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Technology Summary: Advancing Tank Waste Retrieval and Processing

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Technology Summary: Advancing Tank Waste Retrieval and Processing

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Date Published
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Prepared for the U.S. Department of Energy
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Abstract:

This technology overview provides a high-level summary of technologies being investigated and developed by Washington River Protection Solutions (WRPS) to advance Hanford Site tank waste retrieval and processing. Technologies are needed to complete Hanford tank waste retrieval and vitrification by 12/31/2047.

Hanford's underground waste storage tanks hold approximately 57 million gallons of radiochemical waste from nuclear defense production - more tank waste than any other site in the United States. In addition, the waste is uniquely complicated since it contains constituents from at least six major radiochemical processes and several lesser processes. It is intermixed and complexed more than any other waste collection known to exist in the world.

The multi-faceted nature of Hanford's tank waste means that legally binding agreements in the Federal Facility Agreement and Consent Order (known as the Tri-Party Agreement) and between the Department of Energy (DOE) and its contractors may not be met using current vitrification schedules, plans and methods. WRPS and the DOE are therefore developing, testing, and deploying technologies to ensure that they can meet the necessary commitments and complete the DOE's River Protection Project (RPP) mission within environmentally acceptable requirements. Technology solutions are outlined, along with processes and priorities for selecting and developing them.

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EXECUTIVE SUMMARY

This technology overview provides a high-level summary of technologies being investigated, developed, and deployed by WRPS to advance Hanford Site tank waste retrieval and processing. Transformational technologies are needed to complete Hanford tank waste retrieval and treatment by 12/31/2047.

Hanford's underground waste storage tanks hold approximately 57 million gallons of radiochemical waste from nuclear defense production -- more tank waste than any other site in the United States. In addition, the waste is uniquely complicated because it contains constituents from at least six major radiochemical processes and several lesser processes. It is intermixed and complexed more than any other waste collection known to exist in the world.

The multi-faceted nature of Hanford's tank waste means that legally binding agreements in the Federal Facility Agreement and Consent Order (known as the Tri-Party Agreement) and between the Department of Energy (DOE) and its contractors may not be met using current vitrification schedules, plans, and methods. WRPS and the DOE are developing, testing, and deploying technologies to meet the necessary commitments and complete the DOE's River Protection Project (RPP) mission within environmentally acceptable requirements. Technology solutions are outlined, along with processes and priorities for selecting and developing them.

DOE's Office of Environmental Management (EM) identifies the environmental management technology needs and the activities necessary to address them. The U.S. Congress then funds these activities through EM or the DOE field offices. Finally, an array of entities that include DOE site prime contractors and their subcontractors, national laboratories, and other external technology providers execute technology development and deployment.

WRPS executes technology development and deployment for the RPP tank waste management mission at Hanford by integrating numerous processes that define scope, funding, and project execution. Technology development for the RPP spans dozens of individual technologies, some that are mission-critical and some that would reduce mission cost, accelerate mission completion, or enhance site safety.

Priorities for technology development are set based on the urgency of need and the potential benefit of the technology solution. Criteria applied in setting priorities include timing, safety, and cost. Appendix A summarizes key aspects of the technology activities being developed and deployed for the RPP mission.

TERMS, KEY WORDS, ABBREVIATIONS, AND ACRONYMS

Technology Solution: A scientific or engineering solution or answer to a question or gap in the current abilities and methods to attain tank waste goals.

Technology Gap: A shortfall in available knowledge or technology that could prevent the U. S. Department of Energy from accomplishing a cleanup task within expected schedule and/or budget.

Transformational technology: A technological breakthrough that could substantially mitigate risk, reduce cost, or accelerate schedule.

Abbreviations and Acronyms

CD	Critical Decision
DOE	U. S. Department of Energy
DST	Double Shell Tank
EM-31	U. S. Department of Energy, Office of Environmental Management
FBSR	Fluidized Bed Steam Reforming
HLW	High Level Waste
IDF	Integrated Disposal Facility
LAW	Low Activity Waste
MYPP	Multi-Year Program Plan
NAS	National Academy of Sciences
ORP	U. S. Department of Energy, Office of River Protection
RMF	Rotary Microfilter
RPP	River Protection Project
SCIX	Small Column Ion Exchange
SRS	Savannah River Site
SST	Single Shell Tank
TDR	Technology Development Roadmap
TOC	Tank Operations Contractor
TPA	Tri-Party Agreement
WRPS	Washington River Protection Solutions LLC
WTP	Waste Treatment and Immobilization Plant

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1.0 INTRODUCTION

The Hanford Site in southeast Washington State contains 177 aging, underground storage tanks holding approximately 57 million gallons of radiochemical waste from nuclear defense production. Retrieving the waste from these tanks and hardening it into a stable form that cannot leak into the environment is a high priority for the U.S. DOE, the U.S. Environmental Protection Agency (EPA), Washington and Oregon, and many regional and local stakeholders and governments. The U.S. DOE has hired contractor WRPS to manage Hanford's tanks, and to ready the waste to feed into a massive Waste Treatment and Immobilization Plant (WTP) that will immobilize or vitrify the waste.

The composition of Hanford's tank wastes is unique. Although vitrification is used in other areas of the United States and the world, it has never been used to treat waste as complicated and difficult as that at Hanford.

In order to meet DOE goals and agreements to retrieve and treat Hanford's tank waste on time, WRPS is developing, testing and deploying many new technologies. In most cases, these technologies are not just enhancements to existing workable processes. They are either essential to immobilizing the waste or requisite to doing so within acceptable time periods and costs.

This document provides a high-level summary of the technology development and deployment within the U. S. DOE to support the RPP mission at the Hanford Site. Section 2.0 discusses the technology development and deployment process, including how the existing technology gaps will be filled. Additionally, it describes the basic funding sources, work management, and project execution for technology development and deployment.

Section 3.0 discusses how technology development is prioritized, including the logic and definition of low, medium, and high technology priorities. Section 4.0 discusses the results that technology can bring in terms of the RPP project and provides baseline, including flow sheets for both a baseline and mission acceleration that are integrated within technology development scope. Section 5.0 provides a high-level timeline of the technology development activities.

Appendix A briefly summarizes each technology development activity including basic information known currently, such as project benefits, costs and schedule considerations, known gaps and illustrations.

2.0 TECHNOLOGY DEVELOPMENT AND DEPLOYMENT PROCESS

Technology development and deployment activities in Hanford's RPP are performed after carefully integrating processes that scope, fund, and plan the work. Technology development scope to manage Hanford's tank waste is established by the DOE Office of Environmental Management (EM), the DOE Office of River Protection (ORP) at Hanford, and prime contractor WRPS. The DOE also takes input from various external agencies such as the Defense Nuclear Facilities Safety Board, the National Academy of Sciences, and others.

First, technology gaps (shortfalls in available knowledge or technology that could prevent accomplishing a cleanup task on its expected schedule and/or budget) are identified. Next, technology development tasks are initiated to eliminate the gaps.

Because DOE EM manages multiple sites, it must look comprehensively at technology needs across the DOE complex. The needs and inputs of all sites and interested parties must be assessed; prioritized within available budget constraints; and finally sifted to yield an approved subset of activities that become official department or site goals.

Figure 1 illustrates the EM scope definition process.

Figure 1. Office of Environmental Management Technology Development Scope Definition.

Additionally, the RPP, through its Tank Operations Contract (TOC) periodically assesses and updates technology gaps and potential solutions through the system planning process. The RPP may contact vendors or subject matter experts, convene expert panels, and conduct inter-site technology exchanges. The goal is to establish a clear path forward that is comprehensive and closely matched to RPP mission goals. The planning processes results are recorded in three principal documents:

- TFC-PLN-39, “*Risk Management Plan*,” which assists in identifying risks/opportunities and their potential solutions,
- ORP-11242, “*River Protection Project System Plan*,” which helps define mission tasks, quantify the potential benefits of technology development, and establish assumptions that allow planning efforts to move forward, and
- RPP-RPT-41742, “*River Protection Project Mission Analysis Report*,” which establishes significant programmatic mission challenges (cost, schedule, and technical adequacy) and provides a basis for a structured framework to evaluate and understand potential solutions to the challenges.

Technology development needs and potential solutions that emerge from the TOC planning efforts are consolidated in RPP-PLAN-43988, “*WRPS Technology Development Roadmap*,” along with guidance from the EM process. The Technology Development Roadmap (TDR) identifies technology needs, prioritizes the development efforts, and will be updated periodically to capture the iterative technology needs/solutions development process.

Figure 2 depicts the TOC scope definition process.

Figure 2. River Protection Project Technology Development Scope Definition.

2.1 FUNDING AND WORK MANAGEMENT

Technology development funding is dispersed via three separate processes. DOE-EM funds technology development work under its direct management. It allocates other technology development funds to the various DOE sites, with the work managed by the sites' prime contractors. Additional technology development funds are allocated by site prime contractors as part of their operating budgets, for activities under their direct management. The DOE field offices direct these efforts only to the degree that they manage overall contract execution.

A complicating factor is that the ORP baseline budget spans the entire TOC duration, while the EM direct-funded baseline budget is established on an annual basis. Site prime contractors can submit multi-year funding requests for planning purposes, but EM can only authorize work on a fiscal year (FY) basis. Because passage of the congressional budget can slip past the beginning of the FY, EM-funded technology development work can be delayed for extended periods before authorization. Another compounding factor can be EM budgetary shortfalls. When shortfalls occur, funding requestors and EM often have to re-assess which technology development activities to authorize.

Technology development work funded through the ORP baseline budget can be perturbed when ORP experiences annual budgetary shortfalls that necessitate eliminating, re-scoping or delaying some work. Conversely, work can be added, re-scoped, or accelerated when additional budget is

available. These adjustments require that Baseline Change Requests be prepared and approved, sometimes causing further delays.

The net result is that there is always uncertainty in the budget available to perform work beyond each FY. Thus, technology development work planning must be adjusted at the beginning and throughout each FY as budget, scope, and schedule evolve.

Figure 3 shows the three different processes by which technology funding is dispersed.

Figure 3. Technology Development Funding and Work Management

2.2 WORK EXECUTION

The bulk of technology development is typically project execution, although some may be system planning. Project execution is a well established process that does not need discussion here. After Critical Decision (CD) 0 – a major early decision point - technology development work is almost exclusively funded by the project baseline, although some pre-acquisition work may occur in the conceptual phase. A technology is then matured through a progression of tests as the project advances toward Critical Decision 4 (CD-4) – approval to start operations or project completion.

Figure 4 illustrates the relationship between technology development and project execution. Note that the development schedule depends on the complexity of the technology and its integration.

Figure 4. Technology Development Integration with Project Management.

In the TOC, work in the pre-acquisition phase when technology is being matured toward a deployment decision is defined in TFC-PLN-90, “*Technology Development Management Plan.*” Technology development is frequently an iterative process throughout its life-cycle. Senior TOC management is periodically apprised of the progress of a technology’s development. When the developing organization deems the technology to be sufficiently mature, it requests authorization to deploy. Senior management, with ORP concurrence, can authorize equipment deployments. For deployment of facilities, a formal project execution critical decision process (CD-0 approval by DOE) is required.

The insertion point (i.e., first application of the technology in the RPP mission) can be a field demonstration. “Hot” commissioning (full-scale operations) is typically driven by one or more major RPP mission milestones. Therefore, the insertion point may be established long before a technology development activity is initiated.

Scheduling of pre-acquisition (Phase 1) technology development activities must consider the time lag – sometimes many years - between the initial development action and the planned insertion point. A substantial period can elapse before initial development can result in the technology’s field insertion.

After CD-4, the operations budget is used to fund technology development, particularly when it entails next-generation equipment development. If there is a TOC budgetary shortfall for a mission-critical project or development activity, EM funding might be used as an alternate source. However, EM might decide to direct the development work to another DOE site or national laboratory. Even after the technology has been deployed to the field, its development may continue based on “lessons learned” feedback from operations.

Figures 5 and 6 provide an overview of the process by which technologies are developed and deployed to the field. Figure 5 shows the process for equipment deployments, such as the Mobile Arm Retrieval System (MARS), and Figure 6 shows technology deployments that require major facility installations or modifications. The technologies in Figure 6 require qualification testing that includes factory acceptance, construction acceptance, and startup testing.

Figure 5. Equipment Technology Development and Deployment Process

Figure 6. Facilities Technology Development and Deployment Process

3.0 PRIORITIZING TECHNOLOGY DEVELOPMENT

Technology development is expensive and time-consuming. Priorities must be established to ensure that technologies are developed in time to meet RPP mission goals. The urgency of need for the new technology, its expected benefit, cost and schedule must be carefully weighed. Project managers must do their best to accurately forecast and capture the required insertion dates and time for the maturation process. Expected available funding must also be forecast with acumen, because funding shortfalls could prevent technology development from proceeding according to the baseline schedule.

The TOC has set priorities for technology development as follows:

High Priority Technologies: These technologies are mission-critical and need to be fully funded immediately to avoid missed milestones, decision dates, or lost opportunities for substantial mission execution gains.

Medium Priority Technologies: These technologies are not mission-critical but would help the TOC meet major milestones or decision dates. Additionally, these technologies could provide *substantial* mission acceleration, cost reduction, or safety and/or risk mitigation. If the urgent development and subsequent implementation of any of these technologies provide significant benefits, then the priority level could be escalated to High. Funding shortfalls for these technologies could be mitigated or worked around, but the DOE then would have to accept any lost opportunities associated with the funding gap.

Low Priority Technologies: These technologies provide *incremental* mission acceleration, cost reduction, or safety and/or risk mitigation. If the benefits can be maximized by urgent development of any of these technologies, then their priority level could be escalated to Medium. Funding should be allocated to these technologies as available.

Figure 7 illustrates the logic for prioritizing technology development.

Figure 7. Mission-Driven Technology Development Prioritization Logic

4.0 RESULTS THAT TECHNOLOGY CAN BRING: RIVER PROTECTION PROJECT PROCESS FLOW SHEETS

Comparisons between baseline activities and Hanford tank waste work management and flow with technology insertions can be seen in Figures 8 and 9.

Figure 8 presents the RPP baseline flowsheet as taken from RPP-11424, “*River Protection Project System Plan, Rev 4.*” This flowsheet assumes that only two additional types of technologies will be developed and deployed to support the RPP mission: technologies to remove aluminum, and technologies that treat secondary low-activity waste (LAW).

Figure 9 depicts a flowsheet that encompasses all the major technology development activities identified in RPP-PLAN-43988 over the next 10-15 years. This flowsheet would substantially accelerate the RPP mission completion and eliminate the need to install a second LAW vitrification facility. These activities include:

- supplemental pretreatment and LAW treatment methods (in addition to the WTP) to relieve the burden on WTP LAW,
- improved waste blending and melter performance, to reduce the volume of immobilized waste and reduce treatment schedules, and
- improved SST retrieval techniques to support enhanced treatment systems

Figure 8. River Protection Baseline Flowsheet

Figure 9. Mission Acceleration Flowsheet with Integrated Technology Development

5.0 SUMMARY OF RIVER PROTECTION PROJECT TECHNOLOGY DEVELOPMENT ACTIVITIES

Table 1 summarizes the technology development activities identified in RPP-PLAN-43988. These activities are cross-referenced with waste processing gap numbers from the National Academy of Sciences report entitled, “*Advice on the Department of Energy’s Cleanup Technology Roadmap – Gaps and Bridges.*” The waste processing gap numbers are used by DOE-EM to allocate funds and priorities to technology development activities. Also included in this table are the FY 2010 budget, funding sources for the budget, and entities managing the activities.

Figure 10 provides a timeline for major technology development and deployment activities. Included in the timeline are key decisions and insertion points associated with the major technology development and deployment activities.

Appendix A briefly summarizes each technology development activity identified in Table 1. The summary includes an activity description, benefits that would be realized if the technology were deployed to the field, and development status. FY 2010 development funding and priorities are also included.

Figure 10. Timeline of Major Milestones

Table 1. Technology Development Planning Matrix.

Technology Solution	Waste Processing Gap Number	Technology Development Priority	Fiscal Year 2010 Funding (\$K)	Funding Source	Task Management
1.0 Safe Waste Storage					
1.1 Single-Shell and Double-Shell Tank Integrity	N/A	Medium	5,500	NTB-EM	WRPS
1.2 Increased Double-Shell Tank Working Volume	WP-1	High	500	EM Direct	SRNL
1.3 Wiped Film Evaporator	WP-1	Medium	9,450	RA	WRPS
1.4 Waste Reduction Technology Demonstration	WP-1	Medium	1,200	EM Direct	WRPS
2.0 Waste Retrieval					
2.1 Mobile Arm Retrieval System	WP-1	High	10,900	NTB RA	WRPS WRPS
2.2 Chemical Cleaning	WP-1	High	1,000	EM Direct	SRNL
2.3 Waste Rheology	WP-1	Low	750	NTB-EM	WRPS
2.4 In-Tank Elutriation	N/A	Low	140	EM Direct	PNNL
3.0 Waste Pretreatment and Stabilization					
3.1 Double Shell Tank Mixing and Certification Sampling Tests	WP-3	High	5,200 500	NTB-RA EM Direct	WRPS PNNL
3.2 At-Tank Filtration	WP-2	High	2,100	EM Direct	SRNL
3.3 At-Tank Cesium Ion Exchange	WP-2	Medium	715	EM Direct	SRNL
3.4 Tank Waste Blending	N/A	High	0		
3.5 Lithium Hydrotalcite Process	WP-2	High	5,000	EM Direct	WRPS
3.6 Continuous Sludge Leaching	WP-2	Medium	475	EM Direct	Parsons
3.7 Electrochemical Caustic Recovery	WP-2	High	1,560	EM Direct	WRPS/ Ceramatec
3.8 Aluminum Solubility Studies	WP-2	High	760	EM Direct	WRPS
3.9 Phosphate Management	WP-2	Low	1,330	EM Direct ORP	SRNL WSU
3.10 Sulfate Management	WP-2	Low	715	EM Direct	ORNL
3.11 Technetium Management	WP-2	Medium	2,920	EM Direct	PNNL
3.12 Steam Reforming	WP-5	Medium	0	N/A	N/A

Table 1. Technology Development Planning Matrix.

Technology Solution	Waste Processing Gap Number	Technology Development Priority	Fiscal Year 2010 Funding (\$K)	Funding Source	Task Management
3.13 Waste Form Qualification for Steam Reforming Product	WP-5	Medium	1,000	EM Direct	SRNL
3.14 Low Temperature Waste Form Qualification	N/A	Medium	1,200	EM Direct	ANL/CUA/ SRNL
3.15 Advanced Melter	WP-4	High	1,600 1,050	NTB-EM EM Direct	WRPS INL
3.16 Advanced Glass Formulations	WP-5	High	1,300 3,600	NTB-EM EM Direct	WRPS EM-HQ
3.17 Strontium and Transuranic Precipitation	WP-2	Low	715	EM Direct	WRPS
3.18 Glass Waste Form Model Update	N/A	Low	0	N/A	N/A
3.19 Flow Sheet Modeling Improvements	N/A	Low	0	N/A	N/A
4.0 Tank Closure					
4.1 Improved Residual Waste Characterization	WP-2	Low	950	EM Direct	PNNL
4.2 Grout Formulations	N/A	Low	0	N/A	N/A
4.3 Grouting Process	N/A	Low	0	N/A	N/A
Total			67,130		
EM Direct = direct funding from the U. S. Department of Energy (DOE), Office of Environmental Management (EM) EM-HQ = INL = Idaho National Laboratory N/A = not applicable NTB = near-term baseline funding from the DOE, Office of River Protection NTB-EM = near-term baseline funding from the EM NTB-RA = near-term baseline funding from the American Recovery and Reinvestment Act of 2009		ORNL = Oak Ridge National Laboratory ORP = DOE, Office of River Protection PNNL = Pacific Northwest National Laboratory SRNL = Savannah River National Laboratory WRPS = Washington River Protection Solutions LLC WSU = Washington State University			

6.0 CONCLUSIONS

The technology solutions proposed by WRPS can result in huge potential savings in time, money, manpower, and worker and environmental exposure in Hanford tank waste retrieval and processing. They can help meet goals of the Tri-Party Agreement and interested entities and people to effectively, efficiently, and safely disposition Hanford's tank waste to restore the environment of the Columbia Basin, safeguard the Columbia River, and provide future economic choices for the region.

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Appendix A. Technology Development Summary Sheets

1.1 Single-Shell and Double-Shell Tank Integrity

Description: A suite of tools/methods to evaluate Single-Shell Tank (SST) and Double-Shell Tank (DST) leaks and structural integrity are needed to continue safely storing waste in the tanks. These include:

- SST Concrete Core Analysis
- SST Rebar Analysis
- Seismic Analysis
- DST integrity program development (ongoing)

Benefit: Tools will mitigate the risk of storing wastes in aging tanks.

A-2

Status: Expert Panel recommended tools/methods to assess SST integrity. Implementation Plan for these recommendations is being prepared. DST integrity program ongoing.

Priority (Urgency & Impact): MEDIUM

Insertion Point

C-107 dome core November 2010
Core side wall A-106 in FY11

FY10 Budget

\$5,500K

1.1 Single-Shell and Double –Shell Tank Integrity (continued)

Technology Development Risk Level: LOW

- Technologies exist to sample and analyze tank concrete and rebar.
- Side wall core drilling has been performed in the past.

Mission Risks: Without reliable methods to determine tank integrity, leaks to the environment could occur and tanks may not be available for future use.

A-3

Preliminary Schedule:

1.2 Increased Double-Shell Tank Working Volume (WP-1)

Description: A buoyant displacement gas release (BDGRE) model could be used with a modified cone penetrometer to determine whether it is safe to add more sludge to certain partially-filled DSTs. If safety could be verified, the current limits to DST capacities could be modified.

Benefit: Partially filled DSTs could be filled to design limits, if verified to be safe. Full filling would partially offset projected DST storage space shortfalls and enable additional SST waste retrievals to continue prior to WTP startup.

Status: A commercial cone penetrometer measurement tool was tested in FY09. The penetrometer is currently being modified so it can be tested in a DST.

Priority (Urgency & Impact): HIGH

Insertion Point

Deploy cone penetrometer in AN-106
February 2012

FY10 Budget

\$500K

1.2 Increased Double-Shell Tank Working Volume (WP-1) (continued)

Technology Development Risk Level: LOW

A commercial cone penetrometer has been developed and is being modified for use in a DST.

Mission Risks: If cone penetrometer data and revised BDGRE model show it would be unsafe to fill DSTs to design limits, they must remain only partially filled. DST space limitations would then slow SST retrievals.

Preliminary Schedule:

1.3 Wiped-Film Evaporator (WP-1)

Description: The Wiped-Film Evaporator (WFE) is being developed to help concentrate tank liquids. Pilot-scale testing of a transportable WFE system is included.

Benefit: The WFE will help manage and maintain critical DST space, thereby maximizing waste storage capacity. Additionally, SST retrievals can be accelerated by using WFE in conjunction with SST waste consolidation.

A-6

Status: The WFE will enter the procurement cycle mid-FY10.

Priority (Urgency & Impact): MEDIUM

Insertion Point

FY16 Full scale operation

FY10 Budget

\$9,450K

1.3 Wiped-Film Evaporator (WP-1) (continued)

Technology Development Risk Level: LOW

The WFE technology is well understood, relatively predictable, and adaptable.

Mission Risks: If the WFE is not effective, it would not help relieve the shortage of space in DSTs.

Preliminary Schedule:

1.4 Waste Reduction Technology Demonstration (WP-1)

Description: The Waste Reduction Technology Demonstration project will evaluate different evaporation technologies and test simulants and actual waste.

Benefit: An Agitated Thin Film Evaporator (ATFE) supports waste reduction of secondary streams and the WFE by testing simulant and actual tank waste.

A-8

Status: The procurement specification for the agitated thin film evaporator will be initiated FY10.

Priority (Urgency & Impact): MEDIUM

Insertion Point

FY11 Operational Tests (Laboratory Scale)

FY10 Budget

\$1,200K

1.4 Waste Reduction Technology Demonstration (WP-1) (continued)

Technology Development Risk Level: LOW

The ATFE is similar to WFE technology in that it is well understood, relatively predictable, and adaptable.

Mission Risks: Waste reduction technologies are needed because waste tank space is very limited. If the ATFE is not effective with certain wastes, the RPP will need to pursue alternate technologies.

Preliminary Schedule:

2.1 Mobile Arm Retrieval System (WP-1)

Description: The Mobile Arm Retrieval System (MARS) technology consists of a telescoping arm that rotates 360 degrees, enabling it to reach the farthest extremities within an SST. MARS with modified sluicing will be used for sound tanks, and MARS with vacuum will be used for tanks assumed to be leaking.

Benefit: The MARS will facilitate more efficient waste retrieval from both sound and assumed leaking SSTs. In some instances the MARS will allow waste to be retrieved from SSTs that cannot be retrieved with existing technologies.

Status: The sluicing MARS was tested in FY09 and is being modified. The modified MARS will be acceptance tested at the Cold Test Facility in FY10. Design of the vacuum MARS will be completed in FY10.

Priority (Urgency & Impact): HIGH

Insertion Point

C-107 in Sluicing Mode (March 2011)
C-101 in Vacuum Mode (July 2012)

FY10 Budget

\$15,900K

2.1 Mobile Arm Retrieval System (WP-1) (continued)

Technology Development Risk Level: LOW

The sluicing MARS is currently undergoing extensive testing and performing as anticipated. The vacuum MARS design is progressing well.

Mission Risks:

- Installation of new 55 inch diameter risers could present problems in some tanks.
- MARS may not be effective in tanks with significant in-tank obstructions.

Preliminary Schedule:

2.2 Chemical Cleaning (WP-1)

Description: Chemical cleaning inside tanks, using both oxalic acid and caustic sodium hydroxide, is being considered to help dissolve hard heel materials and to work around physical obstructions. If oxalic acid is used, it would need to be neutralized to prevent DST corrosion, or it would need to be destroyed after use to avoid forming sodium oxalate solids. Such solids would hinder WTP operations.

Benefit: Chemical cleaning can help achieve volume-based retrieval goals in sound SSTs.

Status: A caustic cleaning demonstration is planned in the first quarter of FY11, as part of C-108 Retrieval. An oxalic acid cleaning demonstration is planned for FY18 in AX Farm.

Priority (Urgency & Impact): HIGH

Insertion Point

C-108 Caustic Cleaning Demo (1st Q FY11)
AX Farm Acid Cleaning Demonstration FY18

FY10 Budget

\$1,000K for acid
cleaning

2.2 Chemical Cleaning (WP-1) (continued)

Technology Development Risk Level: MEDIUM

- Chemical cleaning may not remove sufficient residual waste to meet SST retrieval and closure goals.
- Acid destruction methods may not be as effective as desired.

Mission Risks:

- Caustic cleaning increases sodium required to be sent to WTP LAW Vit/2nd LAW facility.
- Adding oxalic acid in SST retrievals alters the chemical composition of feed to WTP, which requires further treatment to remove oxalate.

A-13

Preliminary Schedule:

2.3 Waste Rheology (WP-1)

Description: Waste transfer studies and tests are needed to better define the point where constituents such as phosphates and other components plug transfer lines. Rheology (flow behavior) significantly influences whether lines will plug during waste transfers.

Benefit: A better understanding of rheological properties could allow waste to be concentrated to include more solids, thus using DST storage space more efficiently. It could also reduce the risk of transfer lines plugging during waste transfers.

A-14

Status: Planned FY10 and FY11 testing is being directed and funded by EM.

Priority (Urgency & Impact): LOW

Insertion Point

Incorporate into waste retrieval/transfer system designs and operating plans when available

FY10 Budget

\$750K

2.3 Waste Rheology (WP-1) (continued)

Technology Development Risk Level: LOW

Waste rheology and pipeline plugging have been studied in the past. Such studies need to be (continued) and refined.

Mission Risks: Without improved understanding of waste rheology, dilute transfers of slurries will continue to prevent line plugging. Dilute waste transfers increase waste volume and the burden on waste evaporators.

Preliminary Schedule:

2.4 In-Tank Elutriation (WP-1)

Description: In-tank elutriation (separating waste components based on size/density relationships) could be done during SST retrievals to separate inert solids from tank waste.

Benefit: Elutriation in tanks could assist retrieval efforts by making it possible to separate and leave behind inert materials. Volume-based retrieval goals and agreements would need to be re-visited.

Status: Preliminary planning for equipment and methods for in-tank elutriation will begin in FY10.

Priority (Urgency & Impact): LOW

Insertion Point

TBD (regulatory approval for risk-based retrieval required)

FY10 Budget

\$140K

2.4 In-Tank Elutriation (WP-1) (continued)

Technology Development Risk Level: MEDIUM

- Heel samples from SSTs following bulk waste retrieval need to be analyzed to determine the size of particles left behind versus their radionuclide content.
- Separation technology would need to be developed.

Mission Risks:

- If elutriation does segregate inert waste particles from radioactive particles, additional retrieval systems will need to be developed and deployed.
- Closure requirements need to be determined.

Preliminary Schedule:

3.1 Double-Shell Tank Mixing and Certification Sampling Tests (WP-3)

Description: Tank mixing and sampling systems need to be demonstrated in bench- and pilot-scale tests. Four mixing and two sampling configurations will be demonstrated using various waste simulants.

Benefit: The effectiveness of mixing/sampling systems currently planned for DSTs to deliver waste must be well understood in order to plan and design effectively. If DST mixing is insufficient as currently planned, other configurations will need to be considered or a sampling and blending function might be included in the A-Complex Waste Receiver Facility (WRF-A).

Status: Scale testing of DST sampling and mixing components is being performed in FY10 with a draft report issued by the end of the fiscal year.

Priority (Urgency & Impact): HIGH

Insertion Point

Multiple DST mixing upgrades to support FY18 WTP operations

FY10 Budget

\$5,700K

3.1 Double-Shell Tank Mixing and Certification Sampling (WP-3)(continued)

Technology Development Risk Level: LOW

Past mixing studies have been performed and recent scale tests have yielded promising results.

Mission Risks: If tank waste mixing does not achieve homogeneity, sludge batch size for the WTP cannot be decreased and sampling frequency per batch will increase. These outcomes will increase costs.

Preliminary Schedule:

3.2 At-Tank Filtration (WP-2)

Description: A rotary microfilter will be developed and deployed to filter wastes at the tanks. The rotary microfilter is a promising technology being developed at Savannah River, and will be adapted for Hanford.

Benefit: This technology, in conjunction with cesium ion exchange, will provide pretreatment necessary to deploy the Fluidized Bed Steam Reforming (FBSR) process for LAW treatment. It may also be deployed at DSTs to furnish “solids-free” supernate to the WTP pretreatment facility, thus decoupling that facility’s caustic leaching process from its cesium ion exchange process.

Status: Construction of an advanced-design, full-scale prototype will be completed in FY10 for Savannah River.

Priority (Urgency & Impact): HIGH

Insertion Point

Planned Implementation: FY17

FY10 Budget

\$2,100K

3.2 At-Tank Filtration (WP-2) (continued)

Technology Development Risk Level: MEDIUM

- Rotary microfiltration has been tested using simulated and actual SRS and Hanford wastes.
- Ability to deploy in smaller Hanford risers may be challenging.

Mission Risks:

- If the rate of at-tank filtration is not adequate to feed the FBSR or meet schedule goals, additional filtration methods will be required.
- If the microfilter is unable to remove solids from waste streams that contain high amounts of solids, its usefulness will be limited.

Preliminary Schedule:

3.3 At-Tank Cesium Ion Exchange (WP-2)

Description: A small column ion exchange (SCIX) system will be developed and deployed to separate cesium (Cs) at the waste tanks.

Benefit: This technology, in conjunction with filtration, would pretreat liquid tank wastes qualifying them as LAW so they could be treated in the FBSR process.

A-22

Status: Resins to be used in the SCIX will be tested to determine how they withstand radiation. It is important to know if the resins degrade and/or generate flammable gases. Testing at Hanford will be completed in FY10.

Priority (Urgency & Impact): MEDIUM

Insertion Point

Planned Implementation: FY17

FY10 Budget

\$715K

3.3 At-Tank Cesium Ion Exchange (WP-2) (continued)

Technology Development Risk Level: MEDIUM

- Full scale testing of CsIX was conducted during 1968-1985 at Hanford using various ion exchange materials.
- The baseline eluant for the planned resin (spherical resorcinol formaldehyde [sRF]) is dilute nitric acid, which is not compatible with the carbon steel liners of the SST/DSTs. As yet, alternate eluants have not been demonstrated.
- IX columns using sRF need to be redesigned.

A-23

Mission Risks: If Cs breaks through the IX columns (is not thoroughly held in the resins), the resulting LAW feed will not meet specifications.

Preliminary Schedule:

3.4 Tank Waste Blending (WP-2)

Description: A strategy for blending waste from different DSTs is needed to develop an optimized WTP feed that minimizes the amount of HLW glass produced. In addition, the facility to be used (DST or blending facility) must be determined.

Benefit: Tank waste blending could yield 10% to 20% less HLW glass than is predicted in RPP System Plan 4 (ORP-11242). Production of less HLW glass could accelerate the RPP mission and reduce onsite interim storage and offsite disposal costs. (Sufficient LAW capacity is assumed.)

Status: Numerous blending studies have been completed. The latest was issued in December FY09 (RPP-RPT-42968).

Priority (Urgency & Impact): HIGH

Insertion Point

As available to support WTP operations

FY10 Budget

\$0K

A-24

3.4 Tank Waste Blending (WP-2) (continued)

Technology Development Risk Level: LOW
Tank waste blending has been analyzed at Hanford.

Mission Risks:

- If inadequate mixing or sampling occurs, undesirable waste blends will be produced and fed to the WTP.
- Mixing unforeseen/unwanted constituents can create more “hard to handle” waste, such as transuranic waste.

A-25

Preliminary Schedule:

TBD

3.5 Lithium Hydrotalcite Process (WP-2)

Description: The lithium hydrotalcite (LiHT) process is being developed to remove alumina from the WTP feed by precipitating it with lithium. This results in reduction of the amount of sodium hydroxide needed to leach alumina sludge from wastes.

Benefit: Deploying the LiHT process could minimize the addition of fresh caustic from the RPP flowsheet reducing the LAW glass generated.

Status: An engineering evaluation of the LiHT process was completed and a report is planned to be issued in FY10. Simulant laboratory testing is being performed in FY10.

Priority (Urgency & Impact): HIGH

Insertion Point

Aluminum Recovery Facility Commissioning
(July 2022)

FY10 Budget

\$5,000K

3.5 Lithium Hydrotalcite Process (WP-2) (continued)

Technology Development Risk Level: HIGH
Bench-scale testing has achieved a technical readiness level (TRL) of 3, which is not sufficient for implementation. Significant uncertainty remains.

Mission Risks:

- The LiHT process may not remove as much aluminum from the wastes as expected, and thus not be as effective in reducing LAW.
- LiHT waste may not be acceptable for disposal in the Integrated Disposal Facility (IDF).

Preliminary Schedule:

3.6 Continuous Sludge Leaching (WP-2)

Description: Continuous sludge leaching dissolves recalcitrant aluminum solids (Boehmite) in a heated reactor and generates a supernate that is free of solids using a cross flow filter.

Benefit: Implementing continuous sludge leaching technology could minimize the amount of caustic currently needed in the RPP flowsheet. Thus, less LAW glass would be generated.

A-28

Insertion Point

Planned Implementation: FY18

FY10 Budget

\$475K

Status: Bench scale testing of the continuous sludge leaching was completed in FY08.

Priority (Urgency & Impact): MEDIUM

3.6 Continuous Sludge Leaching (WP-2) (continued)

Technology Development Risk Level: MEDIUM
Bench-scale testing has achieved a TRL-4.

Mission Risks: Recycle of caustic solution will include slightly soluble salts of sulfate and phosphate. If caustic solution is not minimized, it will limit leaching from HLW sludge and increase HLW glass volume.

Preliminary Schedule:

3.7 Electrochemical Caustic Recovery (WP-2)

Description: Electrochemical caustic recovery technology separates sodium ions from waste supernate and reacts the ions with water to yield a recyclable caustic stream.

Benefit: Implementing electrochemical caustic recovery technology could minimize the amount of fresh caustic needed in the RPP flowsheet. Thus, less LAW glass would be generated.

Status: A report was issued in FY09 documenting bench scale test results using simulated and actual tank wastes.

Priority (Urgency & Impact): HIGH

Insertion Point

Aluminum Recovery Facility Commissioning (July 2022)

FY10 Budget

\$1,560K

3.7 Electrochemical Caustic Recovery (WP-2) (continued)

Technology Development Risk Level: MEDIUM
Bench-scale testing has achieved a TRL-4.

Mission Risks: Recycle of caustic solution will include slightly soluble salts of sulfate and phosphate. If caustic solution is not minimized, it will limit leaching from HLW sludge and increase HLW glass volume.

Preliminary Schedule:

Lab scale
verification
tests

3.8 Aluminum Solubility Studies (WP-2)

Description: Studies to better understand Aluminum (Al) solubility under typical WTP and tank farm operating conditions are underway. They could result in having to add less sodium to the process to dissolve Al sludges.

Benefit: Better understanding of alumina solubility could minimize the addition of caustic from the RPP flowsheet. Less caustic would reduce the quantity of LAW glass generated.

Status: Aluminum solubility testing was initiated in FY10.

Priority (Urgency & Impact): HIGH

Insertion Point

As available to support WTP operations

FY10 Budget

\$760K

3.8 Aluminum Solubility Studies (WP-2) (continued)

Technology Development Risk

Level: HIGH

Bench-scale testing has only achieved a TRL-2, which means significant development is required to prepare for implementation.

Mission Risks: Without efficient Al dissolution, more LAW glass will be produced.

Preliminary Schedule:

3.9 Phosphate Management (WP-2)

Description: Methods to identify phosphate compounds in HLW sludge are being examined to devise a technology to separate phosphate from HLW prior to its transfer to the WTP. Phosphate can limit waste loading in HLW glass. Currently, the only available approach to phosphate management is glass formulation.

Benefit: Phosphate management may allow greater waste loading, reducing the final volume of HLW glass.

Status: Phosphate management is currently being addressed by testing advanced glass formulations and waste rheology. Alternate candidate technologies will be identified and initial proof-of-concept testing will be completed in FY10.

Priority (Urgency & Impact): LOW

Insertion Point/Date

As available to support WTP operations

FY10 Budget

\$1,330K

3.9 Phosphate Management (WP-2) (continued)

Technology Development Risk Level: HIGH
Tested but not verified at laboratory scale.

Mission Risks: If phosphate is not managed, the WTP will not be able to maximize waste loading in the final HLW glass product.

Preliminary Schedule:

3.10 Sulfate Management (WP-2)

Description: Processes are being investigated to separate sulfate from waste sludge and supernate before they are transferred to the WTP. Sulfate can limit waste loading in both LAW and HLW glass. Currently, the only available approach to sulfate management is glass formulation.

Benefit: Sulfate management processes may be able to increase waste loading for 39% of the HLW glass as predicted by RPP System Plan 4 (ORP-11242). Thus, the final volume of LAW and HLW glass would be reduced.

Status: Sulfate management is currently being addressed through advanced glass formulations. Alternate candidate technologies will be identified and their potential performance assessed in FY10.

Priority (Urgency & Impact): LOW

Insertion Point

As available to support WTP operations

FY10 Budget

\$715K

3.10 Sulfate Management (WP-2) (continued)

Technology Development Risk Level: HIGH
Tested but not verified at laboratory scale.

Mission Risks:

- If sulfate is not managed, the WTP will not be able to maximize waste loading in the final HLW glass product.
- A molten sulfur layer in the LAW melter can corrode the melter and produce unacceptable operating conditions.

Preliminary Schedule:

Activities TBD

3.11 Technetium Management (WP-2)

Description: Technetium (Tc) retention in LAW glass, Goethite precipitation, and the FBSR process are being studied as Tc management techniques. Tc is a long-lived radionuclide that is volatile at high temperatures and must be managed for LAW, secondary wastes and off-gas recycle streams.

Benefit: Developing acceptable secondary waste forms would allow the WTP to operate without a LAW vitrification internal recycle. LAW waste loadings could be increased because sulfate would not build up in the recycle loop.

Status: A Justification of Mission Need to upgrade the Effluent Treatment Facility (ETF) to process secondary wastes was completed in FY09. Approval of CD-0 was deferred until February FY11.

Priority (Urgency & Impact): MEDIUM

Insertion Point

ETF Upgrade Complete (May 2018)

FY10 Budget

\$2,920K

A-38

3.11 Technetium Management (WP-2) (continued)

Technology Development Risk Level: MEDIUM
Candidate secondary waste forms examined thus far do not reduce the necessary Tc leach rate and are unacceptable for IDF disposal.

Mission Risks:

- ETF upgrade may not be capable of processing secondary wastes containing Tc.
- ETF secondary waste may not be acceptable for disposal at IDF due to inadequate Tc retention.

A-39

Preliminary Schedule:

3.12 Steam Reforming (WP-4)

Description: The FBSR process reforms and oxidizes LAW waste by passing it through a superheated, steam-driven fluidized particle bed. Processing LAW in an FBSR would produce a dry, granular material that is an insoluble mineral consisting of several forms of leach-resistant aluminosilicates.

Benefit: The FBSR potentially could be deployed to provide all or part of the supplemental LAW treatment. It may also provide a disposition path for WTP secondary waste.

Status: The FBSR has been tested with Hanford simulants, but scale-up must be demonstrated. Planning is underway to mature this technology for deployment at Hanford. FBSR feed is to be provided by rotary microfiltration and SCIX.

Priority (Urgency & Impact): MEDIUM

Insertion Point
Planned implementation: FY17

FY10 Budget
\$0K

3.12 Steam Reforming (WP-4) (continued)

Technology Development Risk Level: MEDIUM

- The FBSR technology at the Idaho Cleanup project is well understood. The Idaho FBSR construction is nearly complete.
- The FBSR technology will need to be scaled up to process the volumes of waste at Hanford.

Mission Risks: The FBSR process may not allow high waste loadings for some feeds because of the additives needed to make waste forms durable.

A-41

Preliminary Schedule:

3.13 Waste Form Qualification for Steam Reforming Product (WP-4)

Description: The products of the FBSR (carbonate or mineralized aluminosilicate) must be tested to make sure they meet performance standards. The carbonate form may be fed to the WTP to be vitrified. The mineralized product must be proven to be “as good as glass” to be acceptable for land disposal in the IDF.

Benefit: Proving the FBSR mineralized product can comply with Land Disposal Requirements and IDF waste acceptance criteria allows the FBSR process to treat some of Hanford’s LAW, reducing the waste that must be sent to the WTP LAW facility.

Status: Planning is underway to develop a testing plan and procedure to qualify this waste form.

Priority (Urgency & Impact): MEDIUM

Insertion Point

FY17 to support FBSR operations

FY10 Budget

\$1,000K

3.13 Waste Form Qualification for Steam Reforming Product (WP-4) (continued)

Technology Development Risk Level: LOW

The FBSR final waste forms must be tested to assure they meet the same chemical durability standards as immobilized LAW (ILAW) glass. Testing methods have already been developed.

Mission Risks: If waste form testing shows that the FBSR aluminosilicate waste form is not acceptable for land disposal at the IDF, it will not be helpful in processing Hanford LAW.

A-43

Preliminary Schedule:

TBD

3.14 Low Temperature Waste Form Qualification

Description: Ceramcrete and Duralith will be evaluated for potential use in immobilizing treated Hanford LAW. These low temperature waste forms must be tested to ensure they are acceptable for IDF disposal.

Benefit: If the resulting waste forms comply with Land Disposal Requirements and IDF waste acceptance criteria, Ceramcrete and Duralith can be used to immobilize some LAW.

Status: A testing plan and procedure is being developed to qualify this waste form.

Priority (Urgency & Impact): MEDIUM

3.14 Low Temperature Waste Form Qualification (continued)

Technology Development Risk Level: LOW

The examination processes are the same as those for ILAW glass, and have already been developed.

Mission Risks: If the waste form cannot qualify for land disposal at the IDF, an alternative disposition option will be needed.

Preliminary Schedule:

3.15 Advanced Glass Formulations (WP-4)

Description: Higher-capacity joule-heated ceramic melters and cold-crucible induction melters are under consideration for LAW and HLW vitrification. They may be more efficient than those planned for initial deployment in the WTP.

Benefit: Higher capacity melters could reduce the amount of supplemental treatment required and accelerate completion of the RPP mission.

A-46 **Status:** In FY10 design of a next-generation, joule-heated ceramic melter pilot test facility will be initiated for future installation and testing at the Vitreous State Laboratory of the Catholic University of America.

Priority (Urgency & Impact): HIGH

Insertion Point

First Melter Replacement

FY10 Budget

\$2,650K

3.15 Advanced Glass Formulations (WP-4) (continued)

Technology Development Risk Level: LOW
Techniques for designing and optimizing
melters are well understood.

Mission Risks:

- If the advanced melters do not work as expected, more overall glass product will be formed.
- WTP off gas treatment systems for LAW/HLW melters may not be able to support the increased production rates of advanced melters.

A-47

Preliminary Schedule:

3.16 Advanced Glass Formulations (WP-5)

Description: New glass formulations (LAW and HLW) are being continuously investigated to achieve higher waste loadings.

Benefit: Advanced glass formulations could accelerate the RPP mission and reduce the amount of glass requiring interim storage and disposal.

A-48

Status: The test facility at the Vitreous State Laboratory will be used to test improved glass formulations for potential use at Hanford. This work was initiated in FY10.

Priority (Urgency & Impact): HIGH

Insertion Point

Identified as new formulations are developed

FY10 Budget

\$4,900K

3.16 Advanced Glass Formulations (WP-5) (continued)

Technology Development Risk Level: MEDIUM
Hanford waste will require glass formulations that have never been produced before.

Mission Risks: Higher waste loadings might not be achieved. Thus, the volume of LAW requiring supplemental treatment may not be reduced and more glass will be formed .

A-49

Preliminary Schedule:

3.17 Strontium and Transuranics Precipitation (WP-2)

Description: Precipitation technologies require further development to remove soluble strontium (Sr) and transuranics from tanks.

Benefit: Removing strontium and transuranics will reduce the volume of HLW produced.

Status: Laboratory tests have been completed in the past, using sodium permanganate and strontium nitrate to remove the soluble Sr and transuranics.

Priority (Urgency & Impact): LOW

Technology Development Risk Level: MEDIUM
 Scaling up the process from laboratory testing to in-tank processing brings inherent risks.

Mission Risks: If strontium is not separated from the waste stream, liquid waste may not be able to be treated as LAW.

Insertion Point

TBD

FY10 Budget

\$715K

3.18 Glass Waste Form Model Update

Description: The current glass waste form model needs to be updated to reflect more recent information.

Benefit: Updating the model will allow more accurate predictions of the waste vitrification process.

Status: Task Planning to be initiated in FY10.

Priority (Urgency & Impact): LOW

3.18 Glass Waste Form Model Update (continued)

Technology Development Risk Level:
LOW

The model exists and only requires that specific LAW and HLW formulation data be updated.

Mission Risks: Inaccurate modeling can result in under/overestimating waste treatment processes potentially increasing final costs and schedules.

A-52

Preliminary Schedule:

3.19 Flow Sheet Modeling Improvements

Description: Technology development tasks need to be identified and executed to improve the accuracy of Hanford Tank Waste Operations Simulator (HTWOS) modeling results used to develop flow sheets.

Benefit: Improved accuracy of HTWOS modeling will result in better predictions and analyses to predict performance and plan the RPP mission .

Status: Task Planning will be initiated in FY10.

Priority (Urgency & Impact): LOW

Insertion Point
As available to support modeling efforts

FY10 Budget
\$0K

3.19 Flow Sheet Modeling Improvements (continued)

Technology Development Risk Level:

LOW

The model exists and requires data to continually develop results.

Mission Risks: Inaccurate modeling can result in under/overestimating waste treatment processes potentially increasing final costs and schedules.

A-54

Preliminary Schedule:

4.1 Improved Residual Waste Characterization (WP-2)

Description: Develops and tests Raman spectroscopy and radiometric characterization tools to characterize residual wastes left in the tanks after retrieval.

Benefit: Improved in-situ characterization techniques would reduce the number of samples to be collected and analyzed at the laboratory. In addition, characterization results would be available more quickly.

Priority (Urgency & Impact): LOW

Technology Risk Level: LOW

Technology exists that can be modified for Hanford tank use.

Mission Risks: Without improved residual waste characterization, schedule accelerations will not be achieved.

Status: Complete an in-tank detector preliminary design in FY10.

Insertion Point/Date

Identified as characterization tools complete development

FY10 Budget

\$950K

4.2 Grout Formulations

Description: Grout formulations to close tanks, pits, transfer lines, etc. may need further development.

Benefit: Improved grout forms can stabilize or mitigate environmental intrusion into non-operational, closed facilities.

Technology Development Risk Level: LOW
 Grout has been utilized at DOE facilities in the past.

Mission Risks: Without proper closure, contaminated infrastructure will continue to pose risk to the environment.

Status: Grout formulations were successfully demonstrated in FY09. Further developmental actions are not currently planned.

Priority (Urgency & Impact): LOW

Insertion Point/Date

TBD (After Record of Decision for Environmental Impact Statement)

FY10 Budget

\$0K

4.3 Grouting Process

Description: Grouting processes may need further development for closure of tanks, pits, transfer lines, etc.

Benefit: Improved grout processes can stabilize or mitigate environmental intrusion into non-operational, closed facilities.

Priority (Urgency & Impact): LOW

A-57 **Technology Development Risk Level:** LOW
Grouting has been performed at DOE facilities in the past.

Mission Risks: Without proper grouting processes, contaminated infrastructure will still pose a risk to the environment or personnel performing work.

Status: Processes for grouting tanks, pits, and transfer lines were demonstrated in FY09. Further developmental actions are not currently planned.

Insertion Point/Date

TBD (After Record of Decision for Environmental Impact Statement)

FY10 Budget

\$0K