unavailable	If design solutions are exhausted and risers are unavailable, then removal of existing in tank equipment may be required to provide room for S-112 WRS components.	PP010-02, PP010-03, PP017-02, 100.S56-01, C104_RE-53, S-112[RE39], S-102 [RE15]	S-112[RE12]	Roger Bauer	L	M	Saltwell screens have been installed in both risers. One screen has just recently been installed and the other has been in place for roughly 15 yrs. The range of cost values reflects the cost variance between pulling a single pump, best case, and pulling multiple pumps.
	SST Retrieval Needs RPP-CR-032; DST Space Availability RPP-CR-014	Samples - Suitability	Verification	If verification that the tank heel is clean requires sampling and/or tank photography, then incorporating these activities into the baseline may result in additional schedule and cost impacts.	N/A	150.L75[RE03]	R. Wojtasek	VL	VL	Per tank (Schedule delays due to sample analysis).
	SST Retrieval Needs RPP-CR-032; DST Space Availability RPP-CR-014	Retrieval Systems - MRS	MRS Maintenance/Exposure	If the MRS requires hands-on maintenance during retrieval, and decontamination systems are ineffective, then worker exposure may be sufficiently high to prevent adequate repair/maintenance, resulting in unacceptable downtime and substantial cost.	CR-064	C104_RE-10	Keith Carpenter	VL	L	Focus is downtime. Min- 60 days, Most-120, Max- long term. Crew of 10 max assumes replacement but assigned to retrieval system after 1 week.

Appendix C
Technology-Related Risks from the CH2M HILL Risk Management Register (1/23/03)

RPP Critical Risk List #	RPP Critical Risk List Topic	TFC Risk Title Topic	TFC Risk Title	Risk Statement	Related TFC Risk(s)	Past Risk Event Number	Risk Owner	Risk Likelihood (VH,H,M,L,VL)	Residual Risk Likelihood	Additional Notes
RPP-CR-032; RPP-CR-014	SST Retrieval Needs RPP-CR-032; DST Space Availability RPP-CR-014	Retrieval Systems - MRS	Umbilical Management	If the umbilical management or waste hose management system enclosure become contaminated, then operations and recovery will be significantly impacted.	CR-064	C104_RE-11	Keith Carpenter	VL	L	See MRS-3; consequences are additive, however it is not same risk. Focus is downtime. Min-60 days, Most-120, Max-long term. Crew of 10 max assumes replacement but reassigned retrieval system after 1 week.
	SST Retrieval Needs RPP-CR-032; DST Space Availability RPP-CR-014	Scope Changes - Design	Technically Directed Changes	If identification of new mixer pump technology is required by the program, then redesign/reprocurement may be necessary.	N/A	W-211[RE23]	Ed Martinen	VL	L	Minimum - Change design. Maximum - Include procurement for new concept. Higher likelihood in later years.
	SST Retrieval Needs RPP-CR-032; DST Space Availability RPP-CR-014	Tank Space Management	Single Receiver Tank in SY Farm	If SY-102 remains the only receiver tank available for transfer activities in the SY Farm, then the occurrence of an equipment failure or conflict may halt transfers and cause major impacts to budget and schedule.	S-102 [RE01]a	160.320[RE01]	T. Sams	M	VL	SY-101 cross-site connection project due 9/30/01. Will provide a second receiver tank capability. This risk
	SST Retrieval Needs RPP-CR-032; DST Space Availability RPP-CR-014	Tank Space Management	Receiver tank capacity exceeded	If tank C-104 waste requires larger than expected quantities of water for retrieval, then receiver tank capacity may be exceeded with subsequent cost and schedule impacts.	150.B05[RE02]	C104_RE-63	Keith Carpenter	M	M	Original Risk: MIN – cost of evaporator campaign, assuming transfer equipment is in place and operable ML – new OGT, minor mods to alternate tank MAX – new OGT, major mods to alternate tank. Residual Risk: MIN and ML – same as original. MAX reduced b
	SST Retrieval Needs RPP-CR-032; DST Space Availability RPP-CR-014	Riser Availability	Risers Not Available	If S-102 risers are not available for use as planned, then modifications to S-102 WRS design or access approach may be required.	PP010-02, PP010-03, PP017-02, 100.S56-01, C104_RE-53, S-112[RE12], S-112[RE39]	S-102 [RE15]	Mark Sturges	M	L	Would need to extract equipment.
	SST Retrieval Needs RPP-CR-032; DST Space Availability RPP-CR-014	Riser Availability	Riser Access	If access to the riser is unusual and requires significant extra preparations, then delays and added costs my result. These preparations may include the construction of an access ramp for the core sampling truck.	PP010-02, PP010-03, PP017-02, C104_RE-53, S-112[RE12], S-112[RE39], S-102 [RE15]	100.S56-01	T. Pauly	L	VL	
	SST Retrieval Needs RPP-CR-032; DST Space Availability RPP-CR-014	Retrieval Systems - Supplemental Retrieval System	Supplemental Retrieval System	If, in order to mobilize the AW-103 sludge, it becomes necessary to install a supplemental retrieval system (mixer pumps are not capable of fully mobilizing the waste solids), then added costs and delays may result.	CR-064	632	Ed Martinen			
	SST Retrieval Needs RPP-CR-032; DST Space Availability RPP-CR-014	In-Tank Equipment	Camera Failure	If in-tank video fails to operate as required during sluicing, then it will need to be replaced at added costs and delays to the project.	N/A	659	R. Wilson			
	SST Retrieval Needs RPP-CR-032; DST Space Availability RPP-CR-014	AOP Compliance	Organic Vapor Release	If organic vapors are be released during waste retrieval operations, then potential safety hazards and personnel health concerns may arise and cost and schedule delays may result.	C104_RE-48	664	R. Wilson			
	SST Retrieval Needs RPP-CR-032; DST Space Availability RPP-CR-014	Retrieval Systems - Past Practice Sluicing	Past Practice Sluicing is Deemed Unacceptable	If past practice sluicing is deemed unacceptable, then a different retrieval technology must be chosen and the design performed based upon the chosen technology resulting in cost and schedule impacts.	CR-064	720	T. Sams			
	SST Retrieval Needs RPP-CR-032; DST Space Availability RPP-CR-014	Retrieval Systems - Past Practice Sluicing	ReUse of Transfer Equipment and Lines for Sluicing	If reuse of the equipment and the transfer lines is not deemed acceptable, then new piping and transfer equipment will need to be installed.	CR-064	724	T. Sams			
	SST Retrieval Needs RPP-CR-032; DST Space Availability RPP-CR-014	OGT Design	Hose-In-Hose Transfer System Problems	Failure to identify an effective means to prevent reoccurrence of primary line leak will result in negative impacts to the specific operation while a replacement is sought and negative impacts to follow on projects planning use of the HIHTL system if it is deemed unreliable.	S-112[RE40], 3Y50B00[RE01]	E-23	J. McDonald			

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RPP-CR-032; RPP-CR-014	SST Retrieval Needs RPP-CR-032; DST Space Availability RPP-CR-014	Riser Availability	Waste Management	If equipment (e.g. LOWs) must be removed from risers, then SST project cost and schedule increase dramatically in the safe waste management of higher dose rates and radiological contamination.	PP010-03, PP017-02, 100.S56-01, C104_RE-53, S-112[RE12], S-112[RE39], S-102 [RE15]	PP010-02	C. Lewis			
	SST Retrieval Needs RPP-CR-032; DST Space Availability RPP-CR-014	Riser Availability	Riser Availability	If risers are not available (e.g. temperature probe obstructions) for the placement of new LOWs, then TPA milestones and CH2M HILL PIs could be negatively impacted due to their association with salt well pumping.	PP010-02, PP017-02, 100.S56-01, C104_RE-53, S-112[RE12], S-112[RE39], S-102 [RE15]	PP010-03	C. Lewis			
	SST Retrieval Needs RPP-CR-032; DST Space Availability RPP-CR-014	Cross-site Transfers	Cross-site slurry line availability	If the cross-site slurry line is not made operational, then the retrieval production schedule may not be maintained and major cost and schedule impacts may occur.	PP017-06	PP011-03	R. Wilson			ORR and readiness reviews currently approach $1M.
	SST Retrieval Needs RPP-CR-032; DST Space Availability RPP-CR-014	Cross-site Transfers	Cross-site slurry line availability	If the cross-site slurry line is not made operational, then the retrieval production schedule may not be maintained and major cost and schedule impacts may occur.	PP017-06	PP011-03	R. Wilson			ORR and readiness reviews currently approach $1M.
	SST Retrieval Needs RPP-CR-032; DST Space Availability RPP-CR-014	Cross-site Transfers	Cross-site Slurry Line	If the cross-site slurry line is not operational for use by DSTs, then the DST project schedule and costs could be negatively impacted (currently waiting startup and readiness reviews).	PP011-03	PP017-06	G. N. Hanson			
	SST Retrieval Needs RPP-CR-032; DST Space Availability RPP-CR-014	Retrieval Systems - Saltcake Dissolution System	Low Volume Density Gradient (LVDG) Saltcake Dissolution System	If the LVDG system is incapable of achieving these requirements, then deployment of a secondary retrieval system may be required. (The goal of TPA Milestone M-45-03C for Tank S-112 is to retrieve to safe storage roughly 550 curies of mobile, long-lived contaminants of concern and 99% of the tank contents by volume.)	CR-064	PP041-1	T. Sams			*S-112 core samples obtained and being analyzed. All equipment installed* in U-107 for testing pending resolution of line plugging problem.
	SST Retrieval Needs RPP-CR-032; DST Space Availability RPP-CR-014	In-Tank Debris	In-Tank Hardware & Debris Impacts	If in-tank hardware and debris adversely impacts retrieval efficiencies or causes operational down time due to equipment malfunction, then there will be an adverse impact to S-102 WRS cost and schedule.	775, 537, 130.G25-01, 462	S-102 [RE19]	Mark Sturges	L	L	Design is incorporating necessary features to prevent malfunction. - 1. Review Level 2 Specification for adequate handling of potential debris hazards.;
	SST Retrieval Needs RPP-CR-032; DST Space Availability and Integrity - RPP-CR-014 / CR-070A	Tank Space Management	Transfer Volume from S-102 to SY-102	If 241-SY-102 does not have sufficient space available at start of retrieval, then retrieval of S-102 will be delayed.	160.320[RE01]	S-102 [RE01]a	Mark Sturges	L	VL	Min, ML: Based on 25K/day. Max: Minimize long term effects, cost is less than 25K/day.
	SST Retrieval Needs RPP-CR-032; DST Space Availability and Integrity - RPP-CR-014 / CR-070A	Gas Monitoring Requirement	Gas Monitoring Requirement	If ongoing DST vapor space analysis results in a determination that gaseous monitoring devices need to be installed as part of any of the new W-314 ventilation systems, then a negative cost and schedule impact will occur.		W314 [RE11]	Ken Jordan	L	L	Risk applies to the following areas at the stated percentage: AN Phase 2, 100%; AW Phase 2, 100%; AP Phase 2, 100% - Risk handling actions reduce schedule impact. Costs remain the same.

Appendix C
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RPP-CR-040	Sustained Waste Feed Delivery - RPP-CR-040	Change to AB/Safety Requirements	Waste Behavior	If transfer and consolidation of waste solids causes the waste to behave differently, then new safety analyses and control systems may be required.	TRM-23	TRM-24	T. Sams	L		Tech. Concern: Waste Inventory Keyword Grp: Safety Waste behavior differences may include increases gas retention, gas generation rate, degrades heat transfer properties. New controls may include additions or modifications to Safety SSCs.
	Sustained Waste Feed Delivery - RPP-CR-040	BBI Characterization	Feed Rejection	If uncertainty regarding the waste characterization data and the best basis inventory is not reduced, then waste feed to the WTP may be rejected.	N/A	TRM-25	R. Wojtasek	L		Tech. Concern: Waste Inventory Keyword Grp: Safety
	Sustained Waste Feed Delivery - RPP-CR-040	Line Plugging	Pipe Pluggage	If a pipeline plugs, then the line will no longer be available to support the WFD mission.	TRM-14, S-102 [RE28], C104_RE-57, TRM-12	TRM-10	R. Wojtasek	H		Technical Concern: Transfer System Reliability Keyword Group: Pipe Plugging
	Sustained Waste Feed Delivery - RPP-CR-040	Waste Properties	Noble Metal Concentrations in Waste	If noble metals concentrations exceed melter design capability, then the WTP may revise the specification and require TF to change waste feed plans.	TRM-16, TRM-18, TRM-17	TRM-15	R. Wojtasek	H		Tech. Concern: Waste Inventory Keyword Grp: Chemistry
	Sustained Waste Feed Delivery - RPP-CR-040	Waste Properties	Volatile Species in Waste	If CO, H2 and Volatile Species concentrations in the melter and/or off-gas are above the respective lower flammability limits, then the WTP may revise the specification and require TF to change waste feed plans.	TRM-15, TRM-18, TRM-17	TRM-16	R. Wojtasek	H		Tech. Concern: Waste Inventory Keyword Grp: Chemistry
	Sustained Waste Feed Delivery - RPP-CR-040	Waste Properties	Off-Gas Limits (Nitrogen)	If NH3 and NOx concentration in the WTP off-gas system exceeds allowable limits, then the WTP may revise the specification and require TF to change waste feed plans.	TRM-16, TRM-18, TRM-15	TRM-17	R. Wojtasek	H		Tech. Concern: Waste Inventory Keyword Grp: Chemistry
	Sustained Waste Feed Delivery - RPP-CR-040	Waste Properties	Excessive Sulfides/Halides	If halides and sulfate build up to unacceptable levels in melter feed, then the WTP may revise the specification and require TF to change waste feed plans.	TRM-16, TRM-15, TRM-17	TRM-18	R. Wojtasek	H		Tech. Concern: Waste Inventory Keyword Grp: Chemistry
	Sustained Waste Feed Delivery - RPP-CR-040	Samples - Suitability	Out-of-Spec Waste	If TF characterization does not match what the WTP receives or chemical transformation occurs between pulling tank farm samples and material delivery, then Out-of-spec waste may be sent back to TF.	N/A	TRM-19	R. Wojtasek	H		Tech. Concern: Waste Inventory Keyword Grp: Chemistry
	Sustained Waste Feed Delivery - RPP-CR-040	Line Plugging	Transfer Line Plugging	If transfer line plugs during waste transfer operations, then cost and schedule impacts could occur.	TRM-10, S-102 [RE28], TRM-14, TRM-12	C104_RE-57	Keith Carpenter	M	L	Original Risk: MIN – daily flushes mitigate, no impact ML – 10 operators, one day resolution @75/hr. MAX – 10 operators, 60 day resolution @75/hr. Residual Risk: Likelihood decreased, but consequences remain same as original.
	Sustained Waste Feed Delivery - RPP-CR-040	Design Pressure	Waste Pumping Velocity	If the primary pipe design pressure doesn't allow flow rates high enough to maintain the critical velocity as stated in the specification, then the piping may plug.	N/A	TRM-11	J. Eacker	M		Technical Concern: Purex Connectors. Transfer System Reliability Keyword Group: Pipe Plugging
	Sustained Waste Feed Delivery - RPP-CR-040	Design Pressure	AP-101 Pump Overpressure	If transfer piping pressure overpressure protection is required, then the AP-101 pump replacement project may have to install this protection to allow for operation of the pump. (W-211 design for AP-02A pit has a 275 psig rupture disk and relief valve in-line (unisolable) from the AP-101 to WFD plant transfer route. AP-101 pump design which is being built to the WFD level 2 specification requiring a flow rate of 1.6 feet/second and can exceed the #275 psig. The only pressure control being supplied by the AP-101 project is the variable frequency speed drive which is not acceptable by code as a pressure control device.)	W314 [RE10]	WFD-01	J. Freeman-Pollard	M		
RPP-CR-040	Sustained Waste Feed Delivery - RPP-CR-040	Radiation & Contamination	Unplanned radiological exposures	If unplanned radiological exposures or releases occur while contaminated equipment is being removed, then installation of retrieval equipment and subsequent feed delivery operations may be delayed.	PP029-04	CR-011	J. McDonald	M		Conduct of operations and Sr. Management focus adequately applies handling actions to manage this risk.

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	Sustained Waste Feed Delivery - RPP-CR-040	Radiation & Contamination	Unplanned radiological exposures	If unplanned radiological exposures or releases occur while contaminated equipment is being removed, then installation of retrieval equipment and subsequent feed delivery operations may be delayed.	PP029-04	CR-011	J. McDonald	M		Conduct of operations and Sr. Management focus adequately applies handling actions to manage this risk.
	Sustained Waste Feed Delivery - RPP-CR-040	Line Plugging	Waste Viscosity - Plugage	If the waste viscosity is higher than predicted, then plugging may occur in the lines.	TRM-10, S-102 [RE28], C104_RE-57, TRM-14	TRM-12	R. Wojtasek	L		Technical Concern: Transfer System Reliability Keyword Group: Pipe Plugging
	Sustained Waste Feed Delivery - RPP-CR-040	Waste Properties	Waste Viscosity - Slow Pump Rate	If the waste viscosity is higher than predicted, then feed delivery rates may be slowed.	N/A	TRM-13	R. Wojtasek	L		Technical Concern: Transfer System Reliability Keyword Group: Pipe Plugging
	Sustained Waste Feed Delivery - RPP-CR-040	Line Plugging	Particle Size	If the particle size exceeds 700 microns, then equipment and lines could plug.	TRM-10, S-102 [RE28], C104_RE-57, TRM-12	TRM-14	R. Wojtasek	L		Technical Concern: Transfer System Reliability Keyword Group: Pipe Plugging
	Sustained Waste Feed Delivery - RPP-CR-040	Design Pressure	Containment Pipe Leak	If the pressure of a leak exceeds the currently designed and installed containment pressure of the secondary pipe, then waste may leak into the soil column.	N/A	TRM-20	R. Wojtasek	L		Technical Concern: Transfer System Reliability Keyword Group: Safety Status – Preliminary findings are that the pressure rating is dependent upon the solids loading and characteristics of the solids. The transfer piping may need a pressure rating higher than the original 400 psi (650 psi [CH2M Hill 2000]). In the interim, Projects W-314 and W-211 will have a design pressure of 650 psi. However, it is not known at this time if the PUREX connectors will be capable of that pressure rating. Work is continuing to validate the particle size analysis that led to the higher flow rates and pressure drops, to implement a test program on the PUREX connectors, and to provide alternatives where existing piping systems are used for transfers.
	Sustained Waste Feed Delivery - RPP-CR-040	Waste Mixing	Mixing	If , after sampling, the waste settles enough to require repeated mixer pump operation prior to the transfer, then the additional mixer pump operations would result in added costs and delays.	N/A	239	R. Wilson			
	Sustained Waste Feed Delivery - RPP-CR-040	Testing	Transfer system start-up and test operations problems	If issues develop with startup of the transfer system that feeds the Waste Treatment Plant , then potential delays in sending waste to the WTP may occur.	C104_RE-20, W-211[RE22], W-211[RE32]	E-22	J. McDonald			
	Sustained Waste Feed Delivery - RPP-CR-040	Equipment failures	Equipment failures	If equipment failures occur, then a delay in feed delivery could occur along with major programmatic impacts.	PP013-01, PP130-02	PP011-11	G. N. Hanson			Examples of critical equipment include pumps, portable exhausters, lifting bales, CAMS, and annulus leak detectors.
	Sustained Waste Feed Delivery - RPP-CR-040	Design Pressure	Design Pressures	Projects W-314 and W-211 will have a design pressure of 650 psi. However, it is not known at this time if the PUREX connectors will be capable of that pressure rating. If the PUREX connectors are incapable of handling that pressure rating, then considerable rework may be required to make transfer lines adequately sized.	W-314[RE10]	xyz	J. Voogd			ICD Issues 20-16 & 19-15 In certain instances there is insufficient line pressure available for WFD to deliver waste to the WTP facility's receipt tanks. Direction is required from the DOE to determine the most cost-effective solution for delivery of feed to the receipt tanks. Status - Preliminary findings are that the pressure rating is dependent upon the solids loading and characteristics of the solids. The transfer piping may need a pressure rating higher than the original 400 psi (650

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RPP-CR-036; RPP-CR-037	Supplemental LAW Treatment RPP-CR-036 : Alternative TRU/LLW Treatment Technologies RPP-CR-037	Immob Waste Package Specification	ILAW Container Physical Characteristics	If the ILAW container physical characteristics change from those curently planned, then the performance assessment and associated technical documents will need to be modified to accomodate the change.	W-520[RE20]	PP093-01	K. Burgard	M	M	ILAW container design is in BNI scope. - Current ILAW container concept will be used. - Final ILAW container design needs to be established.
	Supplemental LAW Treatment RPP-CR-036 : Alternative TRU/LLW Treatment Technologies RPP-CR-037	Samples - Suitability	Existing LAW Sampling Data not Sufficient	If there is inadequate sample material available to obtain the required dissolution and dilution data (including Compatibility Report), then an additional sample will have to be obtained resulting in increased cost and schedule delays.	PP029-02	120.B20[RE01]	R. Wojtasek	VL	VL	This risk was mitigated by using data from 101-SY dilution and transfer. Maximum assumes a repeat of initial sampling
RPP-CR-035	SST Integrity - RPP-CR-035	Tank Integrity - SST	SST Tank Integrity	If a Single Shell Tank (SST) has significant leakage, then overall TFC baseline strategy may have to be reconsidered (including possible tank sequencing adjustments) to accommodate different retrieval	C104_RE-61, C104 RE-7	CR-084	J. McDonald	L	L	Risk data (impact and likelihood) needs to be defined. Risk Handler and handling action cost needs to be defined. The DST program is currently undergoing risk studies that will satisfy these needs.
	SST Integrity - RPP-CR-035	Equipment failures	LOW Failure	If a LOW fails, then tank farms will be out of compliance with environmental monitoring requirements requiring alternative monitoring procedures that are more labor intensive.	N/A	PP007-03	Ralph Lipfert	L		Based on actual 2 LOW failures in FY02.
	SST Integrity - RPP-CR-035	Tank Integrity - SST	Liquid Addition to Compromised C-104	If liquid is added to C-104 for mobilization and the tank integrity has been compromised, then environmental insult could occur.	CR-084	C104_RE-61	Keith Carpenter	VL	L	Original Risk: MIN – prior agreement with WSDOE to proceed, no impact ML – same as MIN MAX – Redesign ITV, test and deploy. Residual Risk: Likelihood decreased, but consequences remain same as original.
	SST Integrity - RPP-CR-035	Tank Integrity - SST	Structural Integrity	If there are structural integrity issues (e.g. dome loading) in 241-C-104, then there will be impacts to design and construction activities.	CR-084	C104_RE-7	Keith Carpenter	M	M	Original Risk :ML-assumes re-baseline of existing project, Max-assumes project has to start over.
	SST Integrity - RPP-CR-035	LDMM	Leak Detection System Unacceptable	If Ecology deems low-point leak detection system not acceptable, then problems could arise during RCRA permitting activities resulting in additional redesign costs and delays.	S-102 [RE23], S-112[RE03]	W-211[RE07]	Ed Martinen	M	L	Minimum: problem identified during design Most likely: problem identified during procurement Maximum: problem identified during construction. 10k prep package.
	SST Integrity - RPP-CR-035	PHMC Service Support	PHMC Service Support	If the PHMC cannot support the timely fabrication of replacement SST systems (e.g. LOW adapters, spool pieces [LLG parts], jumpers, flanges, electrical stands [TMACs upgrades]) and/or crane and rigging services, then TPA milestones and CH2M HILL PI's could be negatively impacted due to their association with salt well pumping.	PP011-07	PP010-01	D. Lenseigne			

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RPP-CR-014; CR-070A	DST Space Availability and Integrity - RPP-CR-014 / CR-070A	Gas Monitoring Requirement	Gas Treatment and Monitoring Requirement	If ongoing DST vapor space analysis results in a determination that additional treatment units (e.g. HEGA or chilled condensor) and gaseous monitoring devices need to be installed as part of any of the new W-314 ventilation systems, then a negative cost and schedule impact will occur.		W314 [RE12]	Ken Jordan	H	H	Risk applies to the following areas at the stated percentage: AN Phase 2, 8%; AW Phase 2, 62%; AP Phase 2, 100% - Risk handling actions reduce schedule impact. Costs remain the same.
	DST Space Availability and Integrity - RPP-CR-014 / CR-070A	AOP Compliance	Ventilation Systems	If additional upgrades to the DST ventilation systems are required to address aerosols, toxic vapors, and heat removal, then cost and schedule impacts may occur.	W314 [RE11], W314 [RE12]	160.U40[RE01]	Ed Martinen	M	M	Risk Values have been multiplied by 25% as the risk consequence decreases over time (& with occurrence). Occurs first in SY Farm Mitigation Tasks: re-engineer
	DST Space Availability and Integrity - RPP-CR-014 / CR-070A	Tank Integrity - DST	DST Tank Failure	If a DST fails before the end of the RPP mission, then a tank space shortfall may occur.	CR-070A	TRM-7	M. Ostrom	M		Tech. Concern: Waste Inventory Keyword Grp: Tank Space - 28 DSTs assumed available for cleanup. No DSTs assumed to fail during mission. Past direction has been: assume no DSTs fail before FY17, first DST fails in 2017 with one DST failure every 5 yrs, & failed DSTs will be replaced as they fail. Assumed storage capacity of replacement tank equal to DST that failed. Functionally, modeling doesn't change using assumption that no tanks fail or that they fail & are replaced. Thus, waste storage & transfer capability equal to that of the DST system as currently configured is assumed to be available throughout the RPP mission, with no interruptions caused by potential lag time between tank failure & new tank construction. Ultrasonic testing of DSTs, started 1997, allows improved estimates of corrosion rates & remaining tank life, & minimizes risk that tanks would be taken out of service before new tanks could be constructed. Through FY01, 12 DSTs had been examined, with the remaining 16 scheduled to be examined by the end of FY05. DST Life Extension Project, each DST will be reexamined tentatively at 10-year inte
	DST Space Availability and Integrity - RPP-CR-014 / CR-070A	Tank Integrity - DST	DST Tank Failure	If a DST fails before the end of the RPP mission, then a tank space shortfall may occur.	CR-070A	TRM-7	M. Ostrom	M		Tech. Concern: Waste Inventory Keyword Grp: Tank Space - 28 DSTs assumed available for cleanup. No DSTs assumed to fail during mission. Past direction has been: assume no DSTs fail before FY17, first DST fails in 2017 with one DST failure every 5 yrs, & failed DSTs will be replaced as they fail. Assumed storage capacity of replacement tank equal to DST that failed. Functionally, modeling doesn't change using assumption that no tanks fail or that they fail & are replaced. Thus, waste storage & transfer capability equal to that of the DST system as currently configured is assumed to be available throughout the RPP mission, with no interruptions caused by potential lag time between tank failure & new tank construction. Ultrasonic testing of DSTs, started 1997, allows improved estimates of corrosion rates & remaining tank life, & minimizes risk that tanks would be taken out of service before new tanks could be constructed. The remaining 16 DSTs are scheduled to be examined by the end of FY05. DST Life Extension Project, each DST will be reexamined tentatively at 10-year intervals.
	DST Space Availability and Integrity - RPP-CR-014 / CR-070A	Tank Space Management	Diluent impact on tank space	If diluent is added to waste, additional waste will be created, then Tank Space Availability issues may arise.	C104_RE-63	150.B05[RE02]	R. Wilson	L	L	Consequences include the cost of an additional 242-A evaporator campaign.
	DST Space Availability and Integrity - RPP-CR-014 / CR-070A	Tank Integrity - DST	Tank Integrity Analyses	Three significant analyses currently underway could have considerable impact on curemt planned cost and schedule. Those analyses are: 1) seismic analysis of record for DSTs, 2) dome loading analyses for DCRT and catch tanks, 3) DST integrity assessments. If any of these deliverables when approved affects the scope of the planned DST Integrity Project baseline, then further costs and possible delays will result..	CR-070A	PP-018-01	J. McDonald	L		

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RPP-CR-014; CR-070A	DST Space Availability and Integrity - RPP-CR-014 / CR-070A	Tank Integrity - DST	NDE inspection	The tank integrity project is relying upon a single vendor for NDE inspection. If loss or absence of the NDE inspector occurs, then DST annulus inspections will be delayed at added cost and schedule delays.	CR-070A	UT-02	M. Ostrom	L		
	DST Space Availability and Integrity - RPP-CR-014 / CR-070A	Tank Integrity - DST	Ultrasonic Testing of DSTs	If the remote ultrasonic testing inspection (RUTI) system designed to conduct UT of the DST slots fails or is otherwise rendered unusable by tank geometric constraints or debris in the tank bottom slots, then delays and inability to meet milestones would occur.	CR-070A	UT-04	M. Ostrom	L		
	DST Space Availability and Integrity - RPP-CR-014 / CR-070A	Tank Integrity - DST	Ultrasonic Testing of DSTs	If the TSAFTTM fails to examine the high stress region of the DSTs, then an additional technology will have to be developed, tested, and deployed at added costs and delays. (FORCE Institute Y-Arm (extended arm) selected for examining lower knuckle cannot reach predicted location of maximum stress (at tangent point between curved portion and flat bottom).)	CR-070A	UT-07	M. Ostrom	L		
	DST Space Availability and Integrity - RPP-CR-014 / CR-070A	Tank Integrity - DST	DST Tank Integrity	If a Double Shell Tank (DST) has significant leakage or shows signs of failure, then the overall TFC baseline strategy may have to be reconsidered (including possible tank sequencing adjustments and potential construction of new tanks).	PP011-05, PP-018-01, UT-04, UT-07, UT-02, 540, TRM-7	CR-070A	J. McDonald	VL	L	Mitigation Tasks are based on Performance Incentives ORP-09, ORP-10, ORP-19. Cost includes fee associated with the PIs ($3361k) Reference: RPP Cross-cutting Risk #10 "TANK INFRASTRUCTURE FAILURE. Aging tank infrastructure is failing at an increasing rate. Tank farms may not be able to deliver waste as planned. Risk identified 10/2/00. (Risk Manager - Sidpara/Bryson/Kristofzski) RPP-XCUT-017". Best available data indicates that the 3 sub risks to this critical risk will have a combined consequence of as noted.
	DST Space Availability and Integrity - RPP-CR-014 / CR-070A	Ventilation	CAM Temperature Limit	If the DST ventilation exhaust stack airstream is found to exceed the temperature rating of the CAM, then there will be a negative cost and schedule impact.		W314 [RE24]	Ken Jordan	VL	L	Risk applies to the following areas at the stated percentage: AN Phase 2, 100%; AW Phase 2, 50%; AP Phase 2, 50% - Risk handling actions reduce schedule impact. Costs remain the same.
	DST Space Availability and Integrity - RPP-CR-014 / CR-070A	Tank Integrity - DST	AN-106 Annular Salt Ring	If removal of the annular salt ring affixed to the tank wall in Tank AN-106 causes damage to the tank, then costs and delays will result.	CR-070A	540	Ed Martinen			
	DST Space Availability and Integrity - RPP-CR-014 / CR-070A	Tank Integrity - DST	Failure of a DST	If a DST primary tank fails (as indicated by a major annulus leak), then the tank will have to be pumped into another tank, resulting in a potential severe shortage of tank space and major impacts to WTP feed delivery cost and schedule.	CR-070A	PP011-05	G. N. Hanson			
	DST Space Availability and Integrity - RPP-CR-014 / CR-070A	242-A Evap	Availability of the Evaporator	If the 242-A evaporator is temporarily or permanently not available, then the storage capacity of the DSTs will be consumed more quickly, resulting in a potential impact to WTP waste feed delivery and costs.	PP017-05a2, PP017-05b2, PP017-05b2, PP017-05a1	PP011-06	G. N. Hanson			
	DST Space Availability and Integrity - RPP-CR-014 / CR-070A	242-A Evap	Availability of the Evaporator	If the 242-A evaporator is temporarily or permanently not available, then the storage capacity of the DSTs will be consumed more quickly, resulting in a potential impact to WTP waste feed delivery and costs.	PP017-05a2, PP017-05b2, PP017-05b2, PP017-05a1	PP011-06	G. N. Hanson			

Technology-Related Risks from the CH2M HILL Risk Management Register (1/23/03)

RPP Critical Risk List #	RPP Critical Risk List Topic	TFC Risk Title Topic	TFC Risk Title	Risk Statement	Related TFC Risk(s)	Past Risk Event Number	Risk Owner	Risk Likelihood (VH,H,M,L,VL)	Residual Risk Likelihood	Additional Notes
RPP-CR-014; CR-070A	DST Space Availability and Integrity - RPP-CR-014 / CR-070A	Riser Availability	Waste Management	If equipment (e.g. broken pumps) must be removed from risers, then DST project cost and schedule increase dramatically in the safe waste management of higher dose rates and radiological contamination.	PP010-02, PP010-03, 100.S56-01, C104_RE-53, S-112[RE12], S-112[RE39], S-102 [RE15]	PP017-02	C. Shipler			
RPP-CR-034	Pit Conditions - RPP-CR-034	Pit Condition	Pits Cleaned to Adequate Levels	If the C-104 pump and heel pits and the AY-101 pit 01A cannot be cleaned to acceptable worker dose levels, then there may be cost increases and schedule delays.	W314 [RE16]	C104_RE-8	Keith Carpenter	M	L	Max-AB Changes. If risk occurs, it can be worked in parallel with existing schedule, therefore schedule consequence is not significant.
	Pit Conditions - RPP-CR-034	Pit Condition	Tank & Pits Not Acceptable	If pits (SY, S-12A, S-A, and S-C) are not acceptable for use, then design and construction activities will be impacted.	W314 [RE16]	S-112[RE10]	Roger Bauer	L	L	Range of values covers the minimum costs of running OGT around problem pits to the maximum costs of installing an above ground replacement pit. Purchase of OGT planned in budget.
	Pit Conditions - RPP-CR-034	Pit Condition	Pit Condition	If the pits to be upgraded are in worse physical condition than assumed, then additional repairs will be necessary resulting in increased construction costs and schedule delays.		W314 [RE16]	Ken Jordan	L	L	Risk applies to the following areas at the stated percentage: SY Phase 2, 100%*5; AW Phase 2, 100%*8; AP Phase 2, 50%*9 - Risk handling actions reduce schedule impact. Costs remain the same.
	Pit Conditions - RPP-CR-034	Pit Condition	Pits Cleaned to Adequate Levels	If the pits cannot be cleaned to acceptable worker dose levels, then there may be cost increases and schedule delays.	W314 [RE16]	S-102 [RE10]	Mark Sturges	VL	L	
	Pit Conditions - RPP-CR-034	Pit Condition	Tank & Pits Not Acceptable	If the tank and pits are not acceptable for use, then design and construction activities will be impacted.	W314 [RE16]	S-102 [RE09]	Mark Sturges	L	L	Includes planned renovations that do not satisfy project needs.
RPP-CR-039; RPP-CR-041	Regulatory Decisions (Closure Definition) RPP-CR-039 ; Central Plateau End States RPP-CR-041	End State - Tanks	Failure to Receive Agreed to Cleanup End-State Options	If the closure alternatives cannot be identified and agreed upon, then delay in the preparation and approval of the Tank Farms Closure EIS, will affect the schedule and budget.	N/A	544	T. Sams			
RPP-CR-042	WTP Executable Schedule (Close-coupled EPC) – RPP-CR-042	Scope Changes - I/F	Balancing RPP Priorities	If work scope decisions for WTP are not balanced with TFC commitments and priorities, then cost increases, schedule disruptions, and the loss of expert resources for unique activities may occur.	N/A	E-26	Ryan Dodd	M		
RPP-CR-038	Yucca Mountain, NV, Availability to Accept IHLW - RPP-CR-038	Canister	Canister/Waste Spec Revision	If the properties of canister or waste are revised (i.e., canister characteristics, lifting flange configuration, heat load, source terms, etc.), then calculations and design may change resulting in cost and schedule impacts.		W464[RE01]	G. Parsons	M	M	Some of the schedule impact can be absorbed into the design schedule. Relates to issue 14-1 of 24590-WTP-ICD-MG-01-014, Rev A. Could result in use of only half the facility.
	Yucca Mountain, NV, Availability to Accept IHLW - RPP-CR-038	Canister	SNF Delays	If SNF schedule were to be delayed (the W-464 baseline is to use vaults 2 and 3 of the CSB to store IHLW and Spent Fuel activities currently plan for IHLW construction after the SNF MCO weldout completion), then scheduled modifications, testing/operation of the IHLW facility, and the W-464 construction window would result in cost and schedule impacts.		W464[RE04]	G. Parsons	M	M	Integrate W464 and CSB risks. This risk is mitigated, but further action is needed. Critical to project. This risk addresses issues A.1 and A.2 from the RPP-7609 ICD. Consequences are the responsibility of Spent Nuclear Fuel.

RPP Critical Risk List #	RPP Critical Risk List Topic	TFC Risk Title Topic	TFC Risk Title	Risk Statement	Related TFC Risk(s)	Past Risk Event Number	Risk Owner	Risk Likelihood (VH,H,M,L,VL)	Residual Risk Likelihood	Additional Notes
RPP-CR-033	LERF/ETF Facilities incapable of Handling WTP Effluents – RPP CR-033	ETF/LERF Permit	LERF/ETF Incapable of Handling Increased Volumes	If the Liquid Effluent Retention Facility (LERF) or Effluent Treatment Facility (ETF) facilities are incapable of accepting the effluents from the WTP and TFC, then new facilities or significant facility permit restructuring may have to occur, resulting in potential increases to the TFC or WTP cost and schedule.	256, 257	CR-i-02	Ryan Dodd	H	H	Currently, there is uncertainty associated with the accurate measurement of I-129 volume. Study is underway to clarify and develop recommendations and should be completed in April.
	LERF/ETF Facilities incapable of Handling WTP Effluents – RPP CR-033	ETF/LERF Permit	LERF/ETF Incapable of Handling Increased Volumes	If the Liquid Effluent Retention Facility (LERF) or Effluent Treatment Facility (ETF) facilities are incapable of accepting the effluents from the WTP and TFC, then new facilities or significant facility permit restructuring may have to occur, resulting in potential increases to the TFC or WTP cost and schedule.	256, 257	CR-i-02	Ryan Dodd	H	H	Currently, there is uncertainty associated with the accurate measurement of I-129 volume. Study is underway to clarify and develop recommendations and should be completed in April.
	LERF/ETF Facilities incapable of Handling WTP Effluents – RPP CR-033	ETF/LERF Permit	Delayed Permitting of Liquid Effluent Systems	If regulator approval of permit modifications for the TEDF and LERF/ETF is delayed, then schedule and budget may be adversly impacted.	CR-i-02	256	F. Marsh (WTP)			
	LERF/ETF Facilities incapable of Handling WTP Effluents – RPP CR-033	ETF/LERF Permit	WTP Liquid Effluents Outside Treatability Envelope	If the composition of the WTP liquid effluents lies outside the treatability envelope for the LERF/ETF, then added costs and delays may result as the problem is resolved.	CR-i-02	257	F. Marsh (WTP)			
RPP-CR-032; RPP-CR-014; RPP-CR-040	SST Retrieval Needs RPP-CR-032; DST Space Availability RPP-CR-014; Sustained Waste Feed Delivery - RPP-CR-040	Electrical Loads	Electrical Load Requirements	If electrical load requirements increase for Waste Feed Delivery and SST Waste Retrieval, then the existing electrical distribution system may not be adequate to support the mission.	TRM-4, TRM-2, TRM-3	TRM-1	R. Wilson	H		Technical Concern: Transfer System Reliability Keyword Group: Electrical
	SST Retrieval Needs RPP-CR-032; DST Space Availability RPP-CR-014; Sustained Waste Feed Delivery - RPP-CR-040	Electrical Loads	Electrical Load Analyses	If a baseline electrical load analysis is not conducted, then future load impacts for Waste Feed Delivery and SST Waste Retrieval cannot be accurately determined and power may not be available when needed.	TRM-1, TRM-4, TRM-3	TRM-2	R. Wilson	H		Technical Concern: Transfer System Reliability Keyword Group: Electrical 9 simultaneous mixer pump operation is unlikely. Determine the expected maximum load as the analysis case to determine if the electrical capacity is sufficient.

Technology-Related Risks from the CH2M HILL Risk Management Register (1/23/03)

RPP Critical Risk List #	RPP Critical Risk List Topic	TFC Risk Title Topic	TFC Risk Title	Risk Statement	Related TFC Risk(s)	Past Risk Event Number	Risk Owner	Risk Likelihood (VH,H,M,L,VL)	Residual Risk Likelihood	Additional Notes
RPP-CR-032; RPP-CR-014; RPP-CR-040	SST Retrieval Needs RPP-CR-032: DST Space Availability RPP-CR-014: Sustained Waste Feed Delivery - RPP-CR-040	Samples - Suitability	Transfers	If additional sampling for tank-to-tank transfer is required, then additional costs will be incurred and there may be delays.	N/A	628	R. Wojtasek			
	SST Retrieval Needs RPP-CR-032: DST Space Availability RPP-CR-014: Sustained Waste Feed Delivery - RPP-CR-040	242-A Evap	242-A Evaporator Upgrades	If the internal piping of 242-A fails (design life is 2005) and the DST upgrades project has no mitigation plan, then 1) SST retreived dilute waste will use more DST space and the retreival schedule will be impacted; 2) SST retrieval will extend the duration of WTP waste feed delivery resulting in increased costs; 3) SST retrieval could be impacted if constraints are placed in the volume of dilutant used to retrieve waste; and 4) the envelope for WTP feed delivery could change resulting in cost and schedule impacts.	PP017-05a2, PP017-05b2, PP017-05b1, PP011-06	PP017-05a1	G. N. Hanson			
	SST Retrieval Needs RPP-CR-032: DST Space Availability RPP-CR-014: Sustained Waste Feed Delivery - RPP-CR-040	Radiation & Contamination	Operator Contamination	If, during sampling activities, an operator becomes contaminated, then delays and added costs will result.	CR-011	PP029-04	T. Pauly	M		
	SST Retrieval Needs RPP-CR-032: DST Space Availability RPP-CR-014: Sustained Waste Feed Delivery - RPP-CR-040	Radiation & Contamination	Operator Contamination	If, during sampling activities, an operator becomes contaminated, then delays and added costs will result.	CR-011	PP029-04	T. Pauly	M		
RPP-CR-032; RPP-CR-014; RPP-CR-039; RPP-CR-041	SST Retrieval Needs RPP-CR-032: DST Space Availability RPP-CR-014: 7. Regulatory Decisions (Closure Definition) - RPP-CR-039: Central Plateau End States - RPP-CR-041	End State - Tanks	Inability to Measure PU Removed	1.	N/A	C104_RE-59	Keith Carpenter	M	M	Original Risk: MIN – Discussion/negotiation with WSDOE ML – Grap sampling program on ex-tank lines/equipment MAX – In-tank drill sampling program before and after retrieval. Residual risk: Likelihood decreased, but consequences remain same as original.

RPP Critical Risk List #	RPP Critical Risk List Topic	TFC Risk Title Topic	TFC Risk Title	Risk Statement	Related TFC Risk(s)	Past Risk Event Number	Risk Owner	Risk Likelihood (VH,H,M,L,VL)	Residual Risk Likelihood	Additional Notes
RPP-CR-040; RPP-CR-014 / CR-070A	Sustained Waste Feed Delivery - RPP-CR-040: 5. DST Space Availability and Integrity - RPP-CR-014 / CR-070A	Equipment - Non-Compliant	DST Transfer Line Instrumentation	If instrumentation on DST transfer lines is not upgraded to regulatory compliance standards, then those lines will not be available for use.	N/A	TRM-6	J. Eacker	L		Technical Concern: Transfer System Reliability Keyword Group: Regulatory
	Sustained Waste Feed Delivery - RPP-CR-040: 5. DST Space Availability and Integrity - RPP-CR-014 / CR-070A	Design Pressure	Design Pressures	Project W-314's transfer piping and manifolds are designed to a lower pressure than currently required by the DST Level II Specification for DST Primary Waste Transfer System. If it is determined that operation of this system actually requires a system designed to the higher pressure, then design and construction modifications will be required. Resulting increases in costs and schedule delays will be incorporated into the project via an approved BCR.		W314 [RE10]	Ken Jordan	VL	L	Risk applies to the following areas at the stated percentage: WTS, 100%; AN Phase 1, 100% - Same estimate values as original risk.
RPP-CR-035; RPP-CR-014 / CR-070A	SST Integrity - RPP-CR-035: DST Space Availability and Integrity - RPP-CR-014 / CR-070A	Equipment failures	Non-Compliant Existing Instrumentation in Receiver Tank	If existing receiver tank instrumentation for vapor space pressure, waste temperatures, tank temperatures, etc. malfunctions, then repairs will increase costs.	N/A	S-102 [RE22]	Mark Sturges	VL	L	Mitigation is to replace as part of design activities or upon failure.
	SST Integrity - RPP-CR-035: DST Space Availability and Integrity - RPP-CR-014 / CR-070A	Equipment failures	ENRAF Failure	If an ENRAF fails, then tank farms will be out of compliance with environmental monitoring requirements requiring alternative monitoring procedures that are more labor intensive.	N/A	PP007-02	Ralph Lipfert	M		

Appendix D

Selected EMSP Projects Related to Hanford (Funded in FY2000 or Later)

More information projects can be Found in the EMSP Project Database at http://emsp.em.doe.gov/

A. High Level Waste Projects

Project: 73749
Title: Chemical Speciation of Strontium, Americium, and Curium in High-Level Waste: Predictive Modeling of Phase Partitioning During Tank Processing
PI: Dr. Andrew R. Felmy (PNNL)
Year: 2000
Related Opportunity Numbers:
WT-090
WT-068
WT-102

Project: 73827
Title: Non-Invasive Diagnostics for Measuring Physical Properties and Processes in High Level Wastes
PI: Dr. Robert L. Powell (UC Davis)
Year: 2000
Related Opportunity Numbers:
WT-032
WT-149

Project: 73803
Title: Next Generation Extractants for Cesium Separation from High-Level Waste: From Fundamental Concepts to Site Implementation
PI: Dr. Bruce A. Moyer (ORNL)
Year: 2000
Related Opportunity Numbers:
WT-152

Project: 73976
Title: Iron Phosphate Glasses: An Alternative for Vitrifying Certain Nuclear Wastes
PI: Dr. Delbert E. Day (Univ. Missouri-Rolla)
Year: 2000
Related Opportunity Numbers:
WT-155

Project: 73750
Title: Radiation Effects in Nuclear Waste Materials
PI: Dr. William J. Weber (PNNL)
Year: 2000
Related Opportunity Numbers:

Project: 73762
Title: Radiation Effects on Sorption and Mobilization of Radionuclides during Transport through the Geosphere
PI: Dr. Lu-Min Wang (Mich.)
Year: 2000
Related Opportunity Numbers:

Project: 73859
Title: Quantify Silica Reactivity in Subsurface Environments: An Integrated Experimental Study of Quartz and Amorphous Silica to Establish a Baseline for Glass Durability
PI: Dr. Patricia M. Dove (Virg. Tech.)
Year: 2000
Related Opportunity Numbers:
WT-035S
WT-066

Project: 73896
Title: Density Measurements at Low Weight Fractions
PI: Dr. Lawrence L. Tavlarides (Syracuse)
Year: 2000
Related Opportunity Numbers:
WT-032
WT-149

Project: 73832
Title: The NOx System in Homogeneous and Heterogeneous Nuclear Waste
PI: Dr. Dan Meisel (Notre Dame)
Year: 2000
Related Opportunity Numbers:

Project: 74019
Title: Supramolecular Chemistry of Selective Anion Recognition for Anions of Environmental Relevance
PI: Dr. Kristin Bowman-James (Kansas)
Year: 2000
Related Opportunity Numbers:
WT-152

Project: 73759
Title: Computational design of Metal Ion Sequestering Agents
PI: Dr. Benjamin P. Hay (PNNL)
Year: 2000
Related Opportunity Numbers:

Project: 73748
Title: New Metal Niobate and Silicotitanate Ion Exchagers: Development and Characterization
PI: Dr. Yali Su (PNNL), Dr. Tina M. Nenoff (SNL), Dr. Alexandra Navrotsky (UC Davis_
Year: 2000
Related Opportunity Numbers:
WT-152

Project: 73778
Title: Research Program to Investigate the Fundamental Chemistry of Technetium
PI: Dr. Carol J. Burns (LANL), Dr. David Shuh (LBNL)
Year: 2000
Related Opportunity Numbers:
WT-068
WT-102

Project: 73824
Title: Reactivity of Peroxynitritie: Implications for Hanford Waste Management and Remediation
PI: Dr. Sergei V. Lymar (BNL)
Year: 2000
Related Opportunity Numbers:

Project: 81962
Title: Developing a Fundamental Basis for the Characterization, Separation, and Disposal of Plutonium and Other Actinides in High Level Radioactive Waste: The Effect of Temperature and Electrolyte Concentrations on Actinide Speciation
PI: Dr. Sue B. Clark (WSU), Dr. Scott A. Wood (Idaho), Dr. Linfeng Rao (LBNL)
Year: 2001
Related Opportunity Numbers:
WT-090
WT-068
WT-102

Project: 81963
Title: Physical, Chemical and Structural Evolution of Zeolite - Containing Waste Forms Produced from Metakaolinite and Calcined Sodium Bearing Waste (HLW and/or LLW)
PI: Dr. Michael W. Grutzeck (Penn State)
Dr. Carol M. Jantzen (SRTC)
Year: 2001
Related Opportunity Numbers:

Project: 81896
Title: Speciation, Dissolution, and Redox Reactions of Chromium Relevant to Pretreatment and Separation of High-Level Tank Wastes
PI: Dr. Dhanpat Rai (PNNL), Dr. Linfeng Rao (LBNL), Dr. Sue B. Clark (WSU)
Year: 2001
Related Opportunity Numbers:
WT-090

Project: 81912
Title: Electroactive Materials for Anion Separation-Technetium from Nitrate
PI: Timothy L. Hubler (PNNL), Dr. William H. Smyrl (Minnesota), Dr. James McBreen (BNL)
Year: 2001
Related Opportunity Numbers:

Project: 81935
Title: Ion Recognition Approach to Volume Reduction of Alkaline Tank Waste by Separation of Sodium Salt
PI: Dr. Bruce A. Moyer (ORNL), Gregg J. Lumetta PNNL, Dr. Alan P. Marchand (North Texas)
Year: 2001
Related Opportunity Numbers:
WT-088

Project: 81883
Title: Mechanisms and Kinetics of Organic Aging and Characterization of Intermediates in High-Level Waste
PI: Dr. Donald M. Camaioni (PNNL)
Year: 2001
Related Opportunity Numbers:

Project: 81897
Title: Millimeter-Wave Measurements of High Level and Low Activity Glass Melts
PI: Dr. Paul P. Woskov (MIT), Dr. S. Kamakshi Sundaram (PNNL),Dr. William E. Daniel (SRTC)
Year: 2001
Related Opportunity Numbers:

Project: 81940
Title: Characterization of Actinides in Simulated Alkaline Tank Waste Sludges and Leach Solutions
PI: Dr. Kenneth L. Nash (ANL), Dr. Linfeng Rao (LBNL)
Year: 2001
Related Opportunity Numbers:
WT-090
WT-068
WT-102

Project: 81887
Title: Precipitation and Deposition of Aluminum-Containing Phases on Tank Wastes
PI: Dr. Shas Mattigod (PNNL), Dr. David Hobbs (SRTC), Dr. Daniel M. Dabbs (Princeton)
Year: 2001
Related Opportunity Numbers:

Project: 81893
Title: Physiochemical Processes Controlling the Source Term from Tank Residuals
PI: Dr. B. Peter McGrail (PNNL), Dr. Scott L. Wallen (North Carolina)
Year: 2001
Related Opportunity Numbers:
WT-068

Project: 81908
Title: Origins of Deviations from Transition-State Theory: Formulating a New Kinetic Rate Law for Dissolution of Silicates
PI: Dr. Johnathan P. Icenhower (PNNL), Dr. Andreas Luttge (Rice), Dr. David London (Oklahoma)
Year: 2001
Related Opportunity Numbers:
WT-035S
WT-066

Project: 81926
Title: Chemistry of Actinides in Molten Glasses and Its Correlation to Structural Performance of Solid Glasses: Filling the Knowledge Gap

PI: Dr. Sheng Dai (ORNL), Dr. Ray F. Schumacher (SRTC), Dr. Craig E. Barnes (UT Knoxville)
Year: 2001
Related Opportunity Numbers:
WT-066

Project: 81934
Title: Stability of High-Level Radioactive Waste Forms
PI: Dr. Theodore M. Besmann (ORNL), Dr. John D. Vienna (PNNL), Dr. Karl E. (Spear Penn State)
Year: 2001
Related Opportunity Numbers:
WT-066

Project: 81867
Title: Foaming and Antifoaming in Radioactive Waste Pretreatment and Immobilization Processes
PI: Dr. Darsh T. Wasan (llinois Institute of Technology)
Year: 2001
Related Opportunity Numbers:
WT-086

Project: 81891
Title: A New Class of Solvents for TRU Dissolution and Separation: Ionic Liquids
PI: Dr. Robin D. Rogers (Alabama)
Year: 2001
Related Opportunity Numbers:

Project: 81895
Title: Fundamental Chemistry of the Universal Extractant (UNEX) for the Simultaneous Separation of Fission Products and Transuranics form High Level Waste Streams
PI:
Dr. R. Scott Herbst (INEEL), Dr. V. A. Babain (St. Petersburg, Russia), Dr. Sue B. Clark (WSU)
Year: 2001
Related Opportunity Numbers:

Project: 81921
Title: Technetium Chemistry in HLW: Role of Organic Complexants
PI: Dr. Nancy J. Hess (PNNL), Dr. Steven D. Conradson (LANL)
Year: 2001
Related Opportunity Numbers:
WT-068
WT-102

Project: 81929
Title: Novel Fission-Product Separation based on Room-Temperature Ionic Liquids
PI: Dr. Huimin Luo (ORNL), Dr. Robin D. Rogers (Alabama), Dr. Charles L. Hussey (Mississippi)
Year: 2001
Related Opportunity Numbers:

Project: 81936
Title: Combined Extraction of Cesium, Strontium, and Actinides from Alkaline Media: An Extension of the Caustic-Side Solvent Extraction (CSSX) Process Technology
PI: Dr. Laetitia H. Delmau (ORNL), Dr. Ken N. Raymond (UC Berkley), Dr. David Hobbs (SRTC)
Year: 2001
Related Opportunity Numbers:

Project: 81949
Title: Strategic Design and Optimization of Inorganic Sorbents for Cesium, Strontium, and Actinides
PI: Dr. David Hobbs (SRTC), Dr. May D. Nyman (SNL), Dr. Edward J. Maginn (Notre Dame), Dr. Abraham Clearfield (Texas A&M)
Year: 2001
Related Opportunity Numbers:

Project: 81959
Title: A Comprehensive Study of the Solubility, Thermochemistry, Ion Exchange, and Precipitation Kinetics of NO3 Sodalite
PI: Dr. Carlos Jove-Colon (SNL), Dr. Alexandra Navrotsky (UC Davis)
Year: 2001
Related Opportunity Numbers:

Project: 81988
Title: Identification of Non-Pertechnatete Species in Hanford Tank Waste, Their Synthesis, Characterization, and Fundamental Chemistry
PI: Dr. Norman C. Schroeder (LANL), Dr. Kenneth R. Ashley (Texas A&M)
Year: 2001
Related Opportunity Numbers:
WT-068
WT-102

Project: 81898
Title: Increasing Safety and Reducing Environmental Damage Risk from Aging High-Level Radioactive Waste Tanks
PI: Dr. Eric Steffler (INEEL), Dr. Poh-Sang Lam (SRTC), Dr. Frank A. McClintock (MIT)
Year: 2001
Related Opportunity Numbers:
WT-079S
WT-004

Project: 81989
Title: The Influence of Radiation on Pit Solution Chemistry as it Pertains to the Transition from Metastable to Stable Pitting in Steels
PI: Dr. R. Scott Lillard (LANL), Dr. Robert J. Hanrahan (Florida)
Year: 2001
Related Opportunity Numbers:
WT-079S
WT-004

Project: 81866
Title: Development of Advanced Electrochemical Emission Spectroscopy for Monitoring Corrosion in Simulated DOE Liquid Waste
PI: Dr. Digby D. MacDonald (Penn State)
Year: 2001
Related Opportunity Numbers:
WT-079S
WT-004

Project: 81923
Title: Radioanalytical Chemistry for Automated Nuclear Waste Process Monitoring
PI: Dr. Oleg B. Egorov (PNNL)
Dr. Timothy A. DeVol (Clemson)
Year: 2001
Related Opportunity Numbers:

Project: 81924
Title: Optical and Microcantilever-Based Sensors for Real-Time In Situ Characterization of High-Level Waste
PI: Dr. Gilbert M. Brown (ORNL), Dr. David R. Walt (Tufts), Dr. Samuel G. Bryan (PNNL)
Year: 2001
Related Opportunity Numbers:
WT-102

Project: 81927
Title: A New Method for In-situ Characterization of Important Actinides and Technetium Compounds via Fiberoptic Surface Enhanced Raman Spectroscopy (SERS)
PI: Dr. Sheng Dai
Year: 2001
Organization: ORNL
Related Opportunity Numbers:
WT-102

Project: 81939
Title: Hybrid Micro-Electro-Mechanical Systems (MEMS) for Highly Reliable and Selective Characterization of Tank Waste
PI: Dr. Panos G. Datskos (ORNL), Dr. Michael J. Sepaniak (UT Knoxville)
Year: 2001
Related Opportunity Numbers:
WT-102

Project: 81964
Title: Physical Characterization of Solid-Liquid Slurries at High Weight Fractions Using Optical and Ultrasonic Methods
PI: Dr. Lloyd W. Burgess (UW), Dr. Paul Panetta (PNNL)
Year: 2001
Related Opportunity Numbers:
WT-032
WT-149

Project: 81967
Title: Radiochemical Analysis by High Sensitivity Dual-Optic Micro X-ray Fluorescence
PI: Dr. George J. Havrilla (LANL), Dr. Ning Gao (X-ray Optical Systems, Inc.)
Year: 2001
Related Opportunity Numbers:
WT-102

Project: 81889
Title: Investigating Ultrasonic Diffraction Grating Spectroscopy and Reflection Techniques for Characterizing Slurry Properties
PI: Dr. Margaret S. Greenwood (PNNL), Dr. Lloyd W. Burgess (UW)
Year: 2001
Related Opportunity Numbers:
WT-032
WT-149

B. Subsurface Contamination Projects

100 N ^{90}Sr Plume

Project: 40896, EMSP
Title: Mineralogic Residence and Desorption Rates of Sorbed ^{90}Sr in Contaminated Subsurface Sediments: Implications to Future Behavior and In-Ground Stability
Lead PI: John Zachara (PNNL)
Co-PI's: James McKinley (PNNL); Steve Heald (ANL); Chongxuan Liu (PNNL); and Peter Lichtner (LANL)

Project: 86911, EMSP
Title: Coupled Geochemical and Hydrological Processes Governing the Fate and Transport of Radionuclides and Toxic Metals Beneath the Hanford Tank Farms
Lead PI: Philip Jardine (ORNL)
Co-PI's: Scott Fendorf (Stanford Univ.)

Project: 87016, EMSP
Title: Trace Metals in Groundwater and Vadose Zone Calcite: In Situ Containment and Stabilization of ^{90}Strontium and Other Divalent Metals and Radionuclides at Arid West DOE Sites
Lead PI: Bob Smith (Univ. of Idaho)
Co-PI's: Grand Ferris (Univ. of Toronto); Yoshiko Fujita (INEEL); Frederick Colwell (INEEL); and Donna Cosgrove (Univ. of Idaho)

300 Area U Plume & 200 UP-1 U/Tc Plume

Project: 16259, NABIR
Title: In-Situ Immobilization of ^{99}Tc at the Hanford Site by Stimulation of Subsurface Microbiota
Lead PI: Phil Long (PNNL)
Co-PI's: Tim Scheibe (PNNL); John Zachara (PNNL); Jim Fredrickson (PNNL); and Jack Istok (Oregon State Univ.)

Project: 43914, EMSP
Title: Characterization of U(VI) Sorption-Desorption Processes and Model Upscaling
Lead PI: John Zachara (PNNL)
Co-PI's: Chongxuan Liu (PNNL); Zheming Wang (PNNL); Peter Lichtner (LANL); William Ball (Johns Hopkins Univ.); and Gordon Brown (Stanford Univ.)

Project: 86911, EMSP
Title: Coupled Geochemical and Hydrological Processes Governing the Fate and Transport of Radionuclides and Toxic Metals Beneath the Hanford Tank Farms
Lead PI: Philip Jardine, (ORNL)
Co-PI's: Scott Fendorf (Stanford Univ.)
Related Opportunity Numbers:
WT-053S

Project: 86740, EMSP
Title: Phosphate Barriers for Immobilization of Uranium Plumes
Lead PI: Jonathan Icenhower (PNNL)
Co-PI's: Peter Burns (Univ. of Notre Dame); Peter McGrail (PNNL); and Shas Mattigod (PNNL)

Project: 86898, EMSP
Title: Reactivity of Primary Soil Minerals and Secondary Precipitates Beneath Leaking Hanford Waste Tanks
Lead PI: Kathryn Nagy (Univ. of Illinois at Chicago)
Co-PI's: Neil Sturchio (Univ. of Illinois at Chicago)
Related Opportunity Numbers:
WT-053S

<u>200 W Carbon Tetrachloride Plume</u>

Project: 86729, EMSP
Title: Mechanisms of CCl_4 Retention and Slow Release in Model Porous Solids and Sediments
Lead PI: Robert Riley (PNNL)
Co-PI's: Brent Peyton (WSU); David Rector (PNNL); Virginia Rohay (CH2M HILL); James Amonette (PNNL); and Steve Yabusaki (PNNL)

Project: 86820, EMSP
Title: Overcoming Barriers to the Remediation of Carbon Tetrachloride Through Manipulation of Competing Reaction Mechanisms
Lead PI: Paul Tratnyek (Oregon Health & Science Univ.)
Co-PI's: James Amonette (PNNL); Eric Bylaska (PNNL); and Jim Szecsody (PNNL)

<u>Groundwater Monitoring (general)</u>

Project: 86759, EMSP
Title: Radionuclide Sensors for Water Monitoring
Lead PI: Jay Grate (PNNL)
Co-PI's: Timothy DeVol (Clemson Univ.) and Oleg Egorov (PNNL)
Related Opportunity Numbers:
WT-140

Project: 87023, EMSP
Title: A New Framework for Adaptive Sampling and Analysis During Long-Term Monitoring and Remedial Action Management
Lead PI: Barbara Minsker (Univ. of Illinois at Urbana-Champaign)
Co-PI's: Robert Johnson (ANL); Michael Welge (Univ. of Illinois); Albert Valocchi (Univ. of Illinois); Barbara Bailey (Univ. of Illinois); David Goldberg (Univ. of Illinois)
Related Opportunity Numbers:
WT-140

Hanford Tank Farms (general)

Project: 86984
Title: Collaboration: Caustic Water-Soil Weathering Reactions and Their Impacts on Trace Contaminant Migration and Seqestration
Environmental Cat.: Subsurface Contamination
Year of Award: 2002
Previous Project:
Renewal Project: 86984
Lead PI: Dr. Karl T. Mueller (Pennsylvania State University)
Related Opportunity Numbers:
WT-053S

Project Number: 86814
RFA Year: 2002
Title: Colloid-Facilitated Transport of Radionuclides Through the Vadose Zone
Environmental Cat.: Subsurface Contamination
Previous Project: 70135
Renewal Project:
Lead PI: Dr. Markus Flury (Washington State University)
Related Opportunity Numbers:
WT-053S

Project Number: 86807
RFA Year: 2002
Title: Long-Term Stewardship of Mixed Wastes: Passive Reactive Barriers for Simultaneous In Situ Remediation of Chlorinated Solvent, Heavy Metal, and Radionuclide Contaminants
Environmental Cat.: Subsurface Contamination
Previous Project:
Renewal Project:
Lead PI: Dr. William Apel (Idaho National Engineering and Environmental Laboratory)
Related Opportunity Numbers:
WT-061

Project Number: 86753
RFA Year: 2002
Title: The Aqueous Thermodynamics and Complexation Reactions of Anionic Silica and Uranium Species to High Concentration
Environmental Cat.: Subsurface Contamination
Previous Project: 70163
Renewal Project:

Lead PI: Dr. Andrew R. Felmy (Pacific Northwest National Laboratory)

Project Number: 86598
RFA Year: 2002
Title: Coupled Flow and Reactivity in the Variably Saturated Porous Media
Environmental Cat.: Subsurface Contamination
Previous Project:
Renewal Project:
Lead PI: Dr. Carl Palmer)Idaho National Engineering and Environmental Laboratory)

Project Number: 73773
RFA Year: 2000
Title: Isotopic Tracers for Waste Fluid Tracking and Fluid-Soil Interactions: Hanford, Washington
Environmental Cat.: Subsurface Contamination
Previous Project: 55351
Renewal Project:
Lead PI: Dr. Donald J. DePaolo (Lawrence Berkeley National Laboratory)

Project Number: 73758
RFA Year: 2000
Title: Fixations Mechanisms and Desorption Rates of Sorbed Cs in High Level Waste Contaminated Subsurface Sediments: Implications to Future Behavior and In-Ground Stability
Environmental Cat.: Subsurface Contamination
Previous Project: 60355
Renewal Project:
Lead PI: Dr. John M. Zachara (Pacific Northwest National Laboratory)
Related Opportunity Numbers:
WT-053S

Project Number: 86952
RFA Year: 2002
Title: **Multi-**Regional Reactive Transport Due to Strong Anisotropy in Unsaturated Soils with Evolving Scales of Heterogeneity
Environmental Cat.: Subsurface Contamination
Lead PI: Dr. Anderson L. Ward (Pacific Northwest National Laboratory)

Appendix E

Selected Meeting Minutes
Related to Technology Opportunities at Hanford

E.1 CH2M HILL Tough Technical Problems

A meeting was held on May 28, 2003 to identify the CH2M HILL tough technical problems that might yield significant cost and schedule improvements for the RPP mission. These problems were compiled and then discussed at a June 5 meeting with key PNNL staff involved with creative, economic, and practical robotic systems. A week later, PNNL responded to the tough technical problems and identified areas where they might be able to help.

The May 28 Meeting

The May 28 meeting attendees included technical specialists from CH2M HILL Strategic Planning & Mission Analysis, Project Delivery, Closure Projects, and Engineering. The problems they identified are described below.

1. Retrieve waste from a certain number of single-shell tanks faster and cheaper with extremely aggressive commitments over the FY 2003-2006 time frame.
2. Double-Shell Tank Space: one of the critical resources needed for storing and staging waste retrieved from single-shell tanks.
3. Pumping slurries. Up to the present, we have focused on pumping liquids and brines; soon we will also be pumping slurries.
4. Inspecting tank risers. Currently we use plug gauges that require crane crews and massive effort. Is there a hand-held tool that could be lowered into the riser that would determine (electronically compute) riser diameter, circularity, axis alignment, etc.? Currently we are lucky to get all required dimensions, etc. for one riser on a tank; we would like that info on several, or all, of the risers.
5. A simple way to quickly and efficiently install a new riser in an existing SST.
6. Means for installing fill-holes in the tanks for quick and dirty filling of tanks after retrieval is complete.
7. Simple exhausters. Current ones are big and expensive.
8. Non-contact surface-level measurement.
9. Toolbox for dealing with a plugged line such as the line that affected transfer from Tank U-107.
10. PPP pump pit, new swivel.
11. Development of a positive displacement pump with an intake opening that is remotely positionable. Modify the positive displacement pump on the crawler to discharge through the hose management system directly to a transfer line, or modify the intake of the S-112 positive displacement pump to include a flexible suction section positionable by crawler/ or to include a height adjustment with joint to extend to edges of tank.
12. Capability for determining how much waste is in ancillary equipment (e.g., in the pipes).
13. Simple way to assay equipment planned to be removed from a tank prior to its removal. Currently, we get the item pulled, put into a burial box, then assayed.
14. Assay the tank with a tool lowered into the tank.
15. Cost-effective, timely, in-process sampler for use with the hose-in-hose transfer lines. With such a tool, the last material transferred would give a good indication of the residuals still in the tank.
16. A little robot for sampling residual solids off-riser at the bottom of the tank.
17. New pipe connector (replacement for the PUREX connector). SRS is looking at one that is straight through, without the 90° bend. The French use a Zenith connector.

18. Need for DST tank integrity inspection much higher up in the tank than we have ever done before as we plan to fill the DSTs up to the curvature leading into the dome. Need ultrasonic scan and/or other inspection tools.
19. Leak detectors. Currently the big waste transfers rely on old instrumentation. We are in trouble when the instruments fail that are providing the material balance information.
20. OSHA issues regarding vapor emission from the tanks. We will have more vapor emissions as we retrieve new tanks. Are comfort masks (carbon canisters) available? What about fans (which would simulate a gentle breeze)? What about misters? Humidification fans? (e.g., like those used at WIPP where the salt absorbs all available moisture and the resulting dryness needs to be mitigated for safety and OSHA reasons)

The following comments were provided subsequent to the meeting, reflecting input from others (thus there is some duplication):

21. Remote/off-riser sampler: drop a device into the tank and drive it to the area to be sampled. There are always questions about the representativeness of samples, and this would aid in addressing this question.
22. Remote video applications: a little cart that could drive into some of our buildings and video instead of a manned entry (e.g., into 242-T).
23. Potential improvements for ultrasonic testing of tank knuckles.
24. Remote, magnetic, weld-testing device for testing the inside of the dome space welds.
25. A turnkey pump pit/system that either fits on top of a 4-inch riser or is lowered into an existing pit. This suggestion offers the biggest bang for the buck. Attributes would include simple hose-in-hose connections, pre-tested valves and systems prior to field installation, complete containment that drains to existing tank and notifies operations of a leak, provides adequate shielding, and does not weigh so much that it challenges the dome load controls on SST tanks. It needs to be reliable and inexpensive. The prefabricated pump pit on SY-101 is an excellent example, but maybe it could be made smaller.

On May 30, CH2M HILL staff met with AEA Technology's Eric Clement to identify candidate projects for AEA Technology to write Field Work Proposals for FY 2004 "Ear-marked" funding from the DOE Office of Science and Technology (EM-50). Ken Gasper proposed three of the above problems for AEA Technology to consider (perhaps apply technology deployed in their British facilities):

3. Pumping slurries. Up to the present, CH2M HILL has focused on pumping liquids and brines; soon they will also be pumping slurries.
15. Cost-effective, timely, in-process sampler for use with the hose-in-hose transfer lines. With such a tool, the last material transferred would give a good indication of the residuals still in the tank.
17. New pipe connector (replacement for the PUREX connector). SRS is looking at one that is straight through, without the 90° bend. The French use a Zenith connector.

The June 5 Meeting

PNNL is looking for cost-effective environmental management solutions to Hanford cleanup problems that could be made available on a "rental center" basis, so the costs to the users would be lower. PNNL needs to know if CH2M HILL wants such a service before approaching DOE-HQ for funding. Ed Aromi (CH2M HILL General Manager) emphasized that the tank farm work

must be done quickly, but the Lab should ask CH2M HILL staff if the concept has value. Thus, this meeting was scheduled.

There are many problems, and no one technology fits all of them. Tools in the PNNL toolbox can be used just once or many times. The Lab is not proposing any R&D projects, but it just looking for practical, cost-effective solutions to current problems. CH2M HILL would be willing to invest in tools if it makes sense. Some CH2M HILL participants liked the rental center concept and stated that having access to a group of PNNL staff with diverse skills and lots of practical knowledge is appealing.

In the past, tank waste retrieval costs were more than $50 million per tank. We need to get the cost down to $10-12 million per tank. Tank C-106 cost more than $100 million, but the retrieval goals were met and the high-heat waste was removed. CH2M HILL has looked at lots of technologies (e.g., vacuum system technology, MRS, crawler, power fluidics, jet pump, modified dissolution/sluicing), but none of them has been demonstrated yet. They are moving away from waterless systems. They plan to talk to the State about using water (low volumes and low residency times) and trying to sluice everything they can. They need to do technology demonstrations and then move into operations as soon as possible.

Roy Schepens (ORP Manager) is pushing the envelope and accelerating schedules, and has provided performance-based incentives (PBIs) to CH2M HILL to finish their defined scope as soon as possible (e.g., retrieve and close 40 tanks rather than 26, including some known leakers). Unfortunately, the budget is fixed, so they must find cheaper ways to get the work done. They are challenging the requirements of what has to be done. For example, they are asking the regulators if they can skip the interim stabilization step and just go directly to retrieval in some SSTs. Having the ability to go to the toolbox and find quick resolution to a problem is appealing. PNNL needs to figure out how to take existing tools and make them work to solve problems.

PNNL staff worked for EM-50 for 10 years and accumulated much remote robotic equipment, including mobile vehicles. The Lab will staff and maintain the equipment and then rent it to CH2M HILL. Since the equipment is already at the Site, no procurement cycles would be needed. However, there are union issues that need to be resolved. PNNL will request $200K from DOE-HQ to establish the Center. RL could also take advantage of tools in the Center for PUREX and other cleanup needs. A sample cost estimate was prepared for the pit viper, but there is a lot of other equipment available as well. The use fee for the pit viper would be between $225K (using PNNL operators) and $275K (training and using CH2M HILL operators). These costs include one month for training CH2M HILL staff and one month for a cold test dry run.

PNNL talked to Fluor Fernald about the concept, and they expressed interest. Fluor Hanford is a potential client for PFP and T-Plant, and the new River Corridor Contractor is a potential client. The Lab has not talked to Savannah River or Idaho yet.

PNNL has a list of the types of equipment available. Some equipment came from Rocky Flats and has never been deployed. Savannah River has some equipment that PNNL can have if they just pay the shipping costs. CH2M HILL might want to transfer some equipment to the Center (e.g., the light-duty utility arm).

Ken Gasper summarized the 25 CH2M HILL tough problems in the handout. CH2M HILL has to retrieve 40 tanks in three years. Where will they put the waste? They do not plan to build any more DSTs. Should they concentrate the waste more? They need 18 million gallons of space, and so far they have only found half of that amount, so this is a big problem. Another big

problem is plugging transfer lines. Such lines will need to be used extensively for many years, so they need a way to stop the plugging. The U-107 line was severely constricted. They tried for a year to make it work, and eventually gave up. Now they need a quarter mile of hose-in-hose to solve the problem. They want to work above ground as much as possible and abandon everything below ground. A third big problem is inspecting tank risers. They would like to turn this problem over to PNNL. The risers cost a lot, there is a lot of employee exposure to radiation, and sometimes the holes aren't in the right places, so new risers must be added. They also need a turnkey pump pit/system that either fits on top of a four-inch riser or is lowered into an existing pit.

Items 12, 13, and 14 all deal with finding out what is in the tanks and the ancillary equipment (e.g., pipes). They need data for their risk models regarding what will be left behind in the pipes. CH2M HILL would like to grout the ancillary piping in place, but the State says that they cannot do anything that would preclude any future closure actions. They must know what is inside the pipes before the State would allow the pipes to be grouted in place. They would like to get this information through remote inspection/assay without having to dig up the pipes. For problems 18, 19, and 20, CH2M HILL needs more of what the Lab is already doing. For problem 23, they need real-time analysis of tank vapors (i.e., sensors and microprocessors) to protect the workers retrieving the tanks. With the pit viper technology, the technical problems were solvable, but the institutional problems (e.g., the many crafts involving the union workers) remain to be solved.

The two outcomes from this meeting are as follows: 1) PNNL should pursue the rental center concept. 2) The Lab needs to look at the 25 individual problems, and see how to solve them. We don't need a center if we already have all the solutions.

Some PNNL staff members believe that the Hanford Site has "operational pinch points" (e.g., getting crane crews). Thus, these staff members are looking at other options to avoid the need for crane crews, such as the use of water-filled plastic shielding modules to replace steel plates for shielding over transfer lines.

The PNNL Response

After the initial meeting, PNNL categorized CH2M HILL's list of 25 tough technical problems into four distinct areas:

- Immediate Solutions - Immediate solutions are based upon the use of existing equipment at PNNL today.
- Near-Term Solutions – These are solutions that will require one to six months, depending upon the technical requirements, to acquire off-the-shelf components and adapt them to address a specific problem.
- Engineering Design and Build Solutions – These are solutions that PNNL views as engineering "design, build, test, and deliver", which are longer-term (three months or longer).
- Other Solutions – In this category, solutions may be available, but they are either outside the current skill set of the remote systems capabilities or they require additional information and possibly several other skill sets in order to provide a practical solution.

Immediate Solutions: There was one item that fit this category -- number 22, Remote video applications. PNNL has several systems that are available immediately that could support the inspection of some of the buildings necessary to prevent manned entry. PNNL has conducted a number of these inspections for other clients on the Hanford Site over the past five years. The inspection system could be a candidate for the equipment center.

Near-Term Solutions: PNNL has identified solutions that could be delivered near term in support of resolving the problems listed below. Each solution utilizes a strategy of integration and adaptation of existing equipment that could be deployed within one to six months. Each of these could be considered candidates for the equipment center.

Item 4 -Inspecting tank risers – PNNL has successfully performed similar measurements for deployment of equipment at U-Plant to ensure that the equipment could fit through the existing openings below grade. There are several options, depending upon the exact requirements of inspection that could be deployed without the use of crane crews for quick measurements.

Item 16 - Sampling residual solids off-riser- It is assumed that the tank has been retrieved, and residual waste must be sampled. There are several nearly off-the-shelf remote crawler systems that can provide this type of service. This would require procurement of a crawler system, which would be a consumable, but the control system could be used for multiple deployments. During the inspection and characterization of U-Plant, PNNL successfully acquired samples during the inspection.

Item 18 - DST Integrity Inspection - The RONDE system, recently deployed by CH2M HILL for the DST Integrity Program, could be utilized to start the inspection process of the DSTs. While it may need to be modified for use in the upper reaches of the annulus, the technology should be applicable for inspection of the upper regions of the primary liner.

Item 21 - Remote off-riser sampler – This is similar to item 16 above, however; in this case, the tank may still have large volumes of waste that the system needs to negotiate. If this is applied to SSTs, it is likely that the system for the residual off-riser sampler could be modified for this sort of sampling.

Engineering Design and Build Solutions: There were nine problems that fit this category.
Item 3 - Pumping Slurries
Item 7 - Simple Exhausters
Item 9 - Toolbox for plugged transfer lines
Item 11 - A remotely positionable positive displacement pump intake
Item 12 - Capability for measuring waste in ancillary equipment
Item 15 - An in-process sampler for hose-in-hose transfer
Item 17 - A new pipe connector to replace the PUREX connector
Item 23 - Potential improvements for ultrasonic testing of tank knuckles
Item 24 - Remote weld testing device for inside the dome space
Item 25 - A turnkey pump/pit system for a four-inch riser.

PNNL has identified a solution for each of the above problems that would require the development of an engineering design and fabrication/adaptation of a system. For each of these problems, additional requirements specifications are necessary PNNL to definitively state the type of solution they have in mind. There may be several candidates from this category that could be considered for inclusion in the equipment center.

Other Solutions: The remaining ten items require additional specific information on the problem and the associated constraints. These include item 1, retrieve waste from SSTs faster and cheaper; item 2, DST tank space; item 5, simple, efficient, and quick method for new riser installation; item 6, methods for installing fill holes for post retrieval; item 8, non-contact surface-level measurement; item 13, in-situ assay of equipment; item 14, assay the tank interior; item 19,

leak detection; and item 20, OSHA issues regarding vapor emissions. Many of these items have a number of potential solutions or partial solutions that could help CH2M HILL meet their current near-term cleanup goals.

PNNL requested CH2M HILL's endorsement of the equipment deployment center so that the two companies could work together to secure funding from DOE Headquarters to initiate the center. PNNL would work closely with CH2M HILL to address issues that are likely to arise as this concept moves forward. Ultimately, PNNL's goal is to provide technical solutions based upon its unique skill set in remote systems to support CH2M HILL and DOE to clean up the Hanford Site within the target funding and schedule profiles.

E.2 Technical Exchanges

CH2M HILL holds periodic Technical Exchanges with other DOE sites such as the Savannah River Site (SRS) in order to leverage ongoing work at those sites that might be applicable to the Hanford Site. Three Technical Exchanges have been held so far in FY 2003. Each of these is briefly described below.

Technical Exchange at Hanford with SRS and others on Tank Retrieval and closure (January 2003)

A Technical Exchange between Hanford staff, Industrial Design Corporation of Portland, and Savannah River Technology Center and operations staff related to Tank C-106 and retrieval was conducted on January 21, 2003 at Hanford. At that time, Tank C-106 contained 20,000 gallons of sluicing liquid with 3 curies of technetium 99 and a hard heel of solids made up of phosphates with a compressive strength exceeding the limits of Hanford's core sampling truck. About 14 more Hanford tanks contain this hard heel. Hanford staff described the retrieval approaches considered for C-106 retrieval activities, including the Mobile Retrieval System, sluicing, and custom pumps to break up rock-like waste. The job is done if the amount remaining in the tank is less tan 360 ft^3. If more than that remains, then a risk-based cost/benefit analysis will be performed in accordance with Appendix H of the Tri-Party Agreement. SRS staff proposed alternate retrieval and transfer approaches such as auger pumps, sonic vibration, mining out the waste, acid wash to "soften" or help dissolve the residual waste, shape charges, ultrasonics, flash jets, microwave, cutting water jet with an added abrasive, and pole strainers or mud snappers for solids transfer. Hanford staff emphasized that CH2M HILL has focused on more conventional approaches that do not require significant research and development and additional safety analysis. Other topics discussed included methods for moving material under the risers, installing new risers, stabilizing the grout, decontamination of in-tank equipment, above-grade transfer lines, technology for the first 40 tank retrievals, and regulatory strategy.

The Technical Exchange on Tank C-106 and retrieval was continued on January 24 and 27, 2003 between Hanford staff, Washington Safety Management Systems (Savannah River), and the Savannah River HLW Tank Operations. At SRS, tanks were closed in accordance with the Clean Water Act. SRS closure work was conducted in three stages: waste removal, heel removal, and closure. Waste from a 4-pack of single-shell tanks was consolidated into one tank as an interim storage step, and pumped above ground with hose-in-hose transfer lines. A water cannon was used to remove the heel and clean the pipes, with a crawler available for backup. Remaining waste was encapsulated in grout. At SRS, the cold tests done at TNX supported the readiness assessment, and provided training for dedicated operators. SRS emphasized the need to conduct an internal readiness assessment and to obtain agreement on retrieval and closure criteria with

DOE and the regulators before starting waste removal. SRS agreed to send their tank closure plans to Hanford staff, although CH2M HILL agreed to interim closure rather than final closure. SRS staff recommend planning work retrieving multiple tanks in succession and then grouting multiple tanks simultaneously with a common grout staging area to maximize economies of scale. SRS stated their preference for the use of nitric acid in concert with agitation to mobilize sludge without dissolving it. Lawrence or Curtis Wright Electromechanical Division pumps are used for large-scale mixing or slurry pumping. The AEA fluidic pump provides acceptable salt removal and removal of small heels of insoluble solids. ITT Flygt, Pit Bull, and Tsurami manufacture cheaper, disposable transfer pumps. Hanford and SRS staff agreed that more communication is needed on the SRS rail system, mast, waste samplers, and the different pumps that have been used. SRS can benefit from the Hanford experience with robotics, the cone penetrometer, and waste samplers.

SRS Hanford Salt Retrieval Technical Exchange (April 22-23, 2003)
A Technical Exchange between Hanford and Savannah River Site primarily related to saltcake retrieval at both sites was conducted on April 22-23, 2003. This Technical Exchange included information about plans and approaches as well as recent related history at both sites since the last saltcake Technical Exchange in the spring of 2002. Topics of particular interest included salt solution transfer and line pluggage as a function of temperature and dilution; effective draining of liquid from saltcake tanks; modeling of selective dissolution at Hanford and correlation with SRS dissolution retrieval; pumping equipment and approaches; and radiation detection or other instrumentation useful in the field to support salt retrieval. Compact Disks are available (see Ken Gasper) providing copies of all the material presented at this meeting.

Fernald Crawler Retrieval Technical Exchange (April 28-29, 2003)
On April 28-29, 2003, a Technical Exchange was held with Fluor Fernald/Jacobs Engineering staff to discuss the Mobile Retrieval System at the Cold Test Facility. Fernald is planning for waste heel removal in their silos. Fernald is using a vacuum retrieval system for removal of the top two-thirds of their radon-rich waste in each of three 80-foot diameter silos, and crawlers and augers for the lower third, which is sludge. Fernald was interested in Hanford experience with waste simulants for cold testing the depth of waste that can be moved with vehicle-based retrieval equipment. Topics included the need for cameras and lights on the vehicle, decontaminating the vehicle, maintenance and repairs, power demand, and the maximum allowable control cable distance between the in-tank vehicle and the control console.

AECL Technical Exchange (February 3, 2003)
A Technical Exchange with AECL took place at PNNL on June 11, 2001. PNNL made presentations on tank inspection, fluids and solids monitors, vitrification, bulk vitrification, tank waste characterization, C-104 technical support, and safety basis. Tours were provided of the Robotics Lab at 2400 Stevens and the APEL laboratory facilities.

Another AECL Technical Exchange occurred on February 3, 2003. As a result of the discussions in February, AECL invited a CH2M HILL staff member and a PNNL staff member to visit their nuclear waste tank facility at Chalk River, Ontario, Canada on June 23-26, 2003. The purpose of this visit was to identify opportunities to utilize DOE capabilities to help AECL clean up radioactive waste stored in five tanks. The three top opportunities identified were: 1) characterizing waste physical properties, 2) characterizing tank integrity, and 3) characterizing waste topography. Specifically, AECL is looking to CH2M HILL for its expertise in video surveillance and inspection of the radioactive tanks, including a review of available video equipment and guidance to improve the quality of AECL inspection techniques and procedures. AECL is looking to PNNL for expertise in ultrasonic techniques to assess the waste physical

properties (e.g., detect sludge and/or organic layers) and tank integrity. AECL is looking to INEEL for improved methods to install new tank penetrations and provide better tank access.

Mississippi State University (MSU)—Diagnostic and Instrumental Analysis Laboratory (DIAL)
Staff from Mississippi State University Diagnostic Instrumentation and Analysis Laboratory (MSU-DIAL) visited Hanford on June 10, 2003 to discuss MSU-DIAL activities supporting Hanford tank waste retrieval. On July 17, 2003, MSU DIAL sent recommendations for two FY2004 tasks to support Hanford SST waste disposition. These activities are discussed in more detail in Section 3.8.

On June 10, 2003, Dr. John Plodinec led a delegation from MSU-DIAL to Hanford to discuss DIAL's capabilities and how they could be utilized to address Hanford technical issues. Hanford staff attending the exchange included: Ken Gasper, Blaine Barton, Dan Reynolds, Shafik Rifaey, Dave Bechtold, Dan Herting (FH), Bill Bonner (PNNL), Gary Josephson (PNNL), and Lena Mahoney (PNNL).

MSU-DIAL had already been supplied with copies of the publicly available Technical Challenges and MSU-DIAL considered that seven of them matched their capabilities and were the topic of the most discussion. These were: regenerable "Cleanable" HEPA filters, in-tank imaging systems, thermography for maintenance, leak detection and monitoring, tank leak repair, tailored disposal systems, and TRU tank waste processing.

Several Technology Opportunities were also presented to DIAL for their consideration: Dissolution Kinetics (WT-063), Sulfate Separations (WT-146), Tank Chemistry for Protecting Tanks from Corrosion (WT-004, WT-79-S), Tank Heels Solubility (WT-112), Simpler Thermodynamic Models for Tank Chemistry Modeling (WT-091), In-Situ Analysis of Tank Heels (WT-102, WT-115), Long-Term Vadose Zone Monitoring (WT-140), Predicting Long-Term Performance of Waste Forms (WT-151-S), and Glass Surface Area (WT-016).

As a result of the exchange, MSU-DIAL has considered the Hanford opportunities and its own strengths and proposed work in the following areas for FY04: continue improving the database for the thermodynamic modeling to support Hanford tank chemistry, apply thermodynamic modeling to Hanford waste processing alternatives; use optical fibers for gamma detection, in-tank concentration monitoring, neutron measurement, and in-tank U and Tc analysis; in-situ tank analysis using laser-induced fluorescence and spectral reflectance; tank volume measurement using profilometry and stereovision; and Raman spectroscopy for in-line measurement of saltcake anions.

Florida International University (FIU)—Hemispheric Center for Environmental Technology (HCET)
Two Technical Exchanges were held with FIU HCET (FIU) personnel, on April 8-10 at Hanford and on April 24 at FIU. During the first meeting, Dr. Rajiv Siristava led a delegation of three to discuss FIU's current work and additional capabilities that could be utilized to address Hanford technical needs. Hanford staff attending the exchange included: Ken Gasper, Blaine Barton, Dan Reynolds, Shafik Rifaey, Bill Bonner (PNNL), and Gary Josephson (PNNL). At the time of the meeting, the complete set of Technology Opportunity Statements were not available for public release, but the subset of Technical Challenges was available. Six of the Technical Challenges were specifically presented to them for their special consideration: Radiation Survey, Non-Destructive Evaluation (NDE) of Transfer Piping, Leak Detection Monitoring and Mitigation, Pipe Leak Mitigation, and Control of Retrieved Waste Dilution.

Immediately following the Savannah River Technical Exchange in April 2003, Blaine Barton, of CH2M HILL Hanford Group, led a contingent of three to visit the FIU laboratories to inspect the large column equipment and critically review the experimental test plans that were being prepared for the saltcake dissolution trials conducted during the remainder of FY03. As a result of the exchange, FIU modified their design of the water distributor and modified their test plan.

E.3 Environmental Management Science Program

The DOE Office of Environmental Management (EM) was created in 1989 to address the environmental legacy from over 50 years of nuclear weapons research, production, and testing. This is some of the most technically challenging and complex work of any environmental program in the world. The Environmental Management Science Program (EMSP) was implemented in 1996 in response to a recommendation to EM from the 1995 Galvin Commission Report. This report stated that there is a particular need for long-term, basic research in disciplines related to environmental cleanup. Adopting a science-based approach that includes supporting development and expertise could lead to both reduced cleanup costs and smaller environmental impacts at existing sites and to the development of a scientific foundation for advances in environmental technologies.

EMSP is developing the scientific basis for risk-based decision-making and breakthrough approaches for cleaning up the nuclear weapons complex. Since its inception, it has been jointly managed by EM and DOE's Office of Science (SC). Since 1998, it has targeted projects dealing with high-priority EM needs (e.g., high-level waste, subsurface contamination, decontamination and decommissioning). The goals of the EMSP are to:

- Provide scientific knowledge that will revolutionize technologies and cleanup approaches to significantly reduce future costs, schedules, and risks.
- Bridge the gap between broad fundamental research that has wide-ranging applicability such as that performed in DOE's Office of Science and needs-driven applied technology that is conducted in other parts of the agency and in the private sector
- Focus the Nation's science infrastructure on critical DOE environmental management problems.

EMSP seeks to work directly with cleanup staff at DOE sites to identify and collaborate on specific site problems. It is envisioned that this CH2M HILL Technology Opportunities Roadmap could potentially serve as the basis for developing a more detailed S&T roadmap to guide EMSP investments in science to underpin the IMAP acceleration plans for the RPP. The current EMSP projects related to CH2M HILL's mission are summarized in Appendix D.

<u>FY2003 EMSP Principal Investigator Workshop</u>
An EMSP workshop was conducted on May 6-7, 2003, in Richland, WA. The meeting was held in the William R. Wiley Environmental Molecular Sciences Laboratory (EMSL) at PNNL. The purpose of this workshop was to encourage information exchange between EMSP principal investigators and DOE Hanford Site personnel dealing with high-level waste, vadose zone contamination, and groundwater remediation issues. Current EMSP projects in subsurface science and high-level waste were discussed (see Appendix D for a detailed listing). The workshop emphasized chemical reactions and water migration processes in the vadose zone, with emphasis on both high- and low-level waste discharges. These scientific themes were coupled with major, ongoing Hanford Site activities to retrieve, pre-treat, and process high-level waste;

prevent vadose zone contaminants from moving to groundwater; and remediate groundwater plumes with mobile contaminants. The workshop assessed research plans and progress with the goals of 1) focusing research on key S&T issues and needs and 2) identifying key products needed for the Hanford Site. The workshop identified a reporting strategy to capture research results in a form useful to DOE Hanford Site personnel and remediation contractors.

E.4 Earmarked Activities

Some EM funds are allocated directly to institutions. CH2M HILL Technology Integration has met with these institutions to identify work scope that matches the Technical Challenges to the capabilities of the institutions. These activities are described below.

AEA Technologies

AEA Technologies received funding from EM-50 to design, fabricate, and test a prototype multi-charge vessel fluidic mixing and retrieval system to support future applications of power fluidics for SST retrieval. The design of the prototype is consistent with the design of fluidic systems originally under consideration for S-102. CH2M HILL's Technology Integration Program developed a Statement of Work for the procurement. A project kickoff meeting between CH2M HILL Strategic Planning and Mission Analysis staff and technical representatives of AEA Technologies was held on January 29, 2003. Follow-up meetings and teleconferences are being held to finalize specifications and monitor the Statement of Work.

AEA Technologies staff met at the Hanford Site on July 2, 2003 to discuss the prototype testing that will be conducted at the Hanford Cold Test Facility. The primary objectives for prototype testing include:

- Determining the minimum RFD intake distance to the bottom of the tank
- Determining the effective cleaning radius of the 3-CV system, including the effectiveness of the smaller outboard nozzle design
- Determining the capability of the fluidic prototype to manage sludge type waste simulants,
- Evaluating and optimizing operating software/control systems for the range of process scenarios and system configurations identified in the S-102 Conceptual Design Report.

The power fluidic system will be demonstrated at the Hanford Cold Test Facility in the fourth quarter of 2003.

In the May-July 2003 period, CH2M HILL carried on discussions with AEA Technologies about other Technology Challenges to which AEAT might apply their expertise and experience in FY04.

MSU-DIAL

A meeting was held with Mississippi State University Diagnostic Instrumentation and Analysis Laboratory (MSU-DIAL) on June 10, 2003 to discuss MSU-DIAL activities supporting Hanford tank waste retrieval. The purpose of the meeting was to: 1) better acquaint Hanford staff with the activities underway at MSU-DIAL supporting Hanford tank waste retrieval, 2) help MSU-DIAL staff better understand the background and the challenges into which their developments fit, and 3) discuss potential FY04 activities.

MSU-DIAL is an organization that is growing rapidly and has significant technology available. Currently DIAL has 70 FTEs, including both scientists and engineers. DIAL's revenue this fiscal year will be about $9.2 M, of which about 60% is directly from DOE-EM. DIAL currently has funding from about 20 different clients for its measurement and testing services.

Jeff Lindner described the work currently being performed using the ESP code to better understand disposition of chemical species in the wastes being retrieved from Hanford tanks. This work has been well received at Hanford and is being utilized. The results are included in monthly and quarterly reports.

Due to schedule demands of some key Hanford participants, the presentation of non-ESP technologies potentially supporting Hanford was summarized early in the day then presented in more detail later. A number of technologies are being developed at MSU-DIAL that can help accelerate Hanford cleanup. The need for near-term application was stressed, as well as the need for extreme simplicity in installation and operations.

John Plodinec, Director of MSU-DIAL, discussed several areas currently under development at MSU-DIAL and solicited input on how well they might help to meet the accelerated Hanford tank objectives. Several of the technologies are of high interest to Hanford personnel and further development appears to be worthwhile. The items of highest interest include:

- The ESP code developments as applied to waste retrieval and evaporator operations are of major interest to Hanford.
- In-tank waste contour mapping utilizing monochromatic fringe line patterns coupled with a Fourier-transform profilometry (FTP) system that can be lowered through a 4-inch riser by hand and take measurements in a few minutes is also of high interest.
- The in-tank stereovision system for improved tank viewing appears to be another major improvement over existing technology.
- Real-time monitoring of liquid level in salt tanks via dry wells using fiber optic sensors may also be a significant advancement.

On July 17, 2003, MSU DIAL sent descriptions to CH2M HILL and ORP for two FY2004 tasks to support Hanford SST waste disposition. One project will assemble and test in-tank and at-tank waste characterization tools for use during waste retrieval and tank closure. The inspection tools will combine species identification (from the combination of diffuse reflectance spectroscopy and information-sifting techniques) and species spatial distribution determination (from spectral imaging). Targets of opportunity include inspection of tank wall deposits and distribution of important chemical species (such as aluminum hydroxide and uranium deposits) within the tank. A second project will develop and deploy a flexible scintillating optical fiber sensor system for use at the Hanford Site. This sensor system can be deployed into the drywell or pipelines around underground waste tanks at the Hanford Site for continuous real-time monitoring of the moisture level inside Hanford tanks.

FIU HCET

In conjunction with DOE, the Hemispheric Center for Environmental Technology (HCET) was established at Florida International University (FIU) in 1995 to research, develop, and demonstrate innovative environmental technologies and to establish alliances with private contractors and commercial entities that would support implementation of innovative technology solutions. HCET's research has focused on the safe and effective management and reduction of radioactive and hazardous wastes and the decontamination and decommissioning (D&D) of

nuclear facilities. More specifically, the R&D activities have supported DOE's Environmental Management programs in the areas of waste characterization, monitoring, sensor technology, waste storage tank and tank systems remediation, and decontamination and decommissioning.

HCET participates with DOE's Office of Science and Technology, Office of Site Closure, and Office of Project Completion and their field offices in meeting mission objectives. As an R&D institution, HCET is administered by the National Energy Technology Laboratory and works in tandem with DOE to advance solution-driven research, development, testing, and deployment of safe, cost-effective environmental technologies. Work performed on behalf of DOE is requirements-driven. R&D conducted at HCET benefits environmental management initiatives and responds directly to *Environmental Quality* and *Science and Technology* needs identified in the national DOE Strategic Plan.

FIU HCET high-level waste saltcake dissolution studies have been conducted during FY03. The objective of this project is to provide data needed for 1) interpretation and understanding of saltcake dissolution operation, and 2) evaluation and comparison of alternative dissolution techniques. These activities support the S-112 Retrieval Project, the S-102 Saltcake/Sludge Tank Retrieval Project, and related Hanford SST closure projects.

Pilot-scale saltcake tests are being performed to study the dissolution characteristics of Hanford S-112 saltcake simulant. Porous media flow tests through saltcake waste will determine maximum degrees of selective dissolution that may occur during tank retrieval. Also, the composition of the residual materials will presage the types of materials that will be the heels that must be retrieved from S-112 regardless of retrieval style.

E.5 EM-50 Projects

EM's Office of Science and Technology (EM-50) is expected to have an ongoing technology development budget. In FY02, EM-50 put a lot of emphasis on concepts where significant savings might be realized by non-baseline approaches. In FY03, EM-50 identified multiple technical areas of interest at Hanford and allocated a budget to technology development in some, if not all, of these areas. It is anticipated that the Acquisition Strategy will be written this summer and the call for proposals will be made near the end of this fiscal year, with most of the funding to be spent in FY04.

The EM-50 strategy was established in FY02 and is continuing in FY03. EM-50 funds two types of projects: 1) Technical Assistance, which is mainly directed toward sites that are finishing activities for closure (e.g., Fernald) and 2) Alternatives, which are larger projects directed toward developing non-baseline improvements or back-ups with potentially large cost savings. The three Alternatives projects described below have recently been funded at Hanford.

<u>Alternatives for Medium and Low Curie Waste Treatment and Sulfate Removal from Low Activity Waste, Hanford WA</u>

The project focuses on selecting and demonstrating a pretreatment approach on the saltcake waste for reducing the radionuclide (particularly cesium-137 and technetium-99) and hazardous waste constituents (particularly nitrate and nitrite) of waste destined for supplemental treatment and reducing the sulfate destined for the WTP. The project will allow both treatment facilities to reduce the number of containers of low-activity waste that must be produced. The pretreatment

approach will be deployed near-term (at least one tank in FY2005), utilizing existing facilities whenever possible, and will require no new major capital facilities.

Phase 1 work scope will include lab-scale demonstration with simulant waste of flowsheet and associated proposed in-line process monitoring equipment to establish promising process steps and conditions. Recommendations for application to ongoing Hanford tank waste retrievals and processing, including engineering estimates of life-cycle cost impacts, will be included. Phase 2 work scope will include field demonstration of the separation of the retrieved saltcake waste into a cesium/nitrate-rich stream and a separate sulfate-rich stream using actual retrieved waste at a large enough scale to validate processing and process monitoring approach and suitability for integration with existing Hanford facilities and schedules.

Alternatives for In-Situ Stabilization of Tank Heels, Hanford, WA

Following ~99% waste retrieval, the baseline plans include use of a Portland cement-based grout in an initial "lift" or pour to stabilize the tank residuals or heel. This project will provide alternative options to the baseline for stabilizing tank residuals. Project success will include identification and demonstration of significantly improved waste form-getter combinations and delivery systems.

Early work focuses on an initial screening assessment of getters, waste forms, and combinations through Request for Information (RFI) or other methods. The assessment will focus a solicitation on two areas: 1) alternatives for nearer-term application (e.g., modified waste form formulations and Tc getter combinations with promise for early step improvement to baseline approach), and 2) high-risk/high-payoff alternatives for Tc and for additional contaminants of concern such as iodine, uranium, selenium, etc. After performers are selected and initial confirmatory testing is completed with simulated tank wastes, there will be a down-select for waste-form/getter combinations and initiation of real waste and additional simulant testing to verify performance and support permanent closure of tanks.

The final phase of the project will evaluate and recommend near-term step improvement stabilizing agents, including in-tank material delivery methods (e.g., flowability into tanks) and likely long-term stabilization performance to support closures in 2005-2008. The initial identification and screening evaluation of high-risk, high payoff alternatives for heel stabilization for tank closure after 2008 will be completed. Alternatives or combinations of alternatives for extensive simulant and real waste testing in 2006-2007 will be selected to verify performance on specific contaminants of concerns for application to tank closures between 2008 and 2018.

Alternatives for Hanford Tank Farm Caps and Barriers

The current River Protection Project approach is to use the baseline DOE-RL Cap and Barrier design in accordance with the 2002 *Performance Management Plan for the Accelerated Cleanup of the Hanford Site*. This project will focus industry on the next-generation (long-term) surface cap and subsurface barrier design because of the long time that radioactivity remains dangerous. This project will build on existing advanced designs, now available elsewhere, to eliminate the design flaws in the current baseline approach, reduce the size and weight of the caps, and extend their life expectancy. In so doing, this project will support and improve the performance assessment for the waste management areas.

The goal of this project is a viable conceptual design in Phase I, with a proposed method to validate the conceptual design in Phase II by capping a small waste area on the Site that will deliver performance data. The barrier will provide a marked improvement over the present cap

design. Achievement of this goal will provide the necessary information to 1) reduce the risk of meeting DOE-RL's specific commitment to begin capping waste areas in FY2006, 2) negate the need to replace the caps after 30 years, and 3) reduce costs of the caps and their maintenance.

E.6 Small Business Innovative Research

Since its enactment in 1982, as part of the *Small Business Innovation Development Act*, the Small Business Innovative Research (SBIR) Program has helped many small businesses compete for federal research and development awards. The SBIR Program is highly competitive and encourages small businesses to explore their technological potential. By including qualified small businesses in technology development and demonstration initiatives at DOE sites, technology innovation is stimulated and an entrepreneurial spirit is fostered in support of addressing the multitude of technical challenges.

The team of MSE Technology Applications, Inc. (MSE) from Butte, Montana and Lawrence Berkeley National Laboratory (LBNL) received a SBIR award to demonstrate *"The Use of Viscous Liquid Grouts for Temporary Repair at Underground Waste Storage Tanks at Hanford During Sludge Removal."* Successful demonstration and subsequent regulatory acceptance of viscous liquid grouts for temporary repair of underground storage tanks has the potential to expand the "tool box" of demonstrated and accepted technologies for possible application to ex-tank leak mitigation. Furthermore, viscous liquid grouts may enable consideration of a broader range of options for retrieving wastes in the future from tanks known or suspected to have leaked.

During Phase I of the project, MSE consulted with Hanford tank farm personnel to determine specific objectives and needs inherent to retrieval and closure efforts. MSE also maintained contact with Hanford tank farm personnel during the planning for their Phase II proposal to ensure proper focus on retrieval and closure objectives.

In Phase I, MSE performed bench-scale compatibility testing, column injections, and hydraulic conductivity testing of several viscous liquid grouts in Hanford soils as a "proof-of-concept." Two types of grouts were tested, polysiloxane and colloidal silica grouts. Both types characteristically have low viscosities and, therefore, may be injected into the subsurface at low pressures, which will minimally disturb the subsurface infrastructure. The results of these tests on Hanford soil showed promise and demonstrated a reduction in hydraulic conductivity of two to four orders of magnitude. The ultimate acceptability of this reduction in hydraulic conductivity would be determined through risk and performance assessment modeling conducted in support of tank farm retrieval and closure activities.

For Phase II, MSE proposed additional laboratory testing, along with a cold field-scale demonstration to verify the placement and performance of viscous liquid grouts as an ex-tank leak mitigation measure. Phase II would have supported the efforts at the Hanford tank farm in several different ways. The near-term applications involved leak mitigation of SSTs during sluicing/retrieval of the tank wastes and for leak mitigation at a dormant or abandoned tank (not slated for retrieval until a later date) where a leak is detected.

The future application was for use before sluicing/waste retrieval from the suspected or known leaking tanks is initiated. The grout is injected into the subsurface around the suspected leak area(s) to provide a seal around the tank to mitigate additional leakage during sluicing and transfer of the waste to the WTP.

In Phase II, MSE would have continued to work with Lawrence Berkeley National Laboratory (LBNL) on the proposed viscous liquid technology. The work to be proposed in Phase II of the project consisted of the following: 1) hydraulic conductivity testing of the increased pH grouted soil columns, 2) modeling of the displaced porewater that results from the grout injection, 3) modeling of the chemical interactions between the contaminants and the grout material(s), 4) column testing with surrogate contaminants to support modeling of the contaminant/grout interactions, 5) testing to evaluate the adherence of the grouted soils to concrete, 6) planning for the field demonstration at the Hanford Site, and 7) field demonstration and verification activities.

On July 9, 2003, MSE was notified that the SBIR Phase II application, *"The Use of Viscous Liquid Grouts for Temporary Repair of Underground High-Level Waste Storage Tanks at Hanford During Sludge Removal"*, was not selected to receive funding. MSE requested a debriefing and plans to receive the technical reviewers' comments in August 2003.