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TFA TANKS FOCUS AREA

Site Needs Assessment FY 1998

March 1998

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Pacific Northwest National Laboratory
Richland, Washington 99352

Executive Summary

The Tanks Focus Area's (TFA's) mission is to manage an integrated technology development program that results in the application of technology to safely and efficiently accomplish tank waste remediation across the U.S. Department of Energy (DOE) complex. The TFA uses a systematic process for developing its annual program that draws from the tanks technology development needs expressed by four DOE tank waste sites – Hanford Site, Idaho National Engineering and Environmental Laboratory (INEEL), Oak Ridge Reservation (ORR), and Savannah River Site (SRS). The process is iterative and involves the following steps:

- Collection of site needs
- Needs analysis
- Development of technical responses and initial prioritization
- Refinement of the program for the next fiscal year (FY)
- Formulation of the program budget for the current FY plus 2 outyears (including the preparation of the Internal Review Budget (IRB))
- Preparation of Program Execution Guidance (PEG) for the next FY
- Revision of the multiyear program plan (MYPP).

This document describes the outcomes of the first phase of this process, from collection of site needs to the initial prioritization of technical activities.

Each site's Site Technology Coordination Group (STCG) was responsible for developing and delivering priority tank waste needs. This was accomplished using a standardized needs template. The TFA received the site needs during December 1997 and January 1998.

The TFA gathered and cataloged a total of 75 needs. The needs were analyzed and 89 distinct potential technical responses were drafted and prioritized. The TFA matched the needs to one of six functions: safety, characterization, pretreatment, immobilization, retrieval, and closure. A summary of the TFA's functional assignment of the needs and technical responses by site is shown in Table ES.1.

Table ES.1. Summary of Site Needs Submitted to the Tanks Focus Area and Technical Responses Generated

Functional Area	Hanford		INEEL		ORR		SRS		Total	
	Needs	Resp.	Needs	Resp.	Needs	Resp.	Needs	Resp.	Needs	Resp.
Safety	7	7	1	1	0	1	4	6	12	15
Characterization	4	4	1	1	2	2	2	5	9	12
Pretreatment	3	5	6	6	2	2	6	6	17	19
Immobilization	7	7	3	3	1	1	5	5	16	16
Retrieval	3	5	2	2	2	3	5	5	12	15
Closure	6	7	0	0	2	2	1	3	9	12
Total	30	35	13	13	9	11	23	30	75	89

To prioritize the technical responses, the TFA used four rating criteria:

- **Broad-based benefit** – This criterion rated whether the technical responses could satisfy needs at multiple sites (complex-wide impact).

- **User commitment to deploy** – The TFA assessed the user's commitment based on interest expressed in the needs description and present or future co-funding of development and/or deployment.

- **Project Baseline Summary (PBS) risk** – This criterion tied the technical response to the need(s) and then to the appropriate PBS(s) at the sites. The risk factor assigned to each PBS tied the TFA's technical response to the sites 2006 Plan objectives.

- **Other technical impact** – The TFA considered a technical response's impact on schedule, cost avoidance, and link to regulatory requirements to determine impact.

In February 1998, draft technical responses were provided to TFA Site Representatives, members of the TFA User Steering Group (USG), and the TFA Technical Advisory Group for their review and comment. These responses were discussed at a March 12 meeting where the TFA Management Team established the priority listing in preparation for input to the DOE Office of Science and Technology (OST) budget process. At the time of publication of this document, the TFA continues to clarify intended work scopes for FY 1999 and FY 2000 tasks, fine tune task priorities, and finalize funding estimates. Of the 89 responses to the 75 needs, a total of 61 passed through the prioritization process, 5 were screened out or withdrawn by the sites, and 23 were combined with other responses to integrated activities. The TFA screened out needs that were not considered within the TFA mission area, did not have a technology development component, or for which a response was not feasible in cost or schedule. The final results will be summarized in the publication of the next TFA MYPP during September 1998.

This year's needs assessment process yielded a few lessons learned. First, between site needs submission and the TFA's requirement to submit IRB documentation, insufficient time exists for the TFA to fully analyze the needs, develop complete and cogent technical responses, and coordinate with other OST resources. A more fully leveraged, fully integrated program would result from having needs submitted to the TFA in October. Secondly, application of risk factors from the sites' Project Baseline Summary (PBS) submittals was problematic. Inconsistencies appeared in the sites' application of the risk factor, as well as inconsistencies with the relationship between a site need and the corresponding PBS. For example, the site need was only a small portion of the scope within the PBS, and not necessarily tied to the PBS scope driving the risk factor. The TFA will need to work with the site users and DOE-Headquarters to further improve the application of PBS risk analysis to TFA prioritization.

Finally, the contribution and value of the TFA Management Team and USG cannot be overstated. The TFA's day-to-day user interface, represented by the TFA Management Team and USG, was invaluable in providing guidance, establishing the program development process, and developing the annual task prioritization.

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Acronyms

DOE	U.S. Department of Energy
DOE-HQ	U.S. Department of Energy – Headquarters
EM	DOE's Office of Environmental Management
FY	fiscal year
HLW	high-level waste
INEEL	Idaho National Engineering and Environmental Laboratory
IRB	Internal Review Budget
LLW	low-level waste
MOU	memorandum of understanding
MYPP	multiyear program plan
ORR	Oak Ridge Reservation
OST	DOE's Office of Science and Technology
PBS	project baseline summary
PEG	Program Execution Guidance
SRS	Savannah River Site
STCG	Site Technology Coordination Group
TAG	(TFA's) Technical Advisory Group
TFA	Tanks Focus Area
TIM	Technology Integration Manager
TRU	transuranic (waste)
TTP	technical task plan
USG	(TFA's) User Steering Group

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Section 1 - Introduction

This report documents the process used by the Tanks Focus Area (TFA) to analyze and develop responses to technology needs submitted by four major U.S. Department of Energy (DOE) sites with radioactive tank waste problems, and the initial results of the analysis. The sites are the Hanford Site, Idaho National Engineering and Environmental Laboratory (INEEL), Oak Ridge Reservation (ORR), and Savannah River Site (SRS).

This is the fourth edition of the TFA site needs assessment. As with the previous editions, this version serves to provide the basis for accurately defining the TFA program for the upcoming fiscal year (FY), and adds definition to the program for an additional 2 years. Therefore, this version distinctly defines the FY 1999 program and adds further definition to the FY 2000 - FY 2001 program. Each year the TFA uses a similar program development cycle to update its program. The process enables the TFA to adjust its program to meet the needs of the eventual technology users at each of the four major tank waste sites.

Overall, the TFA's annual program development cycle involves the

- Collection of site needs
- Needs analysis
- Development of technical responses and initial prioritization
- Refinement of the program for the next FY
- Formulation of the program budget for the current FY plus 2 outyears (including the preparation of the Internal Review Budget (IRB))
- Preparation of Program Execution Guidance (PEG) for the next FY
- Revision of the multiyear program plan (MYPP).

This document describes the TFA's process of collecting site needs, analyzing them, and creating technical responses to the sites. It also summarizes the information contained within the TFA needs database, portraying information provided by four major DOE sites with tank waste problems. The technical scope of the TFA's 3-year program will be defined in detail with the publication of the companion to this document, the MYPP.

The TFA goal remains unchanged -- to provide integrated solutions that will accelerate safe and cost-effective cleanup and closure of DOE's tank system. At the four major tank waste

sites, the TFA focuses on the 273 tanks[1] that contain approximately 380,000 m^3 of high-level waste (HLW), low-level waste (LLW), and transuranic (TRU) waste. There are a number of smaller tanks at these sites that are outside of the TFA's purview at this time. The varying tank structure, construction, and capacity, as well as the different waste types themselves, have provided extraordinary challenges to the formation of an integrated tanks technology development program. The varying programmatic, institutional, and regulatory issues across the four sites add to the complex-wide challenge of remediation.

The overall TFA program objective is to deliver a tank technology program that reduces the current cost, and the operational and safety risks of tank remediation. The TFA's continues to enjoy close, cooperative relationships with each site. During the past year, the TFA has fostered exchanges of technical information between sites. These exchanges have proven to be healthy for all concerned. The TFA recognizes that site technology needs often change, and the TFA must be prepared not only to amend its program in response, but to help the sites arrive at the best technical approach to solve revised site needs. Additionally, as the results of technology development are not 100% guaranteed, the TFA must be able to work with the sites to find appropriate alternative solutions if development results do not meet expectations.

Since its inception, the TFA continues to cite four tanks technology program attributes essential for TFA success. These attributes continue to guide the TFA's service to the user, such that the program is

- Applicable - addresses users' needs and can be implemented within budget, schedule, and regulatory constraints. The TFA uses a consensus-driven site needs collection and technical response process that enhances a deeper understanding of the interrelationships of the needs. Through this process, the TFA developed a priority listing of FY 1999 and FY 2000 proposed activities in accordance with representatives from all four major tank waste sites.

- Integrated - leverages relevant activities across the DOE Office of Environmental Management (EM) system and, later, across the DOE complex and beyond. The TFA is part of a technology development network that has formed within the focus areas and at each site. The awareness of related work between sites and focus areas continues to grow. The TFA continues to develop this awareness by leveraging opportunities. The TFA made a concerted effort to more fully integrate resources available from all other Office of Science and Technology (OST) activities.

- Acceptable - has broad involvement of key stakeholders and incorporates expertise from outside the laboratory system, e.g., from industry and universities as appropriate. The TFA has made special efforts to involve stakeholders. These stakeholders include the Site Technology Coordination Groups (STCGs), the TFA User Steering Group (USG), and the Community Leaders Network.

[1] In 1997, two of these tanks were closed.

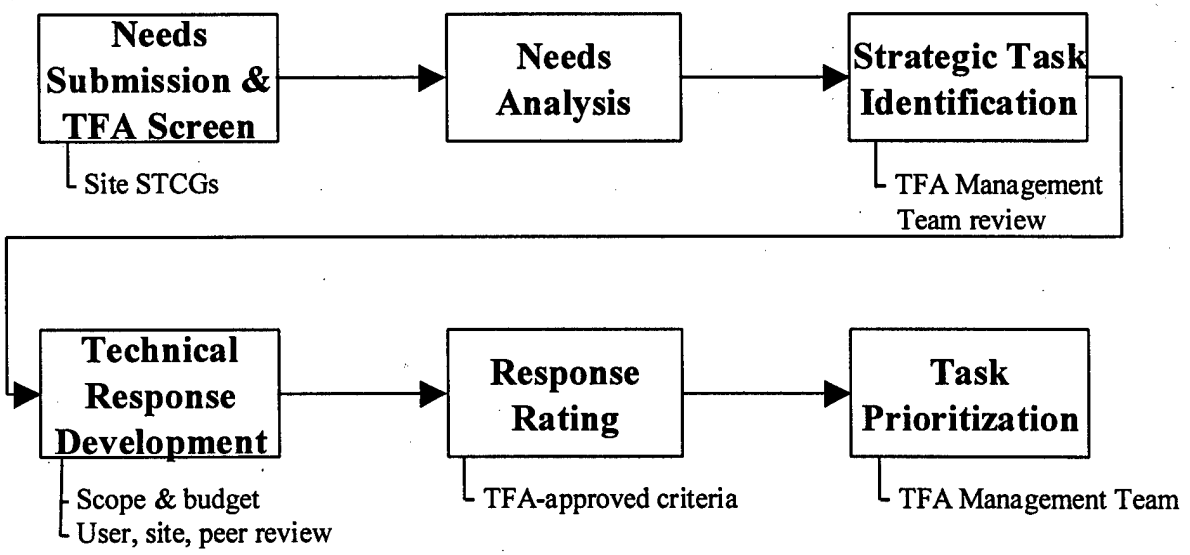
- Accountable - performs within budget, on schedule, and produces a clear benefit. The TFA continues to execute its mission with a high degree of accuracy, both fiscally and within milestone schedules. As a result, the TFA has gained the confidence of users and sites.

The TFA accomplishes its objective by executing an iterative approach to program development that involves site users and stakeholders through the STCGs at each site. The needs assessment forms the basis for TFA program definition. As previously noted, the TFA's program development cycle begins with the collection of site needs and ends with the publication of the MYPP. This site needs needs assessment describes the TFA's efforts through the first part of this cycle, from site needs collection through the development of technical responses and their initial prioritization. The TFA uses six steps to accomplish the first part of this cycle, which are listed below and depicted in Figure 1.1:

- STCG needs submission and TFA screen
- Needs analysis
- Strategic task identification
- Technical response development
- Response rating
- TFA Management Team prioritization.

At the time of this document's publication, the TFA Management Team had approved the results of their initial prioritization of TFA tasks for FY 1999 and FY 2000. Work is

Figure 1.1. FY 1998 Tanks Focus Area Technical Response Development Process



underway to finalize the technical responses developed earlier and to prepare the FY 2000 IRB. These final technical responses will form the basis for PEG development required for execution of the FY 1999 program.

Section 2 of this site needs assessment describes the TFA's process in reaching this point, from needs collection and analysis to task prioritization. Section 3 describes the follow-on program development activities the TFA will use to complete this year's program development process cycle. Appendix A contains descriptions of the needs submitted by the sites and the TFA's initial prioritization of the technical responses to them.

Section 2 – Site Needs Assessment and Technical Response Development Process

The TFA seeks continuous improvement of its annual site needs assessment and technical response development process. Beginning in October 1997 at the TFA Kickoff Meeting held in Augusta, Georgia, the TFA examined in detail each process step used in the previous year. Some modifications were made to the process, and significant consideration was given to the TFA's task prioritization criteria. The highlights of these changes are provided below. In considering the changes, the TFA kept several objectives in mind:

- Increased user participation
- Assurance of prompt communication between the TFA and users
- Recognition of the DOE-Headquarters (DOE-HQ) planning process (e.g., 2006 Plan)
- Development of "strategic" needs and technical responses.

The process steps are (see Figure 1.1)

- STCG needs submission and TFA screen
- Needs analysis
- Strategic task identification
- Technical response development
- Response rating
- TFA Management Team prioritization.

2.1 STCG Needs Submission and TFA Screen

The TFA expected the tank waste sites to submit their technology development needs via the STCGs as done in FY97. Similarly, the TFA planned to screen these needs for relevance to the TFA program. The screening criteria removed site needs outside of the TFA mission area and outside of the anticipated program goals, needs without a technology development component, or the unfeasibility of developing technical solutions within the time frame needed.

As with last year, each site used its own internal process to determine and prioritize as necessary their site needs. Again, a standardized site needs template proved helpful in communicating and understanding the needs. The TFA's Site Representatives were essential in communicating the needs from the sites to the TFA. See Figure 2.1, Tanks Focus Area Organization.

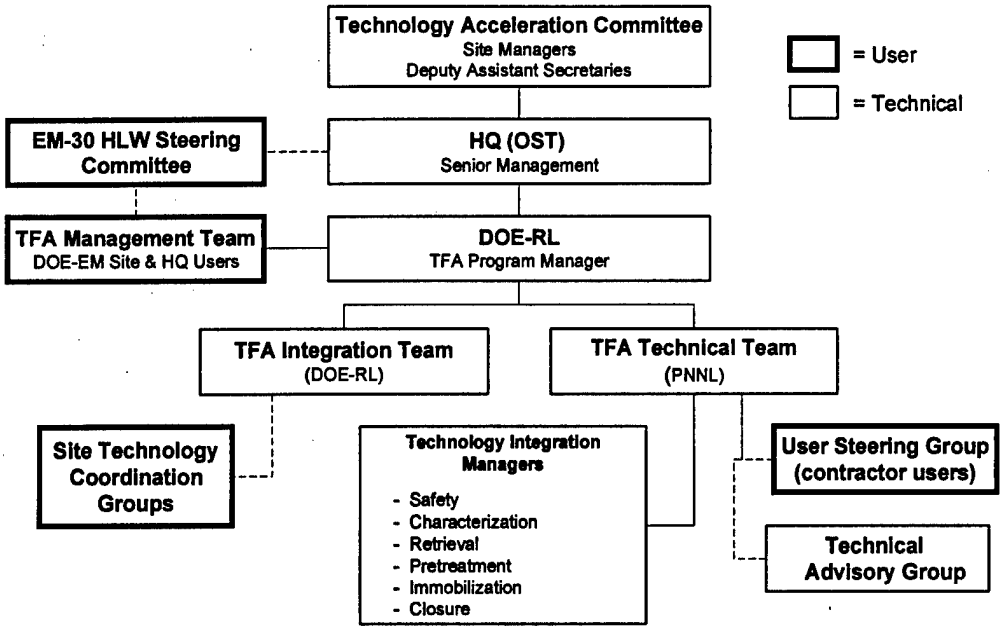


Figure 2.1. Tanks Focus Area Organization

2.2 Needs Analysis

The TFA analyzed each site need that passed through the screening criteria. This analysis served to familiarize the TFA with the general scope of site needs. The TFA worked interactively with the sites to understand better the problem to be solved, required performance specifications, timing of the technical solution, and integration of functional interfaces (e.g., between pretreatment and immobilization).

2.3 Strategic Task Identification

Focusing predominately on the analysis of site-submitted needs, the TFA identified needs whose solutions would be strategic in nature to the TFA. Additionally, the TFA identified technology "gaps" that became apparent in the needs analysis, or that were identified through other TFA processes, such as technology interface workshops. The TFA submitted these issues for review by its Management Team. The Management Team either voiced no objection to the development of a technical response to these issues to be included within the TFA list of needs, or determined that the issue merited no further TFA consideration.

The TFA developed its definition of a strategic task during its Kickoff Meeting in October 1997. The following describes a TFA strategic task

- The technology need exists within a baseline but is not being addressed now. The need would be longer term, not a multiple deployment of existing technologies, and may otherwise go unsatisfied due to budget limitations. The need may or may not have been submitted by a site. Successful response to the need may result in

    - Accelerated schedule
    - Risk reduction
    - Establishment of a basis that drives near-term, related efforts.

- The technology need is a critical issue that is not now being considered. The need may be near or long term in nature, and may or may not represent baseline technology. The need may likely be identified by the TFA, rather than submitted by a site. Satisfaction of the need may result in

    - Prevention of previously unforeseen problems
    - Insurance
    - Risk reduction.

- A technical solution effects a change to a baseline (alternative). The need could be near term, and may require that the TFA leverage other programs. The need may or may not have been submitted by a site. Successful response to the need may result in

    - Mortgage reduction
    - Risk reduction.

The concept for selective identification and funding of strategic activities was widely supported by the TFA's users and a key focus area review panel. While extremely limited funding may inhibit the TFA's ability to initiate new start strategic activities in the immediate future, the discussion of the strategic task concept proved very useful, philosophically, for the TFA. The TFA intends to pursue this concept in the future.

2.4 Technical Response Development

The TFA developed technical responses to all needs passing through the screening criteria. Those needs screened out were coordinated with the submitting site for further disposition. Some screened out needs were potentially outside of the TFA mission area, perhaps best answered within another OST program, such as another focus or crosscutting area. The TFA will formally interact on such cases with the other programs and inform the submitting site STCG of any need identified as such in this process.

The responses were prepared by the Technical Team and submitted to the Technical Advisory Group (TAG), USG, and TFA Management Team for review, comment, and adjustment. To the maximum extent possible, the TFA integrated together responses to like needs. Also, the TFA was careful to take advantage of other OST funding sources to maximize leveraging. The responses for strategic tasks will be very specific on incremental objectives and go/no-go decision points.

The TFA uses an established standard framework to begin its annual program planning process. This framework groups similar or related site needs and the TFA's technical responses, allowing for technical integration across functions to solve specific problems, as opposed to consolidating needs by technical focus. This activity begins the transition from needs collection and analysis to TFA program development. The results of the program development process will be addressed in the upcoming revision to the MYPP.

To establish and maintain this program planning framework, the TFA uses its problem element structure. The problem elements

- Provide an updated method to logically group site needs and TFA technical responses
- Assist in sequencing and scheduling integrated technical solutions
- Identify the problem elements and the needs within them as baseline, enhancements, or alternatives.

The TFA FY 1998 problem element structure appears in Table 2.1.

2.5 Technical Response Rating

The TFA rated each technical response for use in funding decisions based on the approved task selection criteria. Technical responses rated above the anticipated funding line are known as "core" tasks. Selected technical responses below the funding line may be considered for TFA funding if they were previously identified as a strategic task. These strategic tasks will be highlighted for Management Team review and prioritization with rationale describing the benefits of investments relative to the TFA's strategic intent.

The TFA studied each need and developed potential integrated technical responses. As necessary, the TFA contacted the specific need technical point of contact for further clarification. During the initial stages of technical response development, each need was subjected to an initial needs screening. The screening assessed whether or not the

- Need and possible technical response were within the TFA mission area
- Need and possible technical response required a technology development component

- Development, first-time hot demonstration or deployment, re-engineering, etc., was required

- Technology was available, and no technology development was required

- Response was technically feasible (schedule or cost).

From mid-January 1998 through early-March 1998, the TFA prepared an initial draft response for each need. The composite set of technical responses was rated against criteria intended to rank them for further program development activities. The criteria included the following:

- Broad-based benefit
- User commitment to deploy
- Project Baseline Summary (PBS) risk
- Other technical impact.

Broad-Based Benefit - This criterion addressed the potential complex-wide benefit of a technical response.

High: *Two* or more different site STCG-submitted needs with strong interest with a single, integrated response. Note: "strong interest" means site interest is confirmed with the TFA Site Representative and USG member.

High to Medium:

- High/Medium: One STCG-submitted need; two or more sites with strong interest where resulting hardware or data would directly benefit.
- Medium/High: One STCG-submitted need; one site with strong interest where resulting hardware or data would directly benefit.
- Medium: One STCG-submitted need; one site with strong interest where resulting hardware or data would indirectly benefit.

Medium Low: One STCG-submitted need that may be satisfied through deployment of a technology already deployed elsewhere, but still requiring technology development work.

Low/Medium: One STCG-submitted need and one other potential benefiting site based on Technology Integration Manager (TIM) judgment.

Low: One STCG-submitted need; site specific.

User Commitment - The TFA values user commitment to the development and the deployment of technical solutions. This criterion assesses the strength of the user commitment to share the burden of a technology's development and deployment.

High:

- Site co-funds development and demonstration (or deployment)
- High commitment to deploy through out-year baseline, PBS, and budget request; memorandum of understanding (MOU) or other signed document for out-year deployment
- Is in site baseline operational plan with MOU or other signed document committing to funding and plan for deployment in "subject" FY
- Deployment within 1 - 2 years
- Greater than or equal to equal co-funding of development and demonstration for the year of prioritization and duration of the response.

High/Medium: Response results in data delivery for key DOE decisions, e.g., Environmental Impact Statement (EIS) or privatization decisions.

- Site co-funds data development and delivery
- Data will be used within 1 - 2 years
- High commitment to deploy through out-year baseline, PBS, and budget request; MOU or other signed document for out-year deployment
- Greater than or equal to equal co-funding of development and delivery for the year of prioritization and duration of the response.

Medium/High: Approximately equal co-funding to develop and demonstrate during time of the response. High commitment to deploy through out-year baseline, PBS, and budget request; TFA Site Representative commitment to obtain MOU or other signed document for out-year deployment or use of data.

Medium: Less than 10% co-funding; high commitment to deploy through out-year baseline, PBS, and budget request; TFA Site Representative commitment to obtain MOU or other signed document for out-year deployment or use of data.

Low/Medium: Some co-funding (large percentage or small), but with no commitment to deploy or use data (not in out-year plan).

Low: Little or no indication of site co-funding or commitment to deploy.

Note on co-funding: Co-funding needs to be focused on support to the overall project TFA is funding. Co-funding may include direct support the principal investigator, support to on-site operations staff to facilitate testing, sample collection/analysis/

shipping, design and review. Examples of co-funding include ORR Gunite and Associated Tanks cold testing support; SRS Tank 20 closure (application of TFA-funded grout test work).

PBS Risk - This criterion tied the technical response to the need, then to the PBS(s) the sites named for each need. Sites assigned risk factors[1] to each PBS. The TFA rated the technical responses relevant to the assigned PBSs. Only two risk factor categories are possible, Urgent or High.

High: The need is directly connected to a site PBS identified with urgent risk factors in the 2006 Plan

Medium: The need is directly connected to a site PBS identified with high risk factors in the 2006 Plan

Low: The need has neither urgent nor high risk factors.

Other Technology Impact - The objective of this criterion is to broadly assess the overall potential technology impact of a technical response. The TFA considers a response's impact on schedule, cost avoidance, and link to regulatory requirements to determine impact. The ratings include the following:

High: (one or more of the following apply)

- Technology required to meet the baseline assumption in the 2006 Plan
- Documented high cost avoidance (over $250M) to EM (information must be provided to TFA by site with uncertainty analysis)
- Possesses high cost reduction potential (over $250M)
- Technical response is required to meet firm regulatory requirements that could delay tank waste remediation schedules.

Medium: (one or more of the following apply)

- Technology required to meet enhancements or alternatives to baseline in the 2006 Plan

[1] Risk factors are rated by sites in constructing their PBSs. DOE identified three risk factors: public safety and health, worker safety and health, and environmental health. The degree of risk assigned to each factor depends on 1) the probability that an event (i.e., exposure) leading to adverse impacts occurs within a year; or 2) on the proximity in time until the event (i.e., exposure) leading to adverse impact is expected to occur. Urgent is the highest risk factor.

- Documented moderate cost avoidance (between $250M and $50M) to EM or general consensus on high cost avoidance (over $250M) that cannot be documented due to lack of data that will be developed if the task goes forward

- Possesses moderate cost reduction potential

- Technical response adds assurance that regulatory requirements are met, or supports a regulatory requirement that the site may renegotiate.

Low: (one or more of the following)

- Appears that technology could meet baseline or enhancement assumptions, but more data is needed and will be provided explicitly if the task proceeds

- General consensus that moderate cost avoidance (between $250M and $50M) could be achieved but cannot yet be documented

- The technical response's link to regulatory requirements is not fully determined.

The criteria were applied to the initial draft technical responses in TFA meetings held in February 1998. This initial assessment was accomplished in a group consensus of TIMs, monitored by DOE's Richland Operations Office, based on available information stated in the needs. During the remainder of February, the TFA developed the final draft technical responses. The TFA's intent was to ensure that technical responses would

- Be provided for each need received
- Contain an explanation of the priority of the response according to either
  - Screening criteria
  - Prioritization criteria
- Describe multiyear intent
  - 4-year budget estimate (current + 3 years)
  - Basis of estimate
- Describe the intended scope (2 to 3 paragraphs)
- Identify the relationship or benefit to other site needs.

2.6 TFA Management Team Prioritization

From mid-February through early March 1998, the TFA prepared its draft technical responses for TFA Site Representatives', USG, and TAG review. At a meeting on March 12 in Richland, Washington, the TFA Management Team discussed the technical responses and. established FY 1999 funding priorities using the prioritization criteria and in consideration of the results of the initial assessment.

As of the publication date of this document, the TFA was continuing to finalize technical responses to written comments submitted by the Site Representatives, USG, and TAG subsequent to the midyear meeting. The final version of the technical responses will be summarized in the next edition of the TFA MYPP.

2.7 Data Summary

In all, the sites submitted 75 needs. The TFA assigned each need to one of the TFA's six functional areas based on the major subject of the need. Some needs statements were broad enough that they dictated more than one technical response. As a result, the TFA divided some needs into multiple parts. In all, 89 technical responses were prepared by the TFA. A summary of the TFA's functional assignment of needs and technical responses by site is shown in Table 2.2.

The needs across the complex reflect requirements to monitor waste tanks and tank corrosion, reduce waste volumes or minimize the generation of additional waste volumes, retrieve salt and heel wastes, close tanks, optimize waste loading in glass formulations, and determine waste form product acceptance standards. ORR requires additional technologies to close small tanks. The Hanford Site requires continued emphasis to establish the technical basis for closure and support Phase I and Phase II privatization. Hanford and SRS require additional mixing technologies to suspend sludge and saltcake for waste removal, and then settle-decant data to prepare for pretreatment. SRS identified new requirements for alternatives to in-tank precipitation, as well as continuing improvement of the Defense Waste Processing Facility operations. Both INEEL and SRS share a need for improved tank ventilation systems. INEEL requires completion of its deployment of the Light-Duty Utility Arm and continued support to meet Title 1 design.

During its analysis of the site needs, the TFA found that many of the requirements from any one site have multisite benefit. The TFA will exploit the resolution of these requirements to leverage these multisite benefits. Multisite benefit is one of the four criteria the TFA used this year in prioritizing future work. The tentative program for FY 1999 - FY 2000 reflects the importance the TFA places on multisite benefit.

2.8 Lessons Learned

Every year, the TFA learns new lessons in going through the execution of the initial stages of the program development process. Last year, the use of a standardized needs format by all of the tank sites greatly assisted in the subsequent needs analysis and technical response development. However, the TFA must work to refine the needs submission schedule to permit adequate time to analyze the needs and prepare more complete technical responses before task prioritization. The needs submission schedule is bounded by the requirement to submit an IRB. Insufficient time exists between needs submission and IRB submission to analyze the needs, develop technical responses, and coordinate with other OST activities to develop fully integrated technical responses. The TFA wishes to take full advantage of

resources offered by other focus areas, crosscutting programs, industry programs, international programs, university programs, and the EM Science Program. This issue was recognized by the TFA last year. However, the TFA increased its attempts to integrate with these other programs this year. With this increased emphasis, the insufficient time became more apparent. The TFA recognizes that more time is required to fully integrate its program in the future. Unless the program development schedule is amended, full integration will continue to be less than desired.

Secondly, application of risk factors from the sites' Project Baseline Summary (PBS) submittals was problematic. Inconsistencies appeared in the sites' application of the risk factor, as well as inconsistencies with the relationship between a site need and the corresponding PBS. For example, the site need was only a small portion of the scope within the PBS, and not necessarily tied to the PBS scope driving the risk factor. The TFA will need to work with the site users and DOE-Headquarters to further improve the application of PBS risk analysis to TFA prioritization.

Finally, the TFA Management Team and USG provided outstanding guidance and support during this phase of the program development cycle. The TFA would not be successful without the active participation of this team. The team

- Established a program development process and prioritization criteria that well represented the needs of all four sites
- Monitored the conduct of the process
- Led the review of the draft technical responses
- Prioritized the FY 1999 - FY2000 program tasks through a consensus-required process.

The TFA will work to ensure this team continues to play this significant role.

Table 2.1. Problem Element Structure

WBS#	Problem Element
1.0	Remediate Tanks
1.1	Store Waste
1.1.1	Extend Tank Life
1.1.1.1	Monitor Tank Integrity/Avoid Corrosion
1.1.1.3	Remediate Loss of Tank Integrity
1.1.2	Ventilate Tanks
1.1.3	Characterize Waste
1.1.3.1	Characterize Waste In Situ
1.1.3.2	Sample Waste
1.1.3.3	Analyze Waste
1.1.4	Reduce Waste Volume
1.1.4.1	Reduce Source Streams
1.1.4.2	Reduce Recycle Streams
1.2	Process Waste
1.2.1	Retrieve Waste
1.2.1.1	Deploy Equipment
1.2.1.2	Mobilize Bulk and Heel Wastes
1.2.1.4	Transfer Waste
1.2.1.5	Detect and Mitigate Leaks
1.2.1.6	Monitor and Control Retrieval Process
1.2.1.7	Integrate Retrieval and Pretreatment Technology Systems
1.2.1.8	Mobilize Heel
1.2.2	Pretreat Waste
1.2.2.1	Calcine Waste
1.2.2.2	Dissolve Waste
1.2.2.3	Prepare Retrieved Waste for Transfer and Pretreatment
1.2.2.4	Clarify Liquid Stream
1.2.2.5	Remove Radionuclides
1.2.2.6	Integrate Pretreatment and LLW Immobilization Technology Systems
1.2.2.7	Process Sludge
1.2.2.8	Prepare Pretreated Waste for Immobilization
1.2.2.9	Monitor and Control Pretreatment Process
1.2.3	Immobilize Waste
1.2.3.1	Process LLW
1.2.3.1.1	Monitor and Control LLW Immobilization Process
1.2.3.1.2	Prepare LLW Feed
1.2.3.1.3	Immobilize LLW Stream
1.2.3.1.4	Treat LLW Offgas
1.2.3.1.5	Dispose of LLW
1.2.3.2	Process HLW
1.2.3.2.1	Monitor and Control HLW Immobilization Process
1.2.3.2.2	Prepare Secondary Waste from Pretreatment
1.2.3.2.3	Prepare Sludge Feed
1.2.3.2.4	Immobilize HLW Stream
1.2.3.2.5	Treat HLW Offgas
1.3	Store Waste Forms and Close Tanks
1.3.1	Close Tanks
1.3.1.1	Monitor Tank
1.3.1.2	Characterize Heels
1.3.1.3	Define Closure Criteria
1.3.1.4	Treat Supernate in Place
1.3.1.5	Treat Heel in Place
1.3.1.6	Detect Leaks
1.3.1.7	Stabilize Tank for Closure
1.3.1.8	Monitor Site
1.3.2	Dispose of LLW
1.3.2.1	Monitor LLW for Acceptance
1.3.2.2	Determine Performance of Waste Form
1.3.2.3	Provide Disposal System
1.3.3	Store and Dispose HLW
1.3.3.1	Provide Interim Storage HLW
1.3.3.2	Provide Shipping Facilities
1.3.3.3	Monitor HLW for Acceptance

Table 2.2. Summary of Site Needs Submitted to the Tanks Focus Area and Technical Responses Generated

Functional Area	Hanford		INEEL		ORR		SRS		Total	
	Needs	Resp.	Needs	Resp.	Needs	Resp.	Needs	Resp.	Needs	Resp.
Safety	7	7	1	1	0	1	4	6	12	15
Characterization	4	4	1	1	2	2	2	5	9	12
Pretreatment	3	5	6	6	2	2	6	6	17	19
Immobilization	7	7	3	3	1	1	5	5	16	16
Retrieval	3	5	2	2	2	3	5	5	12	15
Closure	6	7	0	0	2	2	1	3	9	12
Total	30	35	13	13	9	11	23	30	75	89

Section 3 – The Next Process Steps

The TFA considers the needs assessment the starting point for the annual refinement and redefinition of its technical program. The grouping of needs within the problem element structure permits a problem-oriented analysis from a complex-wide perspective. When matched with present and ongoing technical activities related to each of the needs, as well as the schedule drivers for the needs, the TFA expects likely technology targets to emerge. As noted earlier, this document reports only on the initial program development steps. Formulation of the final detailed technical response for each submitted need is presently in progress. The purpose of this section is to describe how the activities covered in this site needs assessment fit into the overall program development process. Within the overall program development process, the following major tasks and schedule remain for this year's program development cycle:

- Prepare and submit FY 2000 input to OST budget process (April 1998)
- Finalize FY 1999 and FY 2000 task priority listing (May 1998)
- Prepare and submit FY 1999 program execution documents (June-August 1998)
- Finalize FY 1999 technical activities and proposed FY 2000 technical activities (August 1998)
- Document in the MYPP (September 1998).

3.1 Prepare and Submit FY 2000 Input to OST Budget Process

The TFA is presently preparing its initial FY 2000 budget input based on draft work scope and budget estimates for each proposed task. These work scopes and budget estimates were reviewed and approved by the TFA Management Team at the FY 1998 TFA Midyear Technical Review. Additionally, the proposed tasks were prioritized as noted earlier.

3.2 Finalize FY 1999 and FY 2000 Task Priority Listing

Before the FY 1998 TFA Midyear Technical Review, TFA Site Representatives and TAG reviewed each proposed technical response and the TFA Technical Team's initial assessment of them. At the midyear review, the TFA Management Team established the initial priority listing, which was required for the TFA to meet schedule milestones for the submission of the program's FY 2000 IRB. As always, the TFA expects that priorities are subject to change via a change control process executed by DOE. For example, priorities may shift due to changing schedules at the sites, or as a result of TFA Management Team review of TFA

responses to their questions and comments on preliminary work scope definitions for FY 1999 and FY 2000.

3.3 Prepare and Submit FY 1999 Program Execution Documents

Each year, the TFA uses two documents to provide for program execution. The first, the PEG, is the TFA's guidance to the selected work perfomer and is tied to the users' commitment and priority. This guidance states the mandatory technical and programmatic requirements needed. Upon receipt of the PEG, the performer develops the second document, the Technical Task Plan (TTP). The TTP is the performer's response to the PEG. An approved TTP constitutes a contractual arrangement between the TFA, the performing DOE Field Office, and the performing organization. Both documents are generally required before work initiation and funding authorization.

3.4 Finalize FY 1999 Technical Activities and Proposed FY 2000 Technical Activities

The TFA Site Representatives and TAG reviewed draft technical activities scheduled for FY 1999 and FY 2000. For work ongoing in FY 1998 that was proposed to continue in FY 1999, the midyear review provided the opportunity for amendments to FY 1999 work based on results thus far. The TFA continues its review of all of these activities until all questions, both programmatic and technical, have been answered. Agreement on the work scope for FY 1999 is central to the preparation of program execution documents scheduled for May through September 1998.

3.5 Document in the MYPP

The companion document to this one is the TFA MYPP. It documents the results of the preceding planning steps and is the basis for complementary planning between OST and the Offices of Environmental Restoration and Waste Management in future years, which is reflected in the OST budget process. This approach is consistent with the TFA goal of defining and implementing an integrated technical program. The MYPP describes the TFA's technical strategies and the actions being taken to address the site needs within the strategies. The FY 1999 - FY2001 MYPP is expected to be published during September 1998.

Each year, the MYPP is updated to reflect the changing emphasis of the sites and the subsequent changes in the TFA's technical focus. Based on the FY 1998 STCGs' needs submittal and the resulting technical responses, the FY 1999 - FY 2001 MYPP should show the TFA's continuing emphasis to

- Appropriately support DOE's privatization at Hanford and ORR
- Provide technical answers to vitrification requirements from around the complex
- Support definition of alternatives to in-tank precipitation at SRS
- Support INEEL in Title 1 design.

Section 4 - Bibliography

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Appendix A – Site Needs Database

This appendix contains the specifics of each of the 75 needs submitted by the sites. Three tables precede the presentation of these needs. First, Table A.1 lists a summary of the needs submitted by each site. In developing technical responses to the needs, the Tanks Focus Area (TFA) found it necessary to split apart some needs into more specific elements. Each year, the TFA assigns an identification number, called a "Need ID#" to each submitted need. Needs that were split show a letter following the Need ID#. For example, Table A.1 shows needs 98024A and 98024B. This means the TFA split need #98024 into two parts.

Within each site's listing in Table A.1, the needs are presented in TFA FY 1999 - FY 2000 priority order. Some needs show a priority indicator of "N/A," meaning "not applicable." There are several reasons why the TFA did not assign a priority to a need. For example, a need may have been consolidated with another need under a single technical response.

The next table, Table A.2, shows those same needs organized into the TFA's problem element structure. The TFA uses this structure to help show what functional areas concern the sites.

Lastly, Table A.3 lists the TFA's responses to the site needs in its priority listing for FY 1999 and FY 2000. Technical responses that were not prioritized by the TFA appear at the end of the table with short explanations for their non-rating. Table A.3 shows that the TFA developed and prioritized 61 technical responses that addressed 70 of the 75 needs submitted. The remaining five needs were either screened out or retracted by the sites. The TFA screened out needs that were not considered within the TFA mission area, did not have a technology development component, or were not feasible in cost or schedule.

The remainder of the appendix is devoted to the individual site needs. Each need is described, followed by a short explanation of the TFA's proposed action in response to the need. The purpose of this site needs assessment is to report on the conduct of the needs assessment and initial results from the analysis. More detailed information may be found in other upcoming TFA program development documents, such as the Multiyear Program Plan, Program Execution Guidance, and Technical Task Plans.

For ease of use, the detailed needs descriptions appear in TFA Response# order. The need and the proposed technical response are tracked with this number. For audit trail purposes, this number remains with the need and response, and the number is not duplicated. Therefore, needs submitted last year retained their own distinctive ID#, and needs submitted this year were assigned a unique number.

A separate list of acronyms for this appendix appears after the tables.

Table A.1 Tanks Focus Area Needs Submitted by Sites
(sorted by site in TFA priority order)

TFA Need ID#	Site ID#	TFA Priority	Site Priority	Need Title
Hanford Site				
98004	RL-WT04	2	High	DST Corrosion Monitoring
98024B	RL-WT024	11	High	Enhanced Sludge Washing Process Data
98010	RL-WT010	12	High	ILAW Product Acceptance Inspection and Test Methods
98028	RL-WT028	15	Medium	Waste Mobilization Enhancement
98023	RL-WT023	18	High	Prediction of Solid Phase Formation in Hanford Tank Waste Solutions
98009	RL-WT09	22	High	Representative Sampling and Associated Analysis to Support Operations and Disposal
98013	RL-WT013	23	High	Establish Retreival Performance Evaluation Criteria
98024A	RL-WT024	26	High	Enhanced Sludge Washing Process Data
98026	RL-WT026	27	High	Tank Leak Detection Systems for Underground Single-Shell Waste Storage Tanks (SSTs)
98030	RL-WT030	31	High	Contaminant Mobility Beneath Tank Farms
98013E	RL-WT013	35	High	Establish Retreival Performance Evaluation Criteria (SST Retrieval Enhancements)
98021	RL-WT021	36	High	Cleaning and Decontamination of Hanford Pits
98025	RL-WT025	37	Medium	Remote Sensing of Gas Retention in HLW Slurries
98008	RL-WT08	39	High	Advanced Methods for Achieving LLW Volume Minimization
98017	RL-WT017	40	Medium	Long-Term Testing of Surface Barrier
98019	RL-WT019	41	Medium	Getter Materials
98013F	RL-WT013	44	High	Single Shell Tank Retrieval
98020	RL-WT020	45	Medium	Service Integrity Testing of High-Level Waste Tanks and Piping
98016	RL-WT016	47	High	Glass Monolith Surface Area
98029A	RL-WT029	48	Medium	Data and Tools for Performance Assessments (Tools)
98029B	RL-WT029	56	Medium	Data and Tools for Performance Assessments (Data)
98018	RL-WT018	57	Low	Testing of Sand-Gravel Capillary Barrier
98013D	RL-WT013	60	High	Establish Retreival Performance Evaluation Criteria (Waste Conditioning for Heel Transfer)
98007	RL-WT07	61	Medium	Hanford Capsule Initiative (HCI): A Processing Demonstation of Cs/Sr Capsules for Final Disposition
98001	RL-WT01	N/A	High	Technetium-99 Analysis in Low Level Waste Feed
98002	RL-WT02	N/A	Low	In-Tank Core Sampling...Off-Riser Capability
98003	RL-WT03	N/A	High	Large Volume (3-5 liter) Sludge and Supernate Sampler
98005	RL-WT05	N/A	Medium	Remote Inspection of High-Level Waste Single Shell Tanks
98006	RL-WT06	N/A	High	Identification and Management of Problem Constituents for HLW Vitrification
98011	RL-WT011	N/A	Medium	IHLW Product Acceptance Inspection and Test Methods
98012	RL-WT012	N/A	High	Secondary Products Acceptance Inspection and Test Methods
98014	RL-WT014	N/A	Low	Alternative to Baseline Tank Waste Mixing System

Table A.1 Continued

TFA Need ID#	Site ID#	TFA Priority	Site Priority	Need Title
98015	RL-WT015	N/A	Medium	Standard Method for Determining Waste Form Release Rate
98022	RL-WT022	N/A	High	Tank Knuckle NDE
98027	RL-WT027	N/A	High	Tank Leak Mitigation Systems
Idaho National Engineering and Environmental Laboratory				
98039	ID-2.1.10	20	25	Develop Technology to Characterize Tank Farm Heel Residues
98035	ID-2.1.06	24	22	Solvent Extraction and Ion-Exchange to Remove TRU, Sr, Tc, and Cs from ICPP Tank Farm
98034	ID-2.1.05	25	21	Dissolution of ICPP Calcines
98036	ID-2.1.07	28	24	Develop Technology to Stabilize/Solidify ICPP Low-Activity Waste
98032	ID-2.1.02	29	3 of 13	Process Flowsheet to Calcine Sodium-Bearing Waste
98043	ID-2.1.14	33		Develop Technology for Preconditioning ICPP High-Activity and Low-Activity Wastes
98038	ID-2.1.09	52	27	Remove and Transport Calcine
98031	ID-2.1.01	N/A	1 of 13	Technologies to Reduce Generation of or Alternative Treatments for Radioactive Liquid Waste at the ICPP
98033	ID-2.1.04	N/A	20	Method to Separate Undissolved Solids from Sodium-Bearing Waste & Dissolve Calcine
98037	ID-2.1.08	N/A	26	Develop Technology/Process for the Immobilization of High Activity Waste
98040	ID-2.1.11	N/A	23	Characterize & Remove RCRA Listed Wastes from High & Low Activity Fractions
98041	ID-2.1.12	N/A	7 of 41	Denitrate and Solidify High Activity Waste for Transport
98042	ID-2.1.13	N/A	??	Washable Metal HEPA Filters
Oak Ridge Reservation				
98050A	TK-09	1	7	Oak Ridge National Laboratory Tank Closure
98048	TK-05	3	5	Oak Ridge National Laboratory Tank Sludge and Supernatant Separations
98050B	TK-09	5	7	Oak Ridge National Laboratory Tank Closure
98045	TK-02	6	1	Oak Ridge National Laboratory Tank Solid Waste Retrieval
98051	TK-10	13	9	Oak Ridge National Laboratory Remediated Tank Isolation and Removal
98049	TK-06	32	3	Oak Ridge National Laboratory Tank Sludge and Supernatant Immobilization
98052	TK-11	38	8	Oak Ridge National Laboratory Tank Sludge and Supernatant Pretreatment
98044A	TK-01	49	6	Oak Ridge National Laboratory Tank Waste Characterization (Sludge Mapping BVEST/MVST/OHF)
98044B	TK-01	N/A	6	Oak Ridge National Laboratory Tank Waste Characterization - (Structural Integrity BVEST/MVST)

Table A.1 Continued

TFA Need ID#	Site ID#	TFA Priority	Site Priority	Need Title
98046	TK-03	N/A	2	Oak Ridge National Laboratory Sludge Mixing and Mobilization
98047	TK-04	N/A	4	Oak Ridge National Laboratory Sludge Mixing and Slurry Transport
Savannah River Site				
98067A	SR-2909	4	9 of 20	Develop Advanced Techniques for Life Extension of Tanks/Piping (Tank Inspection)
98059	SR-2906	7	6 of 20	Optimize Melter Glass Chemistry
98057	SR-2908	8	8 of 20	Second Generation Salt Feed Preparation
98058	SR-2907	9	7 of 20	Provide Alternative Processing and/or Concentration Methods for DWPF Recycle Aqueous Streams
98061	SR-2901	10	1 of 20	Demonstrate Alternative Filtration Technologies to Replace HEPA Filters
98053	SR-2911	14	11 of 20	Tank Heel Removal/Closure Technology
98073	SR-2921	16	Unranked	Volume Reduction and Stabilization of CIF Secondary Salt (NaCl) Liquid Waste
98054	SR-2902	17	2 of 20	Alternate Waste Removal Techniques
98062	SR-2910	19	10 of 20	Develop Second Generation DWPF Melter
98056	SR-2913	21	13 of 20	Methods to Unplug Waste Transfer Lines
98063A	SR-2916	30	16 of 20	Develop Advanced Techniques to Improve Safety Infrastructure (Ventilation)
98067C	SR-2909	34	9 of 20	Develop Advanced Techniques for Life Extension of Tanks/Piping (Piping Inspection)
98066	SR-2903	42	3 of 20	Alternative DWPF Canister Decontamination Techniques
98071B	SR-2912	43	12 of 20	Evaporator Residual Waste Removal and Closure (Closure)
98055	SR-2918	46	18 of 20	In-situ Methods for Characterization of Tank Wastes
98075	SR-3022	50	Not Ranked	In-situ Grouting of Underground Tanks (Formerly Used for the Storage of Radioactive Solvents)
98063C	SR-2916	51	16 of 20	Develop Advanced Technology to Improve Safety Infrastructure (Pot Sampler)
98068	SR-2914	53	14 of 20	Demonstrate Remote Disassembly of High Level Waste Melters and Other Processing Equipment
98070	SR-2917	54	17 of 20	Develop Remote Technology to Improve DWPF Operations
98064	SR-2905	55	5 of 20	Develop Techniques to Increase DWPF Throughput and Productivity
98063B	SR-2916	58	16 of 20	Develop Advanced Techniques to Improve Safety Infrastructure (Leaked Waste)
98063D	SR-2916	59	16 of 20	Develop Advanced Techniques to Improve Safety Infrastructure (Monitoring)
98060	SR-2904	N/A	4 of 20	ITP Feed Solution Pretreatment
98065	SR-2920	N/A	20 of 20	Improved Sludge Processing
98067B	SR-2909	N/A	9 of 20	Develop Advanced Techniques for Life Extension of Tanks/Piping (Tank Repair)
98069	SR-2915	N/A	15 of 20	Alternate Mixer Pumps
98071A	SR-2912	N/A	12 of 20	Evaporator Residual Waste Removal and Closure (Heel Removal)
98072A	SR-2919	N/A	19 of 20	In-tank Corrosion Probe Development
98072B	SR-2919	N/A	19 of 20	In-tank Corrosion Probe Development (Sludge Mapping and Percent Solids)
98074	SR-2923	N/A	Unranked	Caustic Recovery and Recycle

Table A.2. Tanks Focus Area Site Needs Distributed within the Problem Element Structure

PE#	Problem Element Title	Site	Priority	Function
1.0	**Remediate Tanks**			
1.1	**Store Waste**			
1.1.1	**Extend Tank Life**			
1.1.1.1	**Monitor Tank Integrity/Avoid Corrosion**			
98004	DST Corrosion Monitoring	Hanford	High	Safety
98005	Remote Inspection of High-Level Waste Single Shell Tanks	Hanford	Medium	Safety
98022	Tank Knuckle NDE	Hanford	High	Safety
98044B	Oak Ridge National Laboratory Tank Waste Characterization (Structural Integrity BVEST/MVST)	Oak Ridge	6	Safety
98055	In-situ Methods for Characterization of Tank Wastes	SRS	18 of 20	Characterization
98067A	Develop Advanced Techniques for Life Extension of Tanks/Piping (Tank Inspection)	SRS	9 of 20	Safety
98072A	In-tank Corrosion Probe Development	SRS	19 of 20	Safety
1.1.1.3	**Remediate Loss of Tank Integrity**			
98067B	Develop Advanced Techniques for Life Extension of Tanks/Piping (Tank Repair)	SRS	9 of 20	Safety
1.1.2	**Ventilate Tanks**			
98061	Demonstrate Alternative Filtration Technologies to Replace HEPA Filters	SRS	1 of 20	Safety
98063A	Develop Advanced Techniques to Improve Safety Infrastructure (Ventilation)	SRS	16 of 20	Safety
1.1.3	**Characterize Waste**			
1.1.3.1	**Characterize Waste In Situ**			
98044A	Oak Ridge National Laboratory Tank Waste Characterization (Sludge Mapping BVEST/MVST/OHF)	Oak Ridge	6	Characterization
98072B	In-tank Corrosion Probe Development (Sludge Mapping and Percent Solids)	SRS	19 of 20	Characterization
1.1.3.2	**Sample Waste**			
98002	In-Tank Core Sampling...Off-Riser Capability	Hanford	Low	Characterization
98003	Large Volume (3-5 liter) Sludge and Supernate Sampler	Hanford	High	Characterization
98009	Representative Sampling and Associated Analysis to Support Operations and Disposal	Hanford	High	Characterization
98039	Develop Technology to Characterize Tank Tank Farm Heel Residues	Idaho	25	Characterization
98054	Alternate Waste Removal Techniques	SRS	2 of 20	Retrieval
98063C	Develop Advanced Technology to Improve Safety Infrastructure (Pot Sampler)	SRS	16 of 20	Characterization
1.1.3.3	**Analyze Waste**			
98001	Technetium-99 Analysis in Low Level Waste Feed	Hanford	High	Characterization
98009	Representative Sampling and Associated Analysis to Support Operations and Disposal	Hanford	High	Characterization
98063D	Develop Advanced Techniques to Improve Improve Safety Infrastructure (Monitoring)	SRS	16 of 20	Characterization
1.1.4	**Reduce Waste Volume**			

Table A.2. Continued

PE#	Problem Element Title	Site	Priority	Function
1.1.4.1	**Reduce Source Streams**			
98008	Advanced Methods for Achieving LLW Volume Minimization	Hanford	High	Pretreatment
98031	Technologies to Reduce Generation of or Alternative Treatments for Radioactive Liquid Waste at the ICPP	Idaho	1 of 13	Retrieval
98042	Washable Metal HEPA Filters	Idaho	?	Safety
1.1.4.2	**Reduce Recycle Streams**			
98058	Provide Alternative Processing and/or Concentration Methods for DWPF Recycle Aqueous Streams	SRS	7 of 20	Pretreatment
98073	Volume Reduction and Stabilization of CIF Secondary Salt (NaCl) Liquid Waste	SRS	Unranked	Pretreatment
1.2	**Process Waste**			
1.2.1	**Retrieve Waste**			
1.2.1.1	**Deploy Equipment**			
1.2.1.2	**Mobilize Bulk and Heel Wastes**			
98013E	Establish Retreival Performance Evaluation Criteria (SST Retrieval Enhancements)	Hanford	High	Retrieval
98014	Alternative to Baseline Tank Waste Mixing System	Hanford	Low	Retrieval
98028	Waste Mobilization Enhancement	Hanford	Medium	Retrieval
98038	Remove and Transport Calcine	Idaho	27	Retrieval
98045	Oak Ridge National Laboratory Tank Solid Waste Retrieval	Oak Ridge	1	Retrieval
98046	Oak Ridge National Laboratory Sludge Mixing and Mobilization	Oak Ridge	2	Retrieval
98053	Tank Heel Removal/Closure Technology	SRS	11 of 20	Retrieval
98054	Alternate Waste Removal Techniques	SRS	2 of 20	Retrieval
98069	Alternate Mixer Pumps	SRS	15 of 20	Retrieval
98071A	Evaporator Residual Waste Removal and Closure (Heel Removal)	SRS	12 of 20	Retrieval
1.2.1.4	**Transfer Waste**			
98013D	Establish Retreival Performance Evaluation Criteria (Waste Conditioning for Heel Transfer)	Hanford	High	Pretreatment
98020	Service Integrity Testing of High-Level Waste Tanks and Piping	Hanford	Medium	Safety
98023	Prediction of Solid Phase Formation in Hanford Tank Waste Solutions	Hanford	High	Pretreatment
98045	Oak Ridge National Laboratory Tank Solid Waste Retrieval	Oak Ridge	1	Retrieval
98056	Methods to Unplug Waste Transfer Lines	SRS	13 of 20	Retrieval
98067C	Develop Advanced Techniques for Life Extension of Tanks/Piping (Piping Inspection)	SRS	9 of 20	Safety
1.2.1.5	**Detect and Mitigate Leaks**			
98020	Service Integrity Testing of High-Level Waste Tanks and Piping	Hanford	Medium	Safety
98026	Tank Leak Detection Systems for Underground Single-Shell Waste Storage Tanks (SSTs)	Hanford	High	Safety
98027	Tank Leak Mitigation Systems	Hanford	High	Safety

Table A.2. Continued

PE#	Problem Element Title	Site	Priority	Function
1.2.1.6	**Monitor & Control Retrieval Process**			
98009	Representative Sampling and Associated Analysis to Support Operations and Disposal	Hanford	High	Characterization
98025	Remote Sensing of Gas Retention in HLW Slurries	Hanford	Medium	Safety
98047	Oak Ridge National Laboratory Sludge Mixing and Slurry Transport	Oak Ridge	4	Characterization
98063A	Develop Advanced Techniques to Improve Safety Infrastructure (Ventilation)	SRS	16 of 20	Safety
1.2.1.7	**Integrate Retrieval and Pretreatment Technology Systems**			
98023	Prediction of Solid Phase Formation in Hanford Tank Waste Solutions	Hanford	High	Pretreatment
1.2.1.8	**Mobilize Heel**			
1.2.2	**Pretreat Waste**			
1.2.2.1	**Calcine Waste**			
98032	Process Flowsheet to Calcine Sodium-Bearing Waste	Idaho	3 of 13	Pretreatment
1.2.2.2	**Dissolve Waste**			
98007	Hanford Capsule Initiative (HCI): A Processing Demonstation of Cs/Sr Capsules for Final Disposition	Hanford	Medium	Immobilization
98034	Dissolution of ICPP Calcines	Idaho	21	Pretreatment
1.2.2.3	**Prepare Retrieved Waste for Transfer and Pretreatment**			
98023	Prediction of Solid Phase Formation in Hanford Tank Waste Solutions	Hanford	High	Pretreatment
1.2.2.4	**Clarify Liquid Stream**			
98033	Method to Separate Undissolved Solids from Sodium-Bearing Waste & Dissolve Calcine	Idaho	20	Pretreatment
98048	Oak Ridge National Laboratory Tank Sludge and Supernatant Separations	Oak Ridge	5	Pretreatment
98060	ITP Feed Solution Pretreatment	SRS	4 of 20	Pretreatment
1.2.2.5	**Remove Radionuclides**			
98035	Solvent Extraction and Ion-Exchange to Remove TRU, Sr, Tc, and Cs from ICPP Tank Farm	Idaho	22	Pretreatment
98040	Characterize & Remove RCRA Listed Wastes from High & Low Activity Fractions	Idaho	23	Pretreatment
98057	Second Generation Salt Feed Preparation	SRS	8 of 20	Pretreatment
98060	ITP Feed Solution Pretreatment	SRS	4 of 20	Pretreatment
1.2.2.6	**Integrate Pretreatment and LLW Immobilization Technology Systems**			
1.2.2.7	**Process Sludge**			
98024A	Enhanced Sludge Washing Process Data	Hanford	High	Pretreatment
98024B	Enhanced Sludge Washing Process Data	Hanford	High	Pretreatment
98052	Oak Ridge National Laboratory Tank Sludge and Supernatant Pretreatment	Oak Ridge	8	Pretreatment
98065	Improved Sludge Processing	SRS	20 of 20	Pretreatment
1.2.2.8	**Prepare Pretreated Waste for Immobilization**			
98008	Advanced Methods for Achieving LLW Volume Minimization	Hanford	High	Pretreatment
98041	Denitrate and Solidify High Activity Waste for Transport Immobilization	Idaho	7 of 41	Immobilization

Table A.2. Continued

PE#	Problem Element Title	Site	Priority	Function
98043	Develop Technology for Preconditioning ICPP High-Activity and Low-Activity Wastes	Idaho	-	Pretreatment
98074	Caustic Recovery and Recycle	SRS	Unranked	Pretreatment
1.2.2.9	**Monitor & Control Pretreatment Process**			
1.2.3	**Immobilize Waste**			
1.2.3.1	**Process LLW**			
1.2.3.1.1	**Monitor & Control LLW Immobilization Process**			
1.2.3.1.2	**Prepare LLW Feed**			
1.2.3.1.3	**Immobilize LLW Stream**			
98036	Develop Technology to Stabilize/Solidify ICPP Low-Activity Waste	Idaho	24	Immobilization
98049	Oak Ridge National Laboratory Tank Sludge and Supernatant Immobilization	Oak Ridge	3	Immobilization
1.2.3.1.4	**Treat LLW Offgas**			
1.2.3.1.5	**Dispose of LLW**			
1.2.3.2	**Process HLW**			
1.2.3.2.1	**Monitor & Control HLW Immobilization Process**			
98064	Develop Techniques to Increase DWPF Throughput and Productivity	SRS	5 of 20	Characterization
1.2.3.2.2	**Prepare Secondary Waste from Pretreatment**			
1.2.3.2.3	**Prepare Sludge Feed**			
1.2.3.2.4	**Immobilize HLW Stream**			
98006	Identification and Management of Problem Constituents for HLW Vitrification	Hanford	High	Immobilization
98007	Hanford Capsule Initiative (HCI): A Processing Demonstation of Cs/Sr Capsules for Final Disposition	Hanford	Medium	Immobilization
98037	Develop Technology/Process for the Immobilization of High Activity Waste	Idaho	26	Immobilization
98041	Denitrate and Solidify High Activity Waste for Transport	Idaho	7 of 41	Immobilization
98059	Optimize Melter Glass Chemistry	SRS	6 of 20	Immobilization
98062	Develop Second Generation DWPF Melter	SRS	10 of 20	Immobilization
98070	Develop Remote Technology to Improve DWPF	SRS	17 of 20	Immobilization
1.2.3.2.5	**Treat HLW Offgas**			
1.3	**Store Waste Forms and Close Tanks**			
1.3.1	**Close Tanks**			
1.3.1.1	**Monitor Tank**			
98050A	Oak Ridge National Laboratory Tank Closure	Oak Ridge	7	Closure
98050B	Oak Ridge National Laboratory Tank Closure	Oak Ridge	7	Retrieval
1.3.1.2	**Characterize Heels**			
98002	In-Tank Core Sampling...Off-Riser Capability	Hanford	Low	Characterization
98030	Contaminant Mobility Beneath Tank Farms	Hanford	High	Closure
98039	Develop Technology to Characterize Tank Farm Heel Residues	Idaho	25	Characterization
1.3.1.3	**Define Closure Criteria**			
98013	Establish Retreival Performance Evaluation Criteria	Hanford	High	Closure

Table A.2. Continued

PE#	Problem Element Title	Site	Priority	Function
	98030 Contaminant Mobility Beneath Tank Farms	Hanford	High	Closure
	98071 Evaporator Residual Waste Removal and Closure	SRS	12 of 20	Closure
1.3.1.4	**Treat Supernate in Place**			
1.3.1.5	**Treat Heel in Place**			
1.3.1.6	**Detect Leaks**			
1.3.1.7	**Stabilize Tank for Closure**			
	98021 Cleaning and Decontamination of Hanford Pits	Hanford	High	Retrieval
	98050A Oak Ridge National Laboratory Tank Closure	Oak Ridge	7	Closure
	98050B Oak Ridge National Laboratory Tank Closure	Oak Ridge	7	Retrieval
	98051 Oak Ridge National Laboratory Remediated Tank Isolation and Removal	Oak Ridge	9	Closure
	98071 Evaporator Residual Waste Removal and Closure	SRS	12 of 20	Closure
	98075 In-situ Grouting of Underground Tanks (Formerly Used or the Storage of Radioactive Solvents)	SRS	Not	Closure
1.3.1.8	**Monitor Site**			
1.3.2	**Dispose of LLW**			
1.3.2.1	**Monitor Low Level Waste for Acceptance**			
	98010 ILAW Product Acceptance Inspection and Test Methods	Hanford	High	Immobilization
1.3.2.2	**Determine Performance of Waste Form**			
	98015 Standard Method for Determining Waste Form Release	Hanford	Medium	Immobilization
	98016 Glass Monolith Surface Area	Hanford	High	Immobilization
1.3.2.3	**Provide Disposal System**			
	98017 Long-Term Testing of Surface Barrier	Hanford	Medium	Closure
	98018 Testing of Sand-Gravel Capillary Barrier	Hanford	Low	Closure
	98019 Getter Materials	Hanford	Medium	Closure
	98029A Data and Tools for Performance Assessments (Tools)	Hanford	Medium	Closure
	98029B Data and Tools for Performance Assessments (Data)	Hanford	Medium	Closure
	98030 Contaminant Mobility Beneath Tank Farms	Hanford	High	Closure
	98063B Develop Advanced Techniques to Improve Safety Infrastructure (Leaked Waste)	SRS	16 of 20	Closure
	98066 Alternative DWPF Canister Decontamination	SRS	3 of 20	Immobilization
1.3.3	**Store and Dispose HLW**			
	98068 Demonstrate Remote Disassembly of High Level Waste Melters and Other Processing Equipment	SRS	14 of 20	Immobilization
1.3.3.1	**Provide Interim Storage HLW**			
1.3.3.2	**Provide Shipping Facilities**			
1.3.3.3	**Monitor High Level Waste for Acceptance**			
	98011 IHLW Product Acceptance Inspection and Test Methods	Hanford	Medium	Immobilization
	98012 Secondary Products Acceptance Inspection and Test Methods	Hanford	High	Immobilization

Table A.3. Tanks Focus Area FY 1999 - FY 2000 Priority Listing

TFA Pri	TFA Resp	Technology Title	Benefiting Sites				Notes*
			Han	Idaho	ORR	SRS	
1	*98050A*	*Oak Ridge/SRS Tank Closure*	■	■	■	■	*Addresses part of 98075(S).*
2	*98004*	*DST Corrosion Monitoring*	■		■	■	*Includes 98072A(S), 98044B(O), and part of 98055(S)*
3	*98048*	*Solid-Liquid Separation Demonstration*	■	■	■	■	*Includes 98057 (S) in part.*
4	98067A	Tank Inspection Techniques for Hanford, SRS, ORR	■	■	■	■	Includes 98005(H), 98022(H), 98044B(O). HOLD
5	98050B	Small, Horizontal, Limited Access Tank Retrieval		■	■	■	Addresses 98071A(S). HOLD/PARTIAL HOLD
6	*98045*	*GAAT Retrieval*	■	■	■	■	*Includes 98047(O)*
7	*98059*	*High Activity Waste (HAW) Glass Formulation to Optimize Loading and Manage Problem Constituents for SRS, Hanford, and INEEL*	■	■		■	*Includes 98006(H) and 98037(I)*
8	98057	Alternatives to In-Tank Precipitation	■	■	■	■	Includes 98060(S) and part of 98052(O ASTD). Part of 98057 addressed in 98048(O).
9	*98058*	*DWPF Recycle Treatment*	■	■	■	■	*Includes part of 98052(O ASTD) and all of 98031(I).*
10	*98061*	*Demonstrating Alternative Filtration Technologies to Replace HEPA Filters*		■		■	*Includes 98042(I)*
11	98024B	Hanford and SRS Sludge Scale-up Studies	■			■	Includes 98065(S). Start settle decant only.
12	*98010*	*Waste Form Product Acceptance Testing*	■	■	■	■	*Includes 98011(H), 98015(H)*
13	*98051*	*GAAT Tank Isolation*	■	■	■		
14	*98053*	*Tank Heel Retrieval at SRS*	■		■	■	
15	*98028*	*Hanford/SRS Waste Mixing-Mobilization Enhancement*	■			■	*Includes 98069(S)*
16	*98073*	*CIF Evaporator*		■	■	■	*Includes part of 98052(O ASTD)*
17	*98054*	*Alternate Salt Removal Methods*	■			■	
18	*98023*	*Leachate Chemistry Behavior (Gel, Precipitation, Dissolution)*	■		■	■	
19	*98062*	*Develop Second Generation DWPF Melter*	■	■		■	*Includes part of 98037(I)*
20	*98039*	*LDUA Deployment at Idaho*	■	■	■	■	*Incorporate 98067A problem.*
21	*98056*	*Methods to Unplug Waste Transfer Lines*	■		■	■	
22	*98009*	*Representative Sampling and Associated Analysis*	■			■	*Includes 98003(H)*
23	*98013*	*Hanford Tanks Initiative*	■			■	*Broad Based A(25), B(45), C(60)*
24	*98035*	*Integrated Pilot Testing of TRU-Sr-Tc-Cs Removal Flowsheet*	■	■			*Partially fund only.*
25	98034	Dissolution of ICPP Calcines		■			HOLD
26	*98024A*	*Parametric Studies for Sludge Processing*	■			■	
27	98026	Tank Leak Detection and Mitigation	■			■	Includes 98027(H), 98067B(S). HOLD
28	*98036*	*Develop Technology to Stabilize/Solidify ICPP Low-Activity Waste*		■			
29	*98032*	*Process Flowsheet to Calcine Sodium Bearing Wastes*		■			
30	98063A	Passive Ventilation	■			■	HOLD
31	98030	Contaminant Mobility Beneath Tank Farms	■	■			Talk to Subcon
32	*98049*	*Tank Sludge and Supernatant Immobilization*		■	■		*Rescope*
33	98043	Vapor Equilibruim and Evaporation Studies		■	■		

Table A.3. Continued

TFA Pri	TFA Resp	Technology Title	Benefiting Sites				Notes*
			Han	Idaho	ORR	SRS	
34	98067C	Transfer Line Inspection and Repair for Hanford and SRS	■			■	Includes 98020(H)
35	*98013E*	*C-106 Sluicing Enhancements*	■			▒	*HOLD*
36	98021	Valve Box/Pump Pit Decontamination and Refurbishment	■			▒	
37	98025	Remote Sensing of Gas Retention in HLW Slurries	■			▒	
38	98052	Sludge Technical Studies	▒		■		
39	*98008*	*Sodium Management by Caustic Recycle and Sodium Recovery*	■			■	*Includes 98074(S)*
40	98017	Long-Term Testing of Surface Barriers	■	▒			
41	98019	Radionuclide Getter Materials	■	▒			
42	98066	Alternative DWPF Canister Decontamination Techniques	▒			■	
43	98071B	Evaporator Closure				■	
44	98013F	Enhanced Single Shell Tank Retrieval Methods	■			▒	
45	98020	Service Integrity Testing of Single-Shell Tanks	■			▒	Partly addressed in 98067C(S)
46	*98055*	*In-situ Methods for Characterization of Tank Waste*	▒			■	*Includes 98072B(S)*
47	98016	Glass Monolith Surface Area and Contaminant Release	■			▒	
48	98029A	Tools for Performance Assessment	■				
49	98044A	MVST/BVEST Sludge Mapping			■		
50	98075	In-situ Grouting of Underground Tanks			▒	■	Partly addressed in 98050(O)
51	98063C	Evaporator Pot Sampler				■	
52	98038	Preparations for Removal and Transport of Calcine	▒	■			
53	98068	Demonstrate Remote Disassembly of HLW Melters and Other Processing Equipment	▒	▒		■	
54	98070	Develop Remote Technology to Improve DWPF Operations				■	
55	98064	Develop Technique to Increase DWPF Throughput and Productivity				■	
56	98029B	Data for Performance Assessments	■				
57	98018	Testing of Sand-Gravel Capillary Barrier	■				
58	98063B	Leaked Waste Stabilization				■	
59	98063D	Non-destructive Analysis for Alpha and Beta in Solid Waste Containers				■	
60	98013D	Waste Conditioning for Transfer	■				
61	98007	Hanford Capsule Inititative (HCI): A Processing Demonstration of Cs/Sr Capsules	■				

* After response number, H= Hanford, I = Idaho, O = Oak Ridge, S = SRS

Note: Italicized text = ongoing FY98 task

■ = Primary Benefit
▒ = Secondary Benefit
□ = No benefit or benefit undetermined

Table A.3. Continued

The following technical responses were not prioritized by the TFA. Please see notes column and individual needs descriptions in this appendix.

TFA Pri	TFA Resp	Technology Title	Benefiting Sites				Notes*
			Han	Idaho	ORR	SRS	
N/A	98001	Technetium-99 Analysis in Low Level Waste Feed					Screened out
N/A	98002	In-Tank Core Sampling...Off-Riser Capability					Screened out
N/A	98003	Large Volume (3-5 liter) Sludge and Supernate Sampler					Addressed in 98009(H)
N/A	98005	Remote Inspection of High-Level Waste Single-Shell Tanks					Addressed in 98067A(S)
N/A	98006	Identification and Management of Problem Constituents for HLW Vitrification					Addressed in 98059(S)
N/A	98011	IHLW Product Acceptance Inspection and Test Methods					Addressed in 98010(H)
N/A	98012	Secondary Product Acceptance Inspection and Test Methods					Should be completed with 98001(H) and 98010(H)
N/A	98014	Alternative to Baseline Tank Waste Mixing System					Addressed in 98028(H)
N/A	98015	Standard Method for Determining Waste Form Release Rate					Addressed in 98010(H)
N/A	98022	Tank Knuckle Nondestructive Evaluation (NDE) for Double-Shell Tanks (DSTs)					Addressed in 98067A(S)
N/A	98027	Tank Leak Mitigation Systems					Addressed in 98026(H)
N/A	98031	Technologies to Reduce Amounts of Radioactive Waste Streams					Addressed in 98058(S).
N/A	98033	Methods to Separate Undissolved Solids from Sodium-Bearing Waste & Dissolve Calcine					Screened out
N/A	98037	Develop Technology/Process for the Immobilization of High Activity Waste					Addressed in 98059(S) and 98062(S)
N/A	98040	Characterize & Remove RCRA Listed Waste from High & Low Activity Fractions					Screened out
N/A	98041	Denitrate and Solidify High Activity Waste for Transport					Addressed in 98037(I)
N/A	98042	Washable Metal HEPA Filters					Addressed in 98061(S)
N/A	*98046*	*Final Cleaning of BVEST*					*Withdrawn by site.*
N/A	98047	Oak Ridge National Laboratory Sludge Mixing and Slurry					Addressed in 98045(O)
N/A	98060	Alternatives to In-Tank Precipitation					Addressed in 98057(S)
N/A	98065	Improved Sludge Processing					Addressed in 98024B(H)
N/A	98069	Alternate Mixer Pumps					Addressed in 98028(H)
N/A	98074	Caustic Recovery and Recycle					Addressed in 98008(H)
N/A	98044B	ORNL Tank Waste Characterization (Structural Integrity)					Addressed in 98067A(S)
N/A	98067B	Tank Repair Technology					Included in 98026(H)
N/A	98071A	Evaporator Residual Waste Removal					Included in 98050B(O)
N/A	98072A	In-Tank Corrosion Probe Development					Addressed in 98004(H)
N/A	98072B	In-tank Corrosion Probe Development (Sludge Mapping and Percent Solids)					Addressed in 98055(S)

* After response number, H= Hanford, I = Idaho, O = Oak Ridge, S = SRS

Note: Italicized text = ongoing FY98 task

= Primary Benefit
= Secondary Benefit
= No benefit or benefit undetermined

Appendix A - Acronyms

ALARA	as low as reasonably achievable
ALV	allowable leak volume
ANS	American Nuclear Society
ARA-1	Auxiliary Reactor Area
BDAT	Best Demonstrated Available Technology
BNFL	British Nuclear Fuels, Ltd.
BNL	Brookhaven National Laboratory
BUSS	Beneficial Uses Shipping System
BVEST	Bethel Valley Evaporator Service Tank
CAB	Citizens Advisory Board
CCD	countercurrent decantation
CDC-	cobalt dicarbollide ion
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
CSA	Criticality Safety Analyses
CSSF	Calcine Solids Storage Facility
CST	crystalline silicotitanate
CUF	cells unit filter
CZE	capillary zone electrophoresis
D&D	decontamination and decommissioning
DNFSB	Defense Nuclear Facilities Safety Board
DOE	U.S. Department of Energy
DOE-EM	U.S. Department of Energy's Office of Environmental Management
DOE-HQ	U.S. Department of Energy-Headquarters
DOE-ID	U.S. Department of Energy's Idaho Operations Office
DOE-RL	U.S. Department of Energy's Richland Operations Office
DSC	differential scanning calorimetry
DST	double shell tank
EA	environmental assessment
Ecology	Washington Department of Ecology
EDTA	ethylenediaminetetraacetic acid
EIS	environmental impact statement
EM	Office of Environmental Management
EM-30	Office of Waste Management
EM-50	Office of Science and Technology
EPA	U.S. Environmental Protection Agency
ESP	Extended Sludge Processing

ESP	extended sludge processing
ESP-JIT	extended sludge processing – just-in-time
ESW	enhanced sludge washing
ETF	effluent treatment faciltiy
FFA	Federal Facility Agreement
FFCA	Federal Facility Consent Order
FTE	full-time equivalent
GAAT	Gunite and Associated Tank
GRE	gas release event
HAW	high activity waste
HCI	Hanford Capsule Initiative
HEDTA	N-(2-hydroxyethyl) ethylenediaminetetraacetic acid
HEPA	high-efficiency particulate air
HLW	high-level waste
HPLC	high-performance liquid chromatography
HPLC/MS	high-performance liquid chromatography/mass spectrometer
HTI	Hanford Tanks Initiative
HVAC	heating, ventilation, and air conditioning
IC	ion chromatography
ICP	inductively coupled plasma
ICPP	Idaho Chemical Processing Plant
IHLW	immobilized high level waste
ILAW	immobilized low activity waste
INEEL	Idaho National Engineering and Environmental Laboratory
ISSTRS	initial single-shell tank retrieval system
ITP	in-tank precipitation
ITP/ESP	in-tank precipitation/extended sludge processing
LANL	Los Alamos National Laboratory
LAW	low activity waste
LDMM	leak detection monitoring and mitigation
LDR	land disposal restriction
LDUA	Light Duty Utility Arm
LLNL	Lawrence Livermore National Laboratory
LLW	low level waste
LWF	late wash facility
M&I	management and integration
MCC	materials characterization center
MLDUA	Modified Light Duty Utility Arm

MST	monosodium titanate
MVST	Melton Valley Storage Tank
N/A	not applicable
NDE	non-destructive examination
NRC	U.S. Nuclear Regulatory Commission
NTS	Nevada Test Site
NWCF	New Waste Calcine Facility
OHF	Old Hydrofracture Tank
ORNL	Oak Ridge National Laboratory
ORR	Oak Ridge Reservation
PCB	polychlorinated biphenyl
PCT	product consistency test
PEW	process evaporator waste
PHA	precipitate hydrolysis aqueous
PHMC	Project Hanford Management Contractor
PNNL	Pacific Northwest National Laboratory
PUF	Pressurized Unsaturated Flow
QC	quality control
R&D	research and development
RCRA	Resource Conservation and Recovery Act
REDOX	reduction-oxidation
RFP	Request for Proposal
RH-TRU	remote handled-transuranic (waste)
RI/FS	remedial investigation/feasibility study
RL	U.S. Department of Energy's Richland Operations Office
RSD	relative standard deviation
SBW	sodium bearing waste
SCC	stress corrosion cracking
SCDHEC	South Carolina Department of Health and Environmental Control
SDF	Saltstone Disposal Facility
SLS	solid-liquid separation
SRS	Savannah River Site
SSHT	Salt Solution Hold Tank
SST	single shell tank
STPB	sodium tetraphenylborate
SVOC	semivolatile organic compound
TAN	Test Area North
TCA	trichloroacetic acid

TCE	trichloroethylene
TCLP	toxicity characteristic leach procedure
TFA	Tanks Focus Area
TGA	thermogravimetric analysis
TPA	*Hanford Federal Facility Agreement and Consent Order* (also known as the Tri-Party Agreement)
TPB-	tetraphenylborate ion
TRU	transuranic
TSD	Treatment, Storage and Disposal
TSR	Technical Safety Requirement
TWRS	Tank Waste Remediation System
UST	underground storage tank
VOC	volatile organic compound
WAC	Washington Administrative Code
WAPS	Waste Acceptance Product Specification
WC	water column
WDOE	Washington Department of Ecology
WESF	Waste Encapsulation Storage Facility
WIPP	Waste Isolation Pilot Plant
WSRC	Westinghouse Savannah River Company

Tanks Focus Area Site Needs

Need Title: Technetium-99 Analysis in Low Level Waste Feed

Site: Hanford **TFA Functional Area:** Characterization
TFA Response#: 98001 **Site Need#:** RL-WT01 **Site Priority:** High **PBS#:** RL-TW05

SITE NEED:

Need Description: An accurate, robust production laboratory method for the measurement of technetium-99 concentration in Hanford waste tank material is needed. The measurement methodology needs to be tested for consistency of performance between DOE Sites characterizing waste materials (round robin exchange, etc.). This methodology must also be suitable for characterizing soils from the vadose zone which receives any leakage of tank wastes.

Science: Measurement methodology must be demonstrated acceptable by peer review. This is performed by sample exchange between national laboratories and process control laboratories. The reduction-oxidation potential will be different from tank-to-tank as a result of organic and inorganic components present. Extractions performed to reduce the effects of radiochemical interferences are only effective when the isotope is in the +7 oxidation state. Therefore the measurement methodology must be robust to overcome the matrix reductants and oxidize all oxidations states of technetium to the pertechnetate form.

Functional Performance Requirements: A methodology is needed which is appropriate for production laboratory use to routinely measure the concentration of technetium-99 in waste tank matrices representing any of the waste classifications considered potential feed sources to the vitrification vendors.
1. Candidate methodologies should be tested by round robin exchanges of actual samples selected for variability due to matrix and interferences.
2. Absolute accuracy represented by agreement in the concentration value of better than +/- 10 percent is required.
3. Precision, as measured by the reproducibility of replicate measurements of a sample should be no greater than +/- 15 percent.
4. The methodology demonstrated should be rapid, representing no more than 4 hours to complete.

Schedule Requirements: Waste identification is in progress in 1997, and waste staging for the private vitrification contractor will be initiated by 1999. Therefore the methodology needs to be available in 1998.

Problem Description: An accurate production laboratory method for establishing the technetium-99 concentration in low level waste and vadose zone soils is needed. Technetium-99 concentration is a critical component of feed to the waste vitrification vendors. The absolute accuracy of these analytical results produced at Hanford has been questioned and found to be in disagreement with results produced at another DOE site. Variability of redox potential and interferences present in Hanford tank wastes produces inconsistent performance of sample preparation methods in use. In addition, the method must be applicable to soils which may receive waste material that leak from the tank. Technetium in the +7 oxidation state is known to be mobile in the soil column and therefore the concentration in tank wastes must be known well to estimate long term effects of waste tank leakage during storage or retrieval operations.

Justifications:

Technical Justification: Private vendors will receive low level waste, after being characterized and concentrations of analytes documented. If sensitive analyte concentrations are inaccurately represented, the DOE will be responsible for environmental and process rework caused. Without this interlaboratory testing and acceptance, the liability is likely to remain unresolved.

Regulatory Justification: The technetium-99 concentration in feed streams classified as low level waste is critical since the resulting vitrified product may contain inventory beyond the permitted quantities for on-site disposal.

ES&H Justification: Pertechnetates can be volatilized during processing of waste for vitrification. High concentrations not removed during pretreatment may be disbursed through the gaseous emissions during the vitrification process. Feed to the private vitrification vendor must be properly classified and manifested.

Tanks Focus Area Site Needs

Need Title: Technetium-99 Analysis in Low Level Waste Feed

Site: Hanford **TFA Functional Area:** Characterization
TFA Response#: 98001 **Site Need#:** RL-WT01 **Site Priority:** High **PBS#:** RL-TW05

Leakage during storage or retrieval operations may deposit waste containing technetium-99 into the soils surrounding the tanks. The mobility and long half-life of the isotope makes the concentration value significant for environmental consequences.

Cultural/Stakeholder Factors: Measurement data will have better credibility with the oversight panels when the measurement methodology has been peer reviewed and accepted. Issues concerning emissions from the pretreatment and vitrification processes should be answerable with documented data.

Cost Savings: Potential cost savings are represented by a measurement method that assures the vendor and DOE that a true concentration of the technetium-99 has been measured. Manifests of the waste are accurate and the vendor should not have concern about the DOE supplied concentration data.

Other Justification:

Consequences of Not Filling Need:

Privatization Potential:

Current Base Technology and Cost: Measurement data will have better credibility with the oversight panels when the measurement methodology has been peer reviewed and accepted. Issues concerning emissions from the pretreatment and vitrification processes should be answerable with documented data.

SUMMARY OF TFA RESPONSE:
The TFA screened out this need. After conversations with site personnel, the TFA understands the work to satisfy this need is complete. No technology development component remains. The TFA Response is 98001.

Tanks Focus Area Site Needs

Need Title: In-Tank Core Sampling...Off-Riser Capability

Site: Hanford **TFA Functional Area:** Characterization
TFA Response#: 98002 **Site Need#:** RL-WT02 **Site Priority:** Low **PBS#:** RL-TW04

SITE NEED

Need Description: There is a need to gather data on single shell and double shell tanks, in areas where conventional core sampling is not effective. Data gathered will support both stabilization and retrieval functions.

Functional Performance Requirements: The system developed must be compatible with the current rotary mode, and push mode core sampling systems. It must be used in conjunction with this system, when it is determined that retrieving a core segment has been unsuccessful (probably by using the x-ray imaging system). This system should be able to deploy a sampler horizontally out from the drill string, at the elevation of the failed core segment, and attain a sample that will be representative of that layer, thus filling in the information void which would have been created if NO sample were attained at this location.

Schedule Requirements: Needed by the Characterization Project in FY1999/2000 time frame, to support completion of the sampling needs, required per DNFSB 93-5.

Problem Description: Currently, the truck core sampling systems (i.e., rotary and push mode core trucks) have difficulty in attaining samples, sometimes. If there are sections (layers) of the tank that waste sample material is not available for analysis, critical information may be missing that is necessary to understand the tank contents, and ultimately dispose of the tank contents.

Justifications:

Technical Justification: Proposed work scope would be used to gather critical waste sample data on single shell and double shell tanks. This information is needed to understand their contents sufficiently to retrieve them, and ultimately dispose of them. In areas where the core sampling is ineffective this data will be missing unless an alternative is developed.

Regulatory Justification: This technology will contribute to increasing the amount of tank characterization data, capable of being attained, and thus increase the confidence in the total tank waste inventory.

ES&H Justification: Will establish methods to calculate environmental insult due to tank waste.

Cultural/Stakeholder Factors: Resolution of major stakeholder issue related to tank waste characterization of both the DSTís and the SSTs.

Cost Savings: By increasing the confidence in each core sampling activity, the need to re-do these costly cores decreases. The cost of re-sampling one core is ~$1 million.

Other Justification: N/A

Consequences of Not Filling Need: Costly core sampling activities will have to be re-run, when voids in characterization information are determined.

Privatization Potential: N/A

Current Base Technology and Cost:

SUMMARY OF TFA RESPONSE:

The TFA screened out this need (the TFA Response is 98002). The site need specified performance requirements that are not technicaly achieveable. Other technical responses (98009 and 98013) are already meeting the intent of this need.

TFA Response#: 98001
Site Need#: RL-WT01

Tanks Focus Area Site Needs

Need Title: Large Volume (3-5 liter) Sludge and Supernate Sampler

Site: Hanford **TFA Functional Area:** Characterization
TFA Response#: 98003 **Site Need#:** RL-WT03 **Site Priority:** High **PBS#:** RL-TW05

SITE NEED:

Need Description: There is a need to obtain large quantities of material from the tanks for analysis, and testing, to support pre-treatment, safety, and retrieval. Current Baseline Technology: 125-ml sampler.

Functional Performance Requirements: The system developed must be capable of removing large volumes (~3-5l) of sludge, and/or supernate, from the DST's and the SST's. This system must be compatible with the current sample casks, and supporting transportation, and sample handling systems at Hanford's 222-S Lab.

Schedule Requirements: Needed by the Characterization Project in FY1999/2000 time frame, to support completion of the sampling needs, required per DNFSB 93-5.

Problem Description: There is no system available to aid in attaining large volume sludge, and supernate. The largest volume sampler for this active, currently, is the 125 ml "Bottle-on - a-string."

Justifications:

Technical Justification: Proposed work scope would be used to gather critical waste sludge and supernate samples, for single shell and double shell tanks. This information is needed to understand their contents sufficiently to retrieve them, and ultimately dispose of them.

Regulatory Justification: This technology will contribute to increasing the amount of tank characterization data, capable of being attained, and thus increase the confidence in the total tank waste inventory.

ES&H Justification: Will establish methods to calculate environmental insult due to tank waste.

Cultural/Stakeholder Factors: Resolution of major stakeholder issue related to tank waste characterization of both the DST's and the SSTs.

Cost Savings: By increasing the amount of liquid/solid sampling material, the ability to adequately "characterize" the tanks is improved, greatly.

Other Justification: N/A

Consequences of Not Filling Need: Attaining the large volumes of sludge, and supernate required for the Privatization effort would have to be done using existing "technology", the needs in this area will not be completed., or it will take a longer time, and greater exposure.

Privatization Potential:

Current Base Technology and Cost:

SUMMARY OF TFA RESPONSE:

The TFA did not rate the technical response to this need separately (TFA Response 98003). The TFA intends to satisfy this need through the technical response prepared for Hanford need RL-TW09 (TFA response 98009).

Tanks Focus Area Site Needs

Need Title: DST Corrosion Monitoring

Site: Hanford **TFA Functional Area:** Safety
TFA Response#: 98004 **Site Need#:** RL-WT04 **Site Priority:** High **PBS#:** RL-TW03

SITE NEED:

Need Description: Corrosion monitoring of DSTs is currently provided by process knowledge and tank sampling. Tanks found to be within chemistry specification limits are considered to be not at risk for excessive corrosion damage. There have been no direct corrosion monitoring systems for DSTs in use at the Hanford Site. As many as 6 Double Shell Tanks (DSTs) have recently been identified as low hydroxide (out of corrosion specification). This condition indicates that this system is inadequate to support corrosion control. Tank samples are infrequent and
their analysis difficult and expensive. Process knowledge is complicated by waste streams that are exempt from the corrosion control specifications. In-tank, real-time measurement of the corrosive characteristics of the tank wastes is needed to provide an acceptable level of corrosion control information. This need supports TWRS Program Logic "Conduct Tank Farm Safe Operations" and "Conduct Reduced Mortgage Tank Farm Safe Operations." There is no baseline technology for direct monitoring of corrosion in high level waste tanks.

Programmatic Risks: A prototype corrosion probe was installed in 241-AZ-101 in fiscal year 1996. A second generation probe was installed in 241-AN-107 in fiscal year 1997. The successful deployment of these probes demonstrate that the successful use of this technology is not in question.

Connection to TWRS Logic: This need supports TWRS Program Logic "Conduct Tank Farm Safe Operations" and "Conduct Reduced Mortgage Tank Farm Safe Operations."

Functional Performance Requirements: Identify the onset of stress corrosion cracking.
Identify the onset of pitting.
Order of magnitude quantification of mass loss during pitting and cracking.
Quantification of uniform corrosion rates.

Schedule Requirements: Work is to be performed in fiscal years 1998 through 2000.

Problem Description: Corrosion control of high level waste DSTs is currently provided by concentration limits on hydroxide, nitrite, and nitrate. Monitoring of the chemistry is provided by tank samples and process knowledge. As many as 6 DSTs at Hanford have operated outside of corrosion chemistry limits in the past 2 years. Detection and remediation of these low hydroxide tanks has been slow and costly.

Available technology for corrosion monitoring has progressed to a point where it is now feasible to monitor and control corrosion by on-line monitoring of the corrosion process and direct addition of corrosion inhibitors. The potential benefits of a corrosion monitoring system include:

1. Safer operation and reduced risk of tank liner failure. Corrosion will be monitored directly, versus monitoring chemical species. Assumptions about tank waste homogeneity and accuracy of the corrosion chemistry specification will be reduced or removed.

2. Significant potential for cost reduction: More than $100K in unplanned work scope at Hanford in fiscal year 1996 and 1997 on sampling and analysis to determine the extent of out of specification conditions.

3. Increased tank life due to more rapid identification and resolution of off-normal conditions.

4. Avoidance of unnecessary chemical additions due to unknown corrosion conditions: More than 10,000 gallons of waste volume added to the tanks at Hanford through fiscal year 1996 and 1997 through unscheduled sodium hydroxide additions. Direct monitoring of the actual tank corrosion conditions may have shown these additions to be unnecessary.

5. Possible cost savings over time as a result of the relaxation of corrosion inhibitor addition requirements as corrosion behavior becomes better understood. Each metric ton of sodium addition avoided (as sodium hydroxide corrosion inhibitor) will save approximately $1,000,000 in low level waste vitrification costs.

Justifications:

Technical Justification: Real time corrosion monitoring has been selected for preliminary evaluation at the Hanford Site. The use of such a system in Hanford waste tanks would allow for real-time monitoring of both corrosion processes and corrosion inhibitor addition. Real-time data collection would facilitate identification of the precise time when a corrosion process begins to occur in a tank. This, coupled with corrosion rate information also generated, would help in determining the extent of design life lost due to degradation by abnormal corrosion conditions.
Similarly, real-time corrosion monitoring during inhibitor addition would allow one to observe corrosion conditions return to an acceptable level. Therefore, unnecessary inhibitor addition could be eliminated. The current system cannot offer this capability.

Available techniques offer the ability to distinguish between uniform corrosion, stress corrosion cracking, pitting, and other forms of localized corrosion as they occur. They also generate uniform corrosion rate data identical to what is currently derived from chemical sampling. Some available corrosion monitoring techniques using electrical resistance probes or linear polarization resistance probes are not capable of distinguishing between uniform and localized forms of corrosion. These would not be considered acceptable. The most likely cause of failure in DSTs is degradation due to some form of localized corrosion.

Regulatory Justification: Washington Administrative Code 173-303-640(2)(c)(iii) requires consideration of existing corrosion protection when performing tank system integrity assessments. On-line corrosion monitoring will provide an acceptable performance measurement of current corrosion protection measures and early warning of potentially corrosive conditions.

DOE Order 5820.2A, Radioactive Waste Management, requires monitoring of cathodic protection systems, methods for periodically assessing waste storage system integrity, and adjustment of waste chemistry to control corrosion.

DOE-STD-1073-93, Configuration Management, requires implementation of a Material Condition and Aging Management Program to control aging processes in major equipment and components. The primary aging processes in waste tank systems are corrosion related.

DOE/RL-92-60, Tank Waste Remediation System Functions and Requirements contains corrosion control requirements for the Store Waste (F4.2.1.1) and Transfer Waste (F4.2.4.4) functions.

ES&H Justification: WHC-SD-WM-OSR-005, Single-Shell Tank Interim Operational Safety Requirements, WHC-SD-WM-OSR-004, Aging Waste Facility Interim Operational Safety Requirements, and WHC-SD-WM-OSR-016, Double- Shell Tank Interim Operational Safety Requirements. These support documents contain interim operational safety requirement - administrative controls for corrosion control, cathodic protection, and integrity assessments. Implementation of these administrative controls necessitates corrosion control activities.

WHC-SD-WM-PLN-068, TWRS Life Management Program Plan, identifies stress corrosion cracking, pitting corrosion, and uniform corrosion as the primary aging mechanisms for DSTs. On-line monitoring of DSTs for these mechanisms will provide necessary data for damage prediction models being developed for the DST Life Management Program.

Tanks Focus Area
Site Needs

Need Title: DST Corrosion Monitoring

Site: Hanford **TFA Functional Area:** Safety
TFA Response#: 98004 **Site Need#:** RL-WT04 **Site Priority:** High **PBS#:** RL-TW03

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.

Cultural/Stakeholder Factors: N/A

Cost Savings: Mortgage Reduction - Estimated Total Life Cycle Cost (TLCC) for wastes added to the DST system is $100 per gallon. Avoidance of the 30,000 gallons of chemicals added in fiscal years 1994-1996 would produce $3,000,000 TLCC savings.

Cost Avoidance - Avoid premature replacement of DSTs. Replacement cost estimated by the Multi-Function Waste Tank Facility Project was $67,000,000 per tank.

Cost Avoidance - Remove $50,000 sampling cost for each corrosion sample avoided. This would also free the sampling crew and equipment to take more urgent samples (safety screening, outsourcing, etc.)

Other Justification: N/A

Consequences of Not Filling Need: Regulatory Impacts: The Hanford Operations contractor has previously entered into negotiations with the Washington State Department of Ecology (WDOE) for determination of acceptable compliance with WAC 173-303-640. Completion of this activity was a part of the negotiations. Failure to complete this activity might be construed by WDOE as failure to comply with WAC legal requirements and failure to negotiate compliance in good faith.

Programmatic Impacts: Corrosion control of double shell tanks is currently provided by process knowledge and tank sampling. The continued operation of 4 low hydroxide (out of corrosion specification) tanks indicates that this system is inadequate to support corrosion control. Tank samples are infrequent and their analysis difficult and expensive. Process knowledge is complicated by waste streams that are exempt from the corrosion control specifications. In-line, real-time measurement of the corrosive characteristics of the tank wastes will augment the current system to provide an acceptable level of corrosion control information to satisfy the programmatic drivers above.

Privatization Potential: Modified commercial technology could be marketed back to the private sector. Several commercial vendors are available who could provide "turn-key" equipment for deployment at Hanford.

Current Base Technology and Cost:

SUMMARY OF TFA RESPONSE:
The TFA tentatively rated the priority of the technical response to this need as #2 (TFA Response 98004). The TFA is providing funding in FY98 and proposes to provide funding in FY99-FY01, given available funding. The TFA intends to satisfy the additional following needs within this technical response:
- ORR TK-01, TFA technical response 98044B
- Part of SRS SR-2918, technical response TFA 98055
- SRS SR-2919, TFA technical response 98072A

Tanks Focus Area Site Needs

Need Title: Remote Inspection of High-Level Waste Single Shell Tanks

Site: Hanford **TFA Functional Area:** Safety
TFA Response#: 98005 **Site Need#:** RL-WT05 **Site Priority:** Medium **PBS#:** RL-TW04

SITE NEED:

Need Description: The Tri Party Agreement (TPA) schedule requires retrieval of wastes in the Single Shell Tanks (SSTs) to begin by 2004 for future vitrification and permanent storage in a waste repository. In order to meet this schedule, a retrieval method needs to be selected to retrieve the waste for processing. A Non-Destructive Examination (NDE) of the tank needs to be performed prior to the selection of a retrieval method to assure successful retrieval of the waste from the tank.

Programmatic Risks: There is an unknown, but undoubtedly high probability that some SSTs will leak when sluiced. If leakage volumes are unacceptably large, there will be high costs and lengthy delays to switch to another waste retrieval technology.

Connection to TWRS Logic: This need supports TWRS Program Logic "Develop SST Retrieval Methods and Requirements."

Functional Performance Requirements: There are two categories of flaws to consider, non through-wall and through-wall. Non through-wall (partial penetration) needs to be evaluated to estimate the time to wall penetration. Through-wall flaws need to be evaluated to determine the potential for tank rupture and estimate rates of leaks that may occur in the future and assess appropriate actions.

Acceptance criteria for NDE has the following allowable flaw sizes:
- Through- wall crack length- 12"
- Maximum allowable crack depth- 3/16"
- Thinnest allowable wall section- 0.8t (where t is the original thickness) and
- Maximum allowable pit depth- 0.5t

The selected remote inspection method needs to be demonstrated in a SST with very little waste. Leakage rates from detected through-wall cracks have to be estimated to assess sluicing feasibility of the SST's.

Schedule Requirements: Functional systems must be deployed prior to December 31, 2000 in order to successfully meet the TPA schedule for retrieval of wastes from the SSTs to begin by 2004.

Problem Description: Initially, SSTs that have little or no waste need to be selected for NDE of the tank wall and floor. If necessary, destructive metallurgical examination of small isolated sections of the SSTs may need to be performed to obtain a thorough understanding of the operating corrosion mechanisms. The number and size of the cracks that led to the leakage of wastes for the leaking SSTs need to be determined. Waste leakage rates should be estimated based on the defect information, and the acceptability of sluicing for retrieval operations
needs to be evaluated for each selected SST.

In order to be able to meet the TPA SST waste retrieval schedule, initially only one tank from a group of tanks containing similar wastes should be studied. The retrieval decision made for this one tank should be extended to remaining tanks in the group.

Every effort should be made to perform the examination with a remote device such as the Light duty Utility Arm (LDUA) or similar robotic equipment to more efficiently minimize costs. The potential benefits of NDE evaluation (and possible destructive evaluation of some of the SSTs) include:
- Determination of feasibility of sluicing as a waste retrieval method for the SSTs.
- Prioritization of tanks for waste retrieval and processing.

Tanks Focus Area Site Needs

Need Title: Remote Inspection of High-Level Waste Single Shell Tanks

Site: Hanford **TFA Functional Area:** Safety

TFA Response#: 98005 **Site Need#:** RL-WT05 **Site Priority:** Medium **PBS#:** RL-TW04

Justifications:

Technical Justification: Sluicing is the baseline approach for SST retrieval. As such, it is necessary to know early on whether or not it is feasible to use this method.

Regulatory Justification: Washington Administrative Code 173-303-640 requires consideration of existing corrosion protection when performing tank system integrity assessments.

DOE-STD-1073-93, Configuration Management, requires implementation of a Material Condition and Aging Management Program to control aging processes in major equipment and components. The primary aging processes in waste tank systems are corrosion related.

DOE/RL-92-60, Tank Waste Remediation System Functions and Requirements contains corrosion control requirements for the Store Waste (F4.2.1.1) and Transfer Waste (F4.2.4.4) functions.

ES&H Justification: WHC-SD-WM-OSR-005, Single-Shell Tank Interim Operational Safety Requirements, WHC-SD-WM-OSR-004, Aging Waste Facility Interim Operational Safety Requirements. These support documents contain interim operational safety requirement - administrative controls for corrosion control, cathodic protection, and integrity assessments. Implementation of these administrative controls necessitates corrosion control activities.

WHC-SD-WM-PLN-068, TWRS Life Management Program Plan, identifies stress corrosion cracking, pitting corrosion, and uniform corrosion as the primary aging mechanisms for DSTs.

BNL/DOE-HQ Tank Structural Integrity Panel, Guidelines for Development of Structural Integrity Programs for DOE High-Level Waste Storage Tanks - DRAFT, discusses the important role of corrosion monitoring in the context of a comprehensive structural integrity program.

Cultural/Stakeholder Factors: N/A

Cost Savings: Determination of the integrity of SSTs prior to retrieval will avoid the use of more costly retrieval techniques.

Other Justification: N/A

Consequences of Not Filling Need: Regulatory Impacts: The U. S. DOE has previously entered into a TPA commitment with the Washington State Department of Ecology (WDOE) and the U. S. Environmental Protection Agency to begin retrieval of SST wastes by the year 2004. Completion of this activity was a part of the negotiations. Failure to complete this activity might be construed by WDOE as failure to comply with TPA commitments, WAC legal requirements, and failure to negotiate in good faith.

Programmatic Impacts: Sluicing is considered to be one of the primary methods to retrieve waste from the SSTs. It is possible that sluicing may not be a viable method for retrieval of some SSTs due to the extensive corrosion experienced by some of the tanks. Therefore, it is important to initiate tank inspection to rule out sluicing at an early stage in order to have adequate time to pursue other retrieval methods prior to the 2004 deadline to initiate retrieval of SST wastes.

Privatization Potential: Remote inspection capabilities developed at Hanford could be returned to the private sector.

Current Base Technology and Cost:

Tanks Focus Area Site Needs

Need Title: Remote Inspection of High-Level Waste Single Shell Tanks

Site: Hanford **TFA Functional Area:** Safety
TFA Response#: 98005 **Site Need#:** RL-WT05 **Site Priority:** Medium **PBS#:** RL-TW04

SUMMARY OF TFA RESPONSE:
The TFA did not rate the technical response to this need separately (TFA Response 98005). The TFA intends to satisfy this need through the technical response prepared for SRS need SR-2909 (TFA response 98067A).

Tanks Focus Area Site Needs

Need Title: Identification and Management of Problem Constituents for HLW Vitrification

Site: Hanford **TFA Functional Area:** Immobilization
TFA Response#: 98006 **Site Need#:** RL-WT06 **Site Priority:** High **PBS#:** RL-TW05

SITE NEED:

Need Description: Currently, HLW glasses are formulated to assure that little or no insoluble phases exist in the HLW melter. Insoluble phases are caused by such problem constituents as chrome minerals, spinels, and noble metals. An alternative method for handling problem constituents in HLW glasses is needed. The volume of HLW glass that will be produced from the sludges at Hanford is dependent on the ability to solubilize or dilute problem constituents that make up a very small fraction of the overall waste. Minimizing the impact of the problem
constituents is important for formulating a strategy and staging the wastes to be treated during the Phase II outsourcing effort. Diluting the problem constituents usually involves blending of waste types and/or increasing the volume of glass waste forms. Alternatively, separations of problem constituents is an option. All of these alternatives are expensive.

Information is needed on the technical viability of producing HLW glasses with insoluble phases. Information such as settling rates and rheological properties is needed for insoluble phases to determine if the phases will settle in a HLW melter and, if so, whether the settled sludge can be discharged through a bottom drain or by other means. Information is also needed to determine the impact of the insoluble phases on the durability of the waste form. Ultimately, new HLW glass formulations can be produced that reduce the overall glass volume for various waste types and reduce the blending requirements at Hanford. Based on the results of this study, the cost and risk of producing waste forms with
insoluble phases will have to be compared with other options such as blending or diluting to determine the best path forward. This information is needed to formulate a strategy for the Phase II outsourcing effort at Hanford. This includes waste blending requirements for the DOE, waste volume minimization requirements for the contractors, and overall contracting strategy.

Functional Performance Requirements: Based on current HLW feed processability reports, identify physical (particle size, particle morphology, and settling rate) and chemical (composition and crystalline structure) characteristics for insoluble phases in HLW glass formulations with high waste loadings. If applicable, determine the physical characteristics of settled layers of insoluble particles (sludges). Evaluate the methods for removing the settled sludge layers either continuously or periodically. Evaluate the processability of the new glass formulations.

Schedule Requirements: This effort needs to be completed in FY 2001 to support trade studies which will be completed in FY 2002 in the Phase 2 RFP Planning.

Problem Description:

Justifications:

Technical Justification: Data from testing will be used to support the RFP generation for Phase 2 of the TWRS Outsourcing Effort.

Regulatory Justification: Regulators agree that DOE should move ahead according to Tri-Party Agreement. RCRA generally requires waste minimization.

ES&H Justification:

Cultural/Stakeholder Factors: A representative of Hanford's Site Technology Coordination Group has registered a suggestion to minimize High Activity or High Level Waste be balanced with minimization of on-site disposal of LAW.

Cost Savings: This is an area of potential high return-on- investment.

Tanks Focus Area Site Needs

Need Title: Identification and Management of Problem Constituents for HLW Vitrification

Site: Hanford **TFA Functional Area:** Immobilization

TFA Response#: 98006 **Site Need#:** RL-WT06 **Site Priority:** High **PBS#:** RL-TW05

Other Justification: None.

Consequences of Not Filling Need: Implementation of baselines demonstrated in Phase 1 and accepting the strategy of relying on the Private sector to make long term technology investments for Phase 2 with private monies.

Privatization Potential: High.

Current Base Technology and Cost:

SUMMARY OF TFA RESPONSE:
The TFA did not rate the technical response to this need separately (TFA Response 98006). The TFA intends to satisfy this need through the technical response prepared for SRS need SR-2906 (TFA response 98059).

TFA Response#: 98006
Site Need#: RL-WT06

Tanks Focus Area Site Needs

Need Title: Hanford Capsule Initiative (HCI): A Processing Demonstation of Cs/SR Capsules for Final Disposition

Site: Hanford **TFA Functional Area:** Immobilization

TFA Response#: 98007 **Site Need#:** RL-WT07 **Site Priority:** Medium **PBS#:** RL-TW09

SITE NEED:

Need Description: To develop and demonstrate a concept for disassembling and processing the cesium and strontium capsules that will condition the halide salts for blending with other HLW feeds prior to vitrification. The effort is required to ensure the vitrification of capsule contents can be performed safely and efficiently.

Waste: Shredded metal alloy - one drum of remote-handled solid waste. Inorganic resin - one drum of slightly radioactive resin. Liquid waste from the decontamination of hot-cell equipment. How Long It Will Take: The expected duration of this development is 2 years.

Functional Performance Requirements: Using previous experience with the disassembly and processing of capsule contents, develop and demonstrate a concept that provides for the remote disassembly of a capsule. The processes needed include:
- removal of the capsule contents
- separation of the capsule contents them from the encapsulating materials
- pulverize the SrF2 and transport it as slurry to a holding tank
- dissolution of CsCl and removal of the chlorides.

All operations must be performed reliably and without excessively contaminating the surrounding hot cell. The HCI will be performed in two phases. The first phase will be focussed on process development and cold testing and will be performed at Hanford. The second phase will be a hot small-scale demonstration of the process at the Savannah River Site, using capsules currently stored in Hanford's 300 Area and SRS's vitrification capabilities.

Schedule Requirements: A proven concept is required by 2008 to enable it to be incorporated into the design of a private HLW vitrification facility at Hanford.

Problem Description: The disassembly of these capsules is a messy operation that results in gross contamination of a hot cell. There is a need to develop and demonstrate methods for performing the disassembly without creating a significant contamination problem. The demonstration of a remote disassembly concept will make vitrification more acceptable as the final disposition of these capsules, and will provide sufficient confidence in the process so that requirements for capsule processing can be included in the outsourcing work scope.

Justifications:

Technical Justification: Past experience with the disassembly of capsules is that the process results in the significant contamination of equipment and facilities. Contamination is a significant issue with the vitrification of the capsule contents. However, the vitrification option is attractive because it: 1) eliminates the repository disposal fee, i.e., blending the capsule contents with other HLW feeds does not increase the overall volume of vitrified product; and 2) the vitrified waste form is much more acceptable to the public than the soluble salt.

Regulatory Justification: Decontamination of a hot cell and disassembly equipment, as well as the encapsulating materials and offgasses, will create effluents. The disposition of those effluents has to be identified and described in a permit. The concept can be tested outside of a hot cell using non-hazardous materials. If the cold demonstration is successful, the hot demonstration will create only minor contamination issues.

ES&H Justification: The hot demonstration will require the transport of capsules from Hanford to the Savannah River Site. The current Safety Analysis Reports for the Beneficial Uses Shipping System (BUSS) cask is in place.

Tanks Focus Area Site Needs

Need Title: Hanford Capsule Initiative (HCI): A Processing Demonstation of Cs/SR Capsules for Final Disposition

Site: Hanford **TFA Functional Area:** Immobilization

TFA Response#: 98007 **Site Need#:** RL-WT07 **Site Priority:** Medium **PBS#:** RL-TW09

Cultural/Stakeholder Factors: This effort would be viewed positively by all stakeholders in that it enables further cleanup at Hanford to proceed.

Cost Savings: The A-Cell in Hanford's 324 Building is currently unusable for other missions, since it is being used to store waste and products from the Federal Republic of Germany (FRD) program. The cell cannot be decontaminated until the capsules are removed from the hot cells. In their current configuration the capsules cannot be returned to the WESF their contents are repackaged. This initiative would allow the cell to be decontaminated without the need to repackage the capsules.

Other Justification:

Consequences of Not Filling Need: If this need is not filled, then the closure of Hanford's 324 Building will wait until the capsules can be repackaged and returned to the WESF for indefinite storage, or an alternative solution is found. Insufficient data will be available for inclusion in the Phase II outsourcing RFP; vendors may be unable or unwilling to respond to this part of the RFP.

Privatization Potential: The results of this effort will be privatized if Hanford follows through on its concept of HLW outsourcing.

Current Base Technology and Cost: $5 million for development, cold testing and hot demonstration

SUMMARY OF TFA RESPONSE:
The TFA tentatively rated the priority of the technical response to this need as #61 (TFA Response 98007). The TFA proposes to provide funding in FY99-01, given available funding.

Tanks Focus Area Site Needs

Need Title: Advanced Methods for Achieving LLW Volume Minimization

Site: Hanford **TFA Functional Area:** Pretreatment
TFA Response#: 98008 **Site Need#:** RL-WT08 **Site Priority:** High **PBS#:** RL-TW05

SITE NEED:

Need Description: There is a need to minimize the volume of the low-level waste. This is both prudent from an overall cost standpoint as well as a requirement when dealing with any RCRA waste. More specifically, there is a need to develop and demonstrate a concept for significant reduction in the volume of low level waste. The current technical baseline has yet-to-be-defined incentives for low level waste minimization.

Functional Performance Requirements: The approach should be definitized enough to provide a suitable basis for scale up to Phase II production scale and allow a detailed engineering, business, and environmental evaluations of the approach for Phase II. The low-level waste minimization should be cost effective on a life-cycle cost basis.

Schedule Requirements: This effort needs to be completed in FY 2001 to support trade studies which will be completed in FY 2002 in the Phase 2 RFP Planning (Multi-Year Work Plan Schedule Identification Number H2343) and subsequent RFP completion and bid evaluation.

Problem Description: Currently, the amount of tank waste is so large that enormous quantities of immobilized low activity waste will be generated and require appropriate low level waste disposal. By removal of essentially non radioactive constituents from the waste by innovative chemical processes, the volume of low level waste requiring disposal can be significantly reduced.

Justifications:

Technical Justification: This effort is required to ensure that reasonable incentives for LLW minimization are developed so that they can be included in the Phase II RFP. This effort will also provide a technical basis for a fair cost estimate as well as for writing a meaningful RFP for Phase II.

Regulatory Justification: Waste minimization is recommended for RCRA wastes.

ES&H Justification: Improvements in each of these areas will result from many fewer disposal vaults needing to be built, and filled. The volume of waste will be reduced, and some of the hazardous constituents such as nitrate will be destroyed to a considerable extent, thus reducing the source term for long term environmental impact. Disposal of secondary waste streams must be addressed as part of potential life-cycle cost savings.

Cultural/Stakeholder Factors: LLW minimization has the potential to minimize land use for on site disposal of LLW.

Cost Savings: A significant cost avoidance (Hundreds of Millions of Dollars) is expected if DOE is armed with information that allows a more precise RFP to be written and a realistic knowledge of Phase II costs with which to evaluate vendors' proposals.

Other Justification: The byproducts of the waste minimization activity could be useful either in pursuing the cleanup at Hanford, other DOE sites, or for non-DOE application. Examples could include materials for road construction, facility decommissioning, and site closure.

Consequences of Not Filling Need: DOE will lack the data needed to tighten specifications over the current baseline for Tank Waste Treatment in the Phase 2 RFP. Breakthrough technologies that save the government money may not be demonstrated and available in Phase 2 unless industry chooses to make investments in long-term technology testing.

Privatization Potential: This area is targeted for outsourcing if proven beneficial.

Current Base Technology and Cost:

Tanks Focus Area Site Needs

Need Title: Advanced Methods for Achieving LLW Volume Minimization

Site: Hanford **TFA Functional Area:** Pretreatment

TFA Response#: 98008 **Site Need#:** RL-WT08 **Site Priority:** High **PBS#:** RL-TW05

SUMMARY OF TFA RESPONSE:

The TFA tentatively rated the priority of the technical response to this need as #39 (TFA Response 98008). The TFA is providing funding in FY98 and proposes to provide funding in FY99-01, given available funding. The TFA intends to satisfy the following need within this technical response: SRS-2923 (TFA Response 98074).

Tanks Focus Area Site Needs

Need Title: Representative Sampling and Associated Analysis to Support Operations and Disposal

Site: Hanford **TFA Functional Area:** Characterization
TFA Response#: 98009 **Site Need#:** RL-WT09 **Site Priority:** High **PBS#:** RL-TW04

SITE NEED:

Need Description: To develop and demonstrate a concept for taking representative samples and associated rapid analysis of feeds which are to be staged for cross site transfer or are to be staged as feed for the Outsourcing Contractors. Feed for Outsourcing Phase I immobilization demonstrations must be shown to be within the RFP feed envelope A, B, and C specifications. To accomplish this, the intermediate waste feed staging tank contents must be sampled while being mixed for transfer to the Private Contractors feed staging tank. A variable depth sampling system is needed that can be operated in conjunction with the active mixing system to certify that the tank contents meet the specified waste envelopes. (Reference: "Alternatives Generation and Analysis for the Phase I Intermediate Waste Feed Staging System Design Requirements, WHC-SD-TWR-AGA-001, Rev.0). Current plans for feed staging tank sampling and analysis involve trying to mix the waste and take "bottle on the string" or other grab samples followed by analysis in the 222-S Laboratory. It takes weeks or even months to analyze a tank of waste. Related Technology Needs/Opportunities Statement: "Real Time Waste Property Measurement System for Waste Transfer."

Functional Performance Requirements: The sampling and analytical capabilities should be able to provide representative samples and measure the parameters needed to support successful cross site transfers and needed as specified in the Outsourcing Contract for envelopes A, B, and C and envelope D. The Outsourcing Phase 1 supernate solutions to be sampled are targeted to be dilute slurry/supernate solutions with a maximum of 5% solids by volume. The samples will be drawn form the tank with a lift distance of up to 50 ft. The system to be provided will need to be deployed using existing spare tank penetrations or be installed into an existing process pit located in the tank farm. The sampling system shall provide required support subsystems as necessary to meet safety and operational requirements. The feed needs to be sampled and analyzed for these activities consistent with ALARA principles.

Schedule Requirements: The cross site transfer line from Tank 102-SY will be operational in FY 1998; this sampling and analysis capability would be beneficially employed anytime thereafter. To support the outsourcing this method needs to be developed by 3/99 so that the LLW plan update can incorporate this method in FY 1999, and these methods can be installed in FY 2000, feed staging can begin in FY 2001, and delivery of feed to the Outsourcing Contractors' feed tanks can occur prior to hot start-up in FY 2002.

Problem Description: A representative, and preferably also rapid, sampling and analysis system has to be developed and demonstrated so that feeds to the cross site transfer line and to both the LLW and HLW Outsourcing Contractors can be staged successfully with a minimum impact on tank space. Current grab samplers consisting of "bottle-on-a-string" are used for slurry/supernate sampling. This system of sampling has been found to be cross contaminated with material from higher elevations above the desired sample depth as it is withdrawn from the tank.
Although this cross contamination is proportional, it could skew the sample results. Also, this method cannot be performed during active mixing system operation, therefore allowing time for in-tank stratification to be re-established before the sampling can be performed. The sampling is a manual operation performed thorough an existing riser using a portable "glove bag" for containment control that has potential for personal contamination and exposure. With Hanford's existing capabilities it takes weeks or even months to sample and analyze a tank.

As the disposal program activities involving 200 Area waste retrieval and outsourcing proceed, Hanford will need the capability to sample and analyze much more rapidly in order to ensure that DOE provides feeds in accordance with its outsourcing contracts and with a minimum use of tank space. Representative sampling involving potentially non homogeneous waste feed is definitely needed. Long sample and analysis times will cause operations to tie up tanks until analytical results are available to determine how the waste should be staged. Quicker sample/analytical responses will provide more flexibility to the tank system.

Possible concept: On-line sampling and analysis could satisfy this need. AEA has developed the capability of obtaining representative samples of slurries of waste with a fluidics sampling pump, and this concept is being

adapted for Savannah River Site waste tank use. If this device were combined with on-line analytical methods, this need could be satisfied.

Justifications:

Technical Justification: This effort is required to ensure that feed is delivered to the cross site transfer line and to Outsourcing Contractors in a timely manner with the use of minimum double shell tank space. This activity will seek improved sampling systems that support ALARA goals and can be operated at variable depths while the DST mixing system is operating.

Regulatory Justification: Will enable waste transfer/transport between separately permitted RCRA TSD facilities.

ES&H Justification: Using on-line instrumentation will reduce the exposure of personnel during taking of the samples in the field and analysis the samples in the laboratory. This will also help in avoiding plugged cross site transfer lines, and the increased exposure of personnel in taking the necessary actions to clear the plugging. The transportation of samples to the 222-S Analytical Lab would be avoided.

Cultural/Stakeholder Factors: N/A

Cost Savings: Set up time for sampling would be reduced and less personnel exposure will result in a cost reduction from current levels. A significant cost savings associated with the manpower to both take and analyze the samples would be achieved if an on-line instrument was developed. The cost of taking and analyzing samples currently is on the order of $400K - $500K per sample. In the future as more tanks are being retrieved, more cross-site transfers will need to be made with less elapsed staging time to avoid the need for additional cross site transfer lines and additional staging tanks. The at-tank farm sampling will also reduce the need for additional sample transportation casks, vehicles, and staff, and reduce the need for additional analytical laboratory facilities and staff.

Other Justification: The Office of Science and Technology, EM-50, has funded the transfer of some non radioactive demonstrations of the sampling technology using power fluidics, and has developed the laser ablation mass spectrometer and installed a prototype unit in the 222-S Analytical laboratory in late FY 1996. These technologies could be integrated in a demonstration relevant to the feed staging applications identified.

Consequences of Not Filling Need: Greater risk of plugging the cross site transfer lines; increased delay in making transfers; possible slippage of retrieval schedules. Outsourcing Contractors' feed may not be delivered by DOE on schedule agreed to in the contract and DOE will be forced to pay the Outsourcing Contractors for idle facilities. PHMC staff will experience greater radiation exposure both in the field taking samples by current methods, and in the analytical laboratory handling the additional samples. Less accurate grab samples will be used which may result in feed that doesn't initially meet specifications (i.e., requires rework prior to transfer to the Private Contractors feed staging tank).

Privatization Potential: The representative sampler could be supplied and possibly also installed by AEA Technology, or possibly BNFL, or possibly Numatec or SGN Systems, or the Russians since this technology or variations thereof have been used by these foreign organizations in their waste management and waste processing activities. A laser ablation mass spectrometer has been developed by Pacific Northwest National Laboratory under EM-50 funding; this work could be made available with suitable contractual arrangements for outsourcing. The sample distribution manifold system is available through British Columbia Research Inc., a Canadian technology development firm. The measurement of rheological properties associated with the representative samples would need to be made with analyzer equipment commercially available and adapted to the sample distribution manifold system. The analysis requirements would be different for the feed staging for the cross site transfer where the emphasis would be on ensuring pumpability through the cross site transfer pipe

and waste compatibility of what is being transferred versus what is in the receiver tank. On the other hand, for the requirements for the intermediate feed staging tanks for outsourcing, the emphasis is to ensure the tank contents complies with the desired feed envelope: A, B, or C for supernatants, and envelope D for sludges.

Current Base Technology and Cost:

SUMMARY OF TFA RESPONSE:
The TFA tentatively rated the priority of the technical response to this need as #22 (TFA Response 98009). The TFA is providing funding in FY98 and proposes to provide funding in FY99-00, given available funding. The TFA intends to satisfy the following need within this technical response: Hanford - RL-WT03 (TFA Response 98003).

Tanks Focus Area Site Needs

Need Title: ILAW Product Acceptance Inspection and Test Methods

Site: Hanford **TFA Functional Area:** Immobilization

TFA Response#: 98010 **Site Need#:** RL-WT010 **Site Priority:** High **PBS#:** RL-TW06

SITE NEED:

Need Description: The United States Department of Energy (DOE), Richland Operations Office (RL) is proceeding with a two-phased approach to privatize the treatment and immobilization of Hanford's low-activity and high-level wastes currently in storage in underground tanks. DOE will provide the tank wastes to the private contractors who will treat and immobilize the wastes and then return the final products to DOE for storage and final disposal. Acceptance of the immobilized wastes may be based on a combination of private contractor activities to
qualify, verify, document, and certify the product and DOE activities to audit, review, inspect, and test the processes and products.

The immobilization contractors will provide to DOE the immobilized low-activity waste (ILAW) products in sealed containers, process and product grab samples, and the appropriate product certification which may include pertinent process data. The DOE may conduct non-destructive testing of the sealed immobilized waste containers and destructive and non-destructive testing of the process and product samples. Specific parameters of interest may include chemical composition of the waste forms, fillers, and containers phase composition radiochemical composition thermal history and surface temperature waste form volume and void space waste form and container weight container dimensions including wall thickness effectiveness of container closure or seal (leak tightness) presence of prohibited materials including free liquids and explosive, pyrophoric or combustible materials dose rate surface contamination waste form homogeneity waste form release rates. The ILAW is expected to be a glass, ceramic, or metal waste form in a 1.2 m x 1.2 m x 1.8 m rectangular metal box.

Generally, the inspection and test methods should not require opening or otherwise breaching the seal of the waste form containers. The appropriate sampling and analysis strategies should provide the basis for making statistically based statements with respect to the confidence with which the products meet specifications. The inspection and test methods must be shown to be relevant to the expected performance parameters of the ILAW.

Functional Performance Requirements: Demonstrate non-destructive examination techniques on full-scale prototypic ILAW waste packages. Techniques must have the required sensitivity, precision, and accuracy to make decisions regarding the acceptability of the products. Techniques must have reliability for application in production type environment.

Schedule Requirements: Early indications of the adequacy of the inspection and test methods is needed early as input to product acceptance strategy revisions, Phase 1B contract negotiations, and inspection facility design. Inspection and test methods must be selected by September 2000 such that operating procedures can be prepared and implemented. Inspection operations will begin in June 2002.

Problem Description: Non-destructive examination techniques are currently being used at commercial and DOE operated disposal facilities to verify that packaged wastes meet acceptance criteria. Radiography, including real-time radiography, digital radiography, and X-ray computed tomography, is used to identify gross inhomogeneities and free liquids within waste containers. Gamma spectroscopy is a common technique for determining the concentration of gamma-emitting radionuclides (60Co, 137Cs, 152Eu, and 154Eu) within a waste drum. Passive/active neutron assay is used to determine the quantity of neutron-emitting and fissile material in waste packages. It is used to differentiate between LLW and TRU wastes. Application of these techniques to the larger ILAW boxes and more dense glass waste forms proposed for the current low-activity waste will need to be demonstrated. Other nondestructive techniques such as eddy current methods, and ultrasonic techniques may have application to the inspection of waste containers and their contents. Acoustics and optics based measuring devices are commercially available and would need to be adapted for measuring package dimensions.

Tanks Focus Area Site Needs

Need Title: ILAW Product Acceptance Inspection and Test Methods

Site: Hanford **TFA Functional Area:** Immobilization
TFA Response#: 98010 **Site Need#:** RL-WT010 **Site Priority:** High **PBS#:** RL-TW06

Justifications:

Technical Justification: Product acceptance inspection and test results will provide part of basis for justifying payment to private contractors. Methods must be technically defensible in case of litigation.

Regulatory Justification: DOE Order 5820.2A requires that waste generators and waste receivers are jointly responsible for assuring compliance with waste acceptance criteria. Adequate product inspections and tests will probably be required to receive a Part-B permit from the Department of Ecology.

ES&H Justification: The ILAW product specifications were developed in part to protect the safety of operators and to protect the environment. Failure to detect non-conforming products could lead to adverse environmental, safety and health impacts.

Cultural/Stakeholder Factors: Stakeholders continue to have concerns for the storage and disposal of radioactive wastes at Hanford.

Cost Savings: Reduces risk of incurring cost in the future for remediating results of failure of waste packages previously accepted as meeting specifications.

Other Justification:

Consequences of Not Filling Need: Potential increases for inadequate waste package slipping through acceptance process and later failing, causing safety and environmental impacts. Technically undefensible inspection and test techniques could lead to losses should payments to private contractors be contested in courts.

Privatization Potential: High. Private companies have systems that can be adapted to Hanford applications.

Current Base Technology and Cost:

SUMMARY OF TFA RESPONSE:
The TFA tentatively rated the priority of the technical response to this need as #12 (TFA Response 98010). The TFA is providing funding in FY98 and proposes to provide funding in FY99-01, given available funding. The TFA intends to satisfy the following need within this technical response: Hanford - RL-WT011 (TFA Response 98011) and Hanford - RL-WT015 (TFA Response 98015).

Tanks Focus Area Site Needs

Need Title: IHLW Product Acceptance Inspection and Test Methods

Site: Hanford **TFA Functional Area:** Immobilization
TFA Response#: 98011 **Site Need#:** RL-WT011 **Site Priority:** Medium **PBS#:** RL-TW09

SITE NEED:

Need Description: The United States Department of Energy (DOE), Richland Operations Office (RL) is proceeding with a two-phased approach to privatize the treatment and immobilization of Hanford's low-activity and high-level wastes currently in storage in underground tanks. DOE will provide the tank wastes to the private contractors who will treat and immobilize the wastes and then return the final products to DOE for storage and final disposal. Acceptance of the immobilized wastes may be based on a combination of private contractor activities to
qualify, verify, document, and certify the product and DOE activities to audit, review, inspect, and test the processes and products.

The immobilization contractors will provide to DOE the immobilized high-level waste (IHLW) products in sealed canisters, process and product grab samples, and the appropriate product certification which may include pertinent process data. The DOE may conduct non-destructive testing of the sealed immobilized high-level waste canisters and destructive and non-destructive testing of the process and product samples. Specific parameters of interest may include chemical composition of the waste forms, fillers, and containers, phase composition, radiochemical composition, thermal history and surface temperature, waste form volume and void space, waste form and container weight, container dimensions including wall thickness, effectiveness of container closure or seal (leak tightness), presence of prohibited materials including free liquids and explosive, pyrophoric or combustible materials, dose rate, surface contamination, waste form homogeneity, and waste form release rates. The IHLW product is expected to be a glass waste form in a 61-cm diameter by 3- to 5-m long
cylindrical stainless steel canister.

Generally, the inspection and test methods should not require opening or otherwise breaching the seal of the waste form containers. The appropriate sampling and analysis strategies should provide the basis for making statistically based statements with respect to the confidence with which the products meet specifications. The inspection and test methods must be shown to be relevant to the expected performance parameters of the IHLW.

Functional Performance Requirements: Demonstrate non-destructive examination techniques on full-scale prototypic IHLW waste packages. Techniques must have the required sensitivity, precision, and accuracy to make decisions regarding the acceptability of the products. Techniques must have reliability for application in production type environment.

Schedule Requirements: Early indications of the adequacy of the inspection and test methods is needed early as input to product acceptance strategy revisions, Phase 1B contract negotiations, and inspection facility design. Inspection and test methods must be selected by September 2000 such that operating procedures can be prepared and implemented. Inspection operations will begin in June 2002.

Problem Description: Non-destructive examination techniques are currently being used at commercial and DOE operated LLW and TRU disposal facilities to verify that packaged wastes meet acceptance criteria. Radiography, including real-time radiography, digital radiography, and X-ray computed tomography, is used to identify gross inhomogeneities and free liquids within waste containers. Gamma spectroscopy is a common technique for determining the concentration of gamma-emitting radionuclides (60Co, 137Cs, 152Eu, and 154Eu) within a waste drum.
Passive/active neutron assay is used to determine the quantity of neutron-emitting and fissile material in waste packages. It is used to differentiate between LLW and TRU wastes. Application of these techniques to the more radioactive and more dense IHLW glass waste forms will need to be demonstrated. Other nondestructive techniques such as eddy current methods, and ultrasonic techniques may have application to the inspection of waste containers and their contents. Acoustics and optics based measuring devices are commercially available and would need to be adapted for measuring IHLW canister dimensions.

Tanks Focus Area Site Needs

Need Title: IHLW Product Acceptance Inspection and Test Methods

Site: Hanford **TFA Functional Area:** Immobilization
TFA Response#: 98011 **Site Need#:** RL-WT011 **Site Priority:** Medium **PBS#:** RL-TW09

Justifications:

Technical Justification: Product acceptance inspection and test results will provide part of basis for justifying payment to private contractors. Methods must be technically defensible in case of litigation.

Regulatory Justification: The immobilized high-level waste product must be acceptable for disposal at a federal HLW geologic repository. As such, the IHLW must meet the repository product specifications and quality assurance requirements.

ES&H Justification: The IHLW product specifications were developed in part to protect the safety of operators and to protect the environment. Failure to detect non-conforming products could lead to adverse environmental, safety and health impacts.

Cultural/Stakeholder Factors: Stakeholders continue to have concerns for the storage and disposal of radioactive wastes at Hanford.

Cost Savings: Reduces risk of incurring cost in the future for remediating results of failure of waste packages previously accepted as meeting specifications.

Other Justification: N/A

Consequences of Not Filling Need: Potential increases for inadequate IHLW canisters slipping through acceptance process and later failing, causing safety and environmental impacts. Technically indefensible inspection and test techniques could lead to losses should payments to private contractors be contested in courts.

Privatization Potential: High. Private companies have systems that can be adapted to Hanford applications.

Current Base Technology and Cost:

SUMMARY OF TFA RESPONSE:
The TFA did not rate the technical response to this need separately (TFA Response 98011). The TFA intends to satisfy this need through the technical response prepared for Hanford need RL-TW010 (TFA response 98010).

Tanks Focus Area Site Needs

Need Title: Secondary Products Acceptance Inspection and Test Methods

Site: Hanford **TFA Functional Area:** Immobilization

TFA Response#: 98012 **Site Need#:** RL-WT012 **Site Priority:** High **PBS#:** RL-TW05

SITE NEED:

Need Description: The United States Department of Energy (DOE), Richland Operations Office (RL) is proceeding with a two-phased approach to privatize the treatment and immobilization of Hanford's low-activity and high-level wastes currently in storage in underground tanks. DOE will provide the tank wastes to the private contractors who will treat and immobilize the wastes and then return the final products to DOE for storage and final disposal. The private contractors are to separate entrained solids, 137Cs, 99Tc, 90Sr, and TRU from the
low-activity waste stream for later immobilization as HLW. Acceptance of the secondary waste products may be based on a combination of private contractor activities to qualify, verify, document, and certify the products and DOE activities to audit, review, inspect, and test the processes and products.

The private contractors will provide to DOE the secondary waste products as liquids or solids depending on the specifications and the appropriate product certification which may include pertinent process data. The DOE may conduct destructive and non-destructive testing of the process and product samples. Specific parameters of interest may include:

- chemical composition of the secondary waste products
- radiochemical composition
- thermal history and surface temperature of secondary waste containers
- weight and/or volume of secondary product
- container dimensions including wall thickness
- effectiveness of container closure or seal (leak tightness)
- presence of prohibited materials including free liquids and explosive, pyrophoric or combustible materials
- dose rate
- surface contamination
- flow properties of liquid secondary waste products.

The separated 137cesium product will be a dry, free flowing product in a container with a 50-year storage capability. The entrained solids, 90strontium, transuranics, and 99technetium will be in a liquid or slurry form with the technetium a distinctly separate product stream.

Generally, the inspection and test methods should not require opening or otherwise breaching the seal of the separated 137cesium product containers. In-tank or in-pipeline inspection and test methods may be needed for the liquid wastes. The appropriate sampling and analysis strategies should provide the basis for making statistically based statements with respect to the confidence with which the products meet specifications.

Functional Performance Requirements: Demonstrate destructive and non-destructive examination techniques and chemical and radiochemical analysis techniques for inspecting and testing expected secondary waste products. Techniques must have the required sensitivity, precision, and accuracy to make decisions regarding the acceptability of the products. Techniques must have reliability for application in
production type environment.

Schedule Requirements: Early indications of the adequacy of the inspection and test methods is needed early as input to product acceptance strategy revisions, Phase 1B contract negotiations, and inspection facility design. Inspection and test methods must be selected by September 2000 such that operating procedures can be prepared and implemented. Inspection operations will begin in June 2002.

Problem Description: Chemical and radiochemical analytical techniques must be demonstrated to have the required sensitivity, precision, and accuracy to characterize the composition and radionuclide content of the entrained solids, 137Cs ,99Tc, 90Sr, and TRU waste products. Techniques to verify that the solutions and slurries can be safely transported via cask or pipeline. Non-destructive techniques are needed to confirm that separated 137Cs waste product and its container meet the specifications for those materials.

Tanks Focus Area Site Needs

Need Title: Secondary Products Acceptance Inspection and Test Methods

Site: Hanford **TFA Functional Area:** Immobilization

TFA Response#: 98012 **Site Need#:** RL-WT012 **Site Priority:** High **PBS#:** RL-TW05

Justifications:

Technical Justification: Product acceptance inspection and test results will provide part of basis for justifying payment to private contractors. Methods must be technically defensible in case of litigation.

Regulatory Justification: DOE Order 5820.2A requires that waste generators and waste receivers are jointly responsible for assuring compliance with waste acceptance criteria. Adequate product inspections and tests will probably be required to receive a Part-B permit from the Department of Ecology.

ES&H Justification: The secondary waste product specifications were developed in part to protect the safety of operators and to protect the environment. Failure to detect non-conforming products could lead to adverse environmental, safety and health impacts.

Cultural/Stakeholder Factors: Stakeholders continue to have concerns for the storage and disposal of radioactive wastes at Hanford.

Cost Savings: Reduces risk of incurring cost in the future for remediating results of failure of secondary waste products previously accepted as meeting specifications.

Other Justification: N/A

Consequences of Not Filling Need: Potential increases for inadequate secondary waste products slipping through acceptance process and upsetting later HLW immobilization, causing cost, safety, and environmental impacts. Technically indefensible inspection and test techniques could lead to losses should payments to private contractors be contested in courts.

Privatization Potential: High - Private companies have systems that can be adapted to Hanford applications.

Current Base Technology and Cost:

SUMMARY OF TFA RESPONSE:
The TFA did not rate the technical response to this need separately (TFA Response 98012). The TFA intends to satisfy this need through the technical response prepared for Hanford need RL-TW01 (TFA Response 98001) which is already complete, and need RL-TW010 (TFA response 98010).

Tanks Focus Area Site Needs

Need Title: Establish Retreival Performance Evaluation Criteria

Site: Hanford **TFA Functional Area:** Closure

TFA Response#: 98013, D, E, F **Site Need#:** RL-WT013 **Site Priority:** High **PBS#:** RL-TW04

SITE NEED:

Need Description: The Tri-Party Agreement (TPA) establishes an interim retrieval performance goal to leave no more than 360 cubic feet of waste in 75 foot diameter SSTs, and no more than 30 cubic feet in 20 foot diameter SSTs. This interim goal is intended to be finalized or modified over time based on demonstrations of retrieval technology, and on evaluation of cost, technical practicability, exposure of workers and public to radiation, and compliance with Nuclear Regulatory Commission requirements that will establish authority to regulate disposal of the radioactive component of residual waste.

A principal function of waste retrieval is to remove sufficient waste from tanks to permit tank closure. The TWRS EIS evaluated environmental impacts associated with retrieval of waste from SSTs using technologies that are expected to leave residual volumes of waste approximating the interim TPA retrieval performance goal. If residual waste must be retrieved from SSTs as part of closure operations, environmental impacts of such waste retrieval, including impacts on tank waste processing, have not been evaluated.

An additional aspect of establishing retrieval performance objectives concerns the amount of leakage of tank waste that would be allowable during retrieval operations. The amount of leakage that would be allowable depends on what will be done to remediate soil as a consequence of such leakage. Thus determination of allowable tank leakage during retrieval is related to and dependent on criteria for closing tank farms.

Evaluation of alternatives for tank farm closure, which would include evaluation of environmental impacts associated with retrieval of waste to the degree required for "clean closure" was not included within the scope of the TWRS EIS. The TWRS EIS stated that "sufficient information is not available to make final decisions on closure." The TWRS EIS states that the Hanford Tanks Initiative would "gather information and reduce uncertainties associated with tank closure" and that "information that would be gathered through the Hanford Tanks Initiative would be used to establish processes and criteria for future closure options."

In a report summarizing its review of the TWRS EIS, the Committee on Remediation of Buried and Tank Wastes, National Research Council, criticized DOE's and Ecology's decision to defer analysis of closure alternatives, because of the interrelationship of retrieval and closure. The Committee endorsed DOE's decision to address issues on retrieval and closure through the Hanford Tanks Initiative.

Several discrete technology needs must be satisfied to support decisions for tank closure alternatives. These needs include improvements to equipment and methods for tank heel removal, conditioning of wastes to slurries acceptable for transport, techniques to measure the residual waste volume following retrieval efforts, methods to capture samples of waste that are not directly below the riser, and methods to map contaminants in the vadose zone. These needs are expanded in the following paragraphs.

Need Title: Vadose Zone Contaminants Distribution

Needs Description: Alternative technologies to conventional core drilling for characterization of the vadose zone that are fast, economical and minimize intrusion to the vadose zone are needed. These technologies should: 1) quantify (i.e., 3-D map) the extent of contaminants leaked to the tank backfill material and vadose zone in tank farms; ;and 2) obtain soil samples at selected depths for confirmatory laboratory analysis. The technology must be capable to detect metal pipes and obstructions. The sampled soil column must be sealed (i.e., grouted) to eliminate any potential pathway for contaminant leakage to the aquifer. Technology to verify the quantity and extent of contaminants leaked to the vadose zone in tank farms will reduce the uncertainty associated with estimates of radionuclide and chemical inventory, which are vital input data to the performance assessment model(s) proposed for tank farms closure.

Tanks Focus Area Site Needs

Need Title: Establish Retreival Performance Evaluation Criteria

Site: Hanford **TFA Functional Area:** Closure

TFA Response#: 98013, D, E, F **Site Need#:** RL-WT013 **Site Priority:** High **PBS#:** RL-TW04

Need Title: SST Retrieval Equipment/System Development

Need Description: Performance and cost data comparing alternate and enhanced retrieval methods to the performance baseline of past-practice sluicing is needed. Data will be applied to the selection of retrieval systems for 1)Tank C-106 Heel Removal, 2) M&I retrieval of SSTs during Privatization Phase I, 3) ISSTRS concept design technical input to the Privatization Phase II specification (TPA Milestone M-45-04A) and 5) performance assessment for SST closure. Supports maintaining core competency by providing expertise in the application of retrieval tools, regardless of the implementor.

Need Title: Waste Conditioning for Tank Heel Transfer

Need Description: The affects of the physical and chemical properties of waste on pipeline transfer, interim storage and subsequent transfer to pretreatment processed needs to be better understood so that waste conditioning requirements can be determined before any Single Shell Tank hard heels (including the tank 106-C heel) can be safely and efficiently transferred to a storage tank for later processing.

Need Title: Methods For Waste Heel Volume Determination Including Thickness and Profile

Need Description: Methods are needed to accurately determine the volume of residual waste in a tank for use in a tank closure assessment. Surface profile and heel thickness are needed to determine waste volume in tanks with unknown tank bottom flatness.

Functional Performance Requirements: Estimated requirement is (+/-) 40 cu. ft. (10% op 360 cu. ft. -- target residual) (Will be negotiated based on available cost-effective technology/methodology).

Need Title: Sampling Methods For Residual Heels - Off Riser Axis

Need Description: Methods are needed to sample the residual waste in a tank for use in establishing retrieval performance evaluation criteria. Conventional sampling methods can prove ineffective due to little or no waste being located directly below the access riser. In addition, enough locations in the tank need to be sampled to show adequate characterization of residual waste for use in tank specific performance assessment work.

Functional Performance Requirements:

Schedule Requirements: Completion of definition of retrieval performance objectives is needed by FY 2000 so that the results can be incorporated into the Outsourcing Phase II specification due to be completed in FY2003 and the first Single Shell Tank Closure Plan, due to be completed by November, 2004 (TPA M-45-06-T01).

Problem Description: Other than the retrieval performance goal provided in the Tri-Party Agreement, which is recognized by the Washington Department of Ecology and DOE in a memorandum of understanding as only an "interim" goal, no basis currently exists for defining retrieval performance objectives that address how much waste must be removed from SSTs and how much leakage during retrieval of SSTs will be allowable.

Justifications:

Technical Justification: This effort is required to establish retrieval system performance requirements relating to how much waste must be removed from SSTs, and how much waste may leak from SSTs during retrieval operations.

Tanks Focus Area Site Needs

Need Title: Establish Retreival Performance Evaluation Criteria

Site: Hanford **TFA Functional Area:** Closure

TFA Response#: 98013, D, E, F **Site Need#:** RL-WT013 **Site Priority:** High **PBS#:** RL-TW04

Regulatory Justification: Analyses completed as part of the effort to address this technology need will serve as the basis for reaching agreement with regulatory agencies on establishing retrieval performance objectives and criteria for closure of Hanford SSTs.

ES&H Justification: Health and safety risks to workers and members of the public associated with alternatives for closing tank farms will be evaluated as part of the effort to address this technology need.

Cultural/Stakeholder Factors: The Washington Department of Ecology and DOE have signed a memorandum of understanding that commits to establishing retrieval performance objectives, as part of the effort to address this technology need, through soliciting input from Indian Nations and stakeholders, through interaction with the Hanford Advisory Board, Community Leaders Network, and the Site Technology Coordinating Group.

Cost Savings: A significant cost avoidance is expected if DOE can reduce uncertainty in the degree of waste removal required for waste retrieval operations and in limiting leakage during retrieval. Reduction of uncertainty in waste retrieval performance requirements will lead to lower contingency factors included in Outsourcing Phase II proposals. In addition, early establishment of retrieval performance objectives will reduce the risk that retrieval systems will need to be deployed a second time in a given SST, after a final retrieval performance goal is established, for SSTs that are retrieved by the PHMC contractor during Phase I Outsourcing.

Other Justification: N/A

Consequences of Not Filling Need: Establishing retrieval system performance objectives based solely on what is technologically achievable, without regard to practicality, cost, and health and safety risk, could lead to inappropriate allocation of site cleanup funds. Deferring establishment of retrieval performance objectives will increase contingency in Phase 2 Outsourcing proposals for retrieval of SST wastes, and will increase the likelihood of requiring multiple deployments of SST retrieval systems by the PHMC contractors during Phase 1 Outsourcing.

Privatization Potential: Retrieval system performance specifications will be provided to the Phase 2 Outsourcing Contractor.

Current Base Technology and Cost:

SUMMARY OF TFA RESPONSE:
The TFA separated this comprehensive need into four parts. The first part responds to the Hanford Tanks Initiative (HTI) requirements. The TFA tentatively rated the priority of the technical response (TFA Response 98013) to these requirements need as #23. The TFA is providing funding in FY98 and proposes to provide funding in FY99-FY00, given available funding.

The second part consists of the TFA's Response 98013D to requirements for Waste Conditioning and Transfer. The TFA tentatively rated the priority of the technical response to this need as #60. This requirement will be partly addressed in the TFA's response to SRS need SR-2913 (TFA Response 98056).

The third part consists of the TFA's Response 98013E to requirements for C-106 Sluicing Enhancements. The TFA tentatively rated the priority of the technical response to this need as #35, and proposes to provide funding in FY99, given available funding.

The fourth part consists of the TFA's Response 98013F to requirements for Enhanced Single Shell Tank Retrieval Methods. The TFA tentatively rated the priority of the technical response to this need as #44, and proposes to provide funding in FY99-01, given available funding

Tanks Focus Area Site Needs

Need Title: Alternative to Baseline Tank Waste Mixing System

Site: Hanford **TFA Functional Area:** Retrieval
TFA Response#: 98014 **Site Need#:** RL-WT014 **Site Priority:** Low **PBS#:** RL-TW04

SITE NEED:

Need Description: Mixing system to homogenize and dilute slurry/supernate waste to support the following objectives: mobilization of settled solids heels; enhance and/or accelerate the dissolution of precipitated soluble salts; homogenize stratified waste layers; mobilization of problematic solids for removal from intermediate feed staging tanks; and to provide the capability to recover from receiving out of specification waste. Feed for Outsourcing Phase I Immobilization Demonstrations must be certified to comply with RFP waste envelope requirements. To accomplish this, the intermediate feed staging tanks contents must be well mixed before being sampled and transferred to the Privatization Phase contractors.

Functional Performance Requirements: The waste solution to be mixed will be a dilute slurry/supernate with a maximum of 5% solids by volume. The system shall be capable of homogenizing dilute slurry/supernate and removing approximately 95% of settled solids heel from the tank. Proposed system will be installed into existing tank penetrations. System may be deployed into tanks currently storing wastes.

Schedule Requirements: Needed for Phase I feed beginning in FY 2000.

Problem Description: Baseline mixing systems are designed for sludge mobilization. Historically, such mixing systems used at other DOE sites have had a short expected operational life. This situation has led to high Life Cycle Costs related to removal and disposal costs. The system to be proposed should provide equipment that has a high reliability for the environment that it will operate in and also have an improved operational life expectancy.

Justifications:

Technical Justification: This activity will identify systems that more closely fit the demands of the mixing operation while providing the needed mobilization capabilities. The proposed system shall provide enhanced reliability.

Regulatory Justification: Will support certification of the waste that is to be transferred to the Phase I Privatization Contractor for immobilization.

ES&H Justification: Less required replacement of failed equipment is ALARA.

Cultural/Stakeholder Factors: N/A

Cost Savings: Less expensive mixer systems. Fewer equipment failure requiring replacement and disposal of failed equipment and reduce personnel exposure related to removing and reinstallation of equipment.

Other Justification: N/A

Consequences of Not Filling Need: Baseline mixing systems with lower reliability will be used with higher life cycle costs.

Privatization Potential: This task will show where industry has the capabilities to perform now and the potential for mobilization and retrieval success under Privatization Phase II.

Current Base Technology and Cost:

SUMMARY OF TFA RESPONSE:

The TFA did not rate the technical response to this need separately (TFA Response 98014). The TFA intends to satisfy this need through the technical response prepared for Hanford need RL-TW028 (TFA response 98028).

TFA Response#: 98014
Site Need#: RL-WT014

Tanks Focus Area Site Needs

Need Title: Standard Method for Determining Waste Form Release Rate

Site: Hanford **TFA Functional Area:** Immobilization

TFA Response#: 98015 **Site Need#:** RL-WT015 **Site Priority:** Medium **PBS#:** RL-TW09

SITE NEED:

Need Description: The release of radionuclides from a waste form and package to the environment results from the interactions between the waste form and water in the disposal system. For the disposal of immobilized low-activity tank waste (ILAW), the waste form and package are expected to be in an extremely dry environment. In such an environment, the release rate is a sensitive function of physical (temperature, water content) and chemical environment (pH, amount and type of mineral and non-mineral species).

Waste forms are typically developed to minimize the rate of release as measured by a variety of test methods. Current ILAW product specifications require PCT testing and ANS 16.1 testing of the waste forms which involve testing the waste form in an environment where water is abundant and where chemical effects are minimized. These test methods will not be representative of the expected disposal system environment at Hanford. A release rate test method yielding results that can be related to the waste form release rate under expected service conditions is needed as a basis for Phase 2 ILAW product specifications.

Tests are also used to determine release data for use in the analysis for the assurance that long-term public health and safety will be protected using the proposed disposal method. Such tests must examine a wider set of environmental conditions that product acceptance tests and will form the basis of the Performance Assessment for the disposal action. As shown in the "Hanford Low-Level Tank Waste Interim Performance Assessment" (WHC-EP-0884), the contaminant release rate from the waste form is one of the few major factors in the assurance of public health and safety.

As part of the performance activity, the Pressurized Unsaturated Flow (PUF) test was developed (Proceedings of the American Ceramic Society and of Materials Research Society) by the Pacific Northwest National Laboratory to obtain contaminant release rates from waste form under dry conditions.

Functional Performance Requirements: 1) Develop and standardize a waste form release rate method applicable to dry environments. The effort should compare results from this method to others.
2) Conduct sufficient tests (under a variety of geochemical and hydraulic conditions and using a variety of waste forms) to provide data to form a basis for Phase 2 waste form release rate specification.
3) Coordinate efforts with Hanford Low-Level Tank Waste Performance Assessment to ensure that environmental conditions are typical of Hanford.

Schedule Requirements: 1) For use in the Hanford Low-Level Tank Waste Performance Assessments such data and testing are needed by February 2001. Preliminary versions of the performance assessments will need data by January 1999.
2) A standard method for determining waste form release rate and supporting data is needed to prepare the ILAW product specifications for Phase 2 of the TWRS outsourcing beginning in approximately 2003.

Problem Description: Develop a standard waste form release rate test method that is relevant to expected performance in the disposal environment and that can be used as a ILAW product specification. The test should be accepted by a standards test organization such as the ASTM.

The test method must provide usable results within a 90-day time period such that the compliance of the waste form to the product specifications can be confirmed and payment to the private contractor authorized. The test method will be implemented in a production environment.

The test method must be suitable over a range of temperatures (T = 14 to 90oC), moisture conditions (_ = 0.1 to 1.0), and pH (ph = 6.0 to 12.0) conditions for use in performance assessment activities.

Tanks Focus Area Site Needs

Need Title: Standard Method for Determining Waste Form Release Rate

Site: Hanford **TFA Functional Area:** Immobilization

TFA Response#: 98015 **Site Need#:** RL-WT015 **Site Priority:** Medium **PBS#:** RL-TW09

Justifications:

Technical Justification: Numerous test methods including the MCC test, PCT, and ANS 16.1 have been used to determine waste form release rates. Current methods for measuring release rates from a waste form do not mimic the conditions that the waste form will experience in the disposal environment. A standardized test is needed.

Regulatory Justification: DOE Order 5820.2a requires that waste acceptance criteria address chemical and structural stability of waste packages. The same order requires an assessment of long-term public health and safety. Contaminant release rates are an important input to this assessment.

ES&H Justification: The long-term contaminant release rate is the driving factor in determining human health and environmental impact from the disposal of the low-activity fraction of the Hanford tank waste.

Cultural/Stakeholder Factors: Stakeholders are interested in the parameters which drive environmental impact rather than the parameters that are specified in a contract and only have a weak relationship to real-life performance.

Cost Savings: A better understanding of long-term release might allow DOE to relax requirements for the short-term testing now required under the outsourcing contract. A more relevant test method could lead to product specifications that are easier to achieve and perhaps to simpler disposal system designs.

Other Justification:

Consequences of Not Filling Need: Without data for long-term tests under expected conditions, the performance assessment will use conservative parameters which would require DOE to set tighter requirements on immobilization product vendors or on disposal facility design. Inadequate specification of release rates could lead to future environmental impacts.

Privatization Potential: Uses of glass as a waste form are in unsaturated media. Having a more suitable, standardized test would be of significant value in the DOE complex as well as in private industry.

Current Base Technology and Cost:

SUMMARY OF TFA RESPONSE:
The TFA did not rate the technical response to this need separately (TFA Response 98015). The TFA intends to satisfy this need through the technical response prepared for Hanford need RL-TW010 (TFA response 98010).

Tanks Focus Area Site Needs

Need Title: Glass Monolith Surface Area

Site: Hanford **TFA Functional Area:** Immobilization
TFA Response#: 98016 **Site Need#:** RL-WT016 **Site Priority:** High **PBS#:** RL-TW09

SITE NEED:

Need Description: A method is needed to estimate the surface area of vitrified low activity waste. The contaminant release rate from glasses is proportional to the surface area reachable by moving moisture. As glass cools it experiences internal stresses and strains which may cause the glass to crack and hence increase the surface area on the glass. External stresses (for example, those caused by earthquakes) could also increase surface area.

In addition, cracks may expose imperfections in waste form (internal gas pockets, nucleation sites, devitrification regions) which may cause increased contaminant release rates. Relatively little is known about the long-term behavior of such cracks. Yet, the total contaminant release must be known (or at least estimated) for thousands of years.

Functional Performance Requirements: For typical low-level waste glass monoliths using a variety of sizes and cooling methods:
1) Determine surface area and crack patterns.
2) Determine area reachable by moisture.
3) Accelerate aging and repeat measurements.
4) Determine unsaturated hydraulic properties of fractured and aged specimens.

Schedule Requirements: For use in the Hanford Low-Level Tank Waste Performance Assessments such data and testing are needed by September 2000. Preliminary versions of the performance assessments will need data by September 1998.

Problem Description: Status of technology for measurement and aging not known.

Justifications:

Technical Justification: Contaminant release from the waste form is proportional to the surface area reachable by moving moisture. This release rate determines the impact from waste disposal using very slow-release waste forms.

Regulatory Justification: Contaminant release rates are an important input the performance assessment which is required under DOE Order 5820.2A (soon to be codified under 10 CFR 834).

ES&H Justification: The long-term contaminant release rate is the driving factor in determining human health and environmental impact from the disposal of the low-activity fraction of the Hanford tank waste.

Cultural/Stakeholder Factors: Stakeholders are interested in the parameters which drive environmental impact rather than the parameters that are specified in a contract and only have a weak relationship to real-life performance.

Cost Savings: A better understanding of long-term release might allow DOE to relax requirements for the short-term testing now required under the outsourcing contract. Possible cost savings could be in the hundred's of millions of dollars.

Other Justification:

Consequences of Not Filling Need: Without data, the performance assessment will use conservative parameters which would require DOE to set tighter requirements on immobilization product vendors or on disposal facility design, thus increasing costs. Better definition of contaminant release will lead to a performance assessment which can more easily be defended.

Tanks Focus Area Site Needs

Need Title: Glass Monolith Surface Area

Site: Hanford **TFA Functional Area:** Immobilization
TFA Response#: 98016 **Site Need#:** RL-WT016 **Site Priority:** High **PBS#:** RL-TW09

Privatization Potential: Methods could support the vitrification technology industry by providing a means to quantify long-term performance of vitrified products.

Current Base Technology and Cost:

SUMMARY OF TFA RESPONSE:
The TFA tentatively rated the priority of the technical response to this need as #47 (TFA Response 98016). The TFA proposes to provide funding in FY99-01, given available funding.

Tanks Focus Area Site Needs

Need Title: Long-Term Testing of Surface Barrier

Site: Hanford **TFA Functional Area:** Closure
TFA Response#: 98017 **Site Need#:** RL-WT017 **Site Priority:** Medium **PBS#:** RL-TW09

SITE NEED:

Need Description: Surface barriers are being used over many Hanford environmental restoration and waste management sites and more barriers are expected in the future. Such barriers are used to reduce moisture infiltration and plant and animal intrusion.

Short-term testing of barriers has occurred under project-sponsored activities, but long-term studies remain a funding orphan. Project-specific funding at Hanford ends in September 1997. Since the design life of the barrier is 1,000 years, need data on degradation to better understand the validity of the design life estimate.

A similar Technology Needs statement has also been included in the Subcon needs list.

Functional Performance Requirements: Monitor performance of an existing barrier under both natural conditions and artificially applied increases in precipitation to reflect variability of natural conditions and possible human intrusion). Develop degradation experiments and perform them.

Schedule Requirements: For use in the Hanford Low-Level Tank Waste Performance Assessments such data and testing are needed by September 2000. Preliminary versions of the performance assessments will need data by September 1998. Closure will start occurring in 2005.

Problem Description: Short-term testing has been performed. Need continuing testing.

Justifications:

Technical Justification: The estimated natural recharge at the proposed tank waste disposal facility location is 3 mm/year. The specifications of the Hanford surface barrier are 0.5 mm/year for 1,000 years.

Regulatory Justification: DOE Order 5820.2A (soon to be codified as 10 CFR 834) requires a performance assessment. The length of time required to move contaminants from the disposal facility to groundwater is proportional to the amount of infiltration allowed through by the surface barrier. Given headquarters definition of the time of compliance as not more than 1,000 years, the design life of the surface barrier becomes an element in a defense in depth philosophy for waste disposal system design.

ES&H Justification: See regulatory just above.

Cultural/Stakeholder Factors: A major environmental impact identified in the Hanford Remedial Action Environmental Impact Statement is the mining of materials for surface barrier construction from the McGee Ranch of the Hanford Site. The McGee Ranch area is a wildlife corridor which many see as vital in maintaining the unique shrub-steppe biological community in this area.

Cost Savings: Surface barriers are being used among the DOE complex and particularly at Hanford. Improvements in design would establish confidence in long-term performance and would greatly affect both waste management and environmental restoration budgets.

Other Justification:

Consequences of Not Filling Need: The performance assessment may need to use conservative values or the facility design may be more expensive than necessary. In particular, more material than necessary may be used from an area of significant cultural value or the DOE may be forced to import suitable materials from a considerable distance.

Tanks Focus Area Site Needs

Need Title: Long-Term Testing of Surface Barrier

Site: Hanford **TFA Functional Area:** Closure
TFA Response#: 98017 **Site Need#:** RL-WT017 **Site Priority:** Medium **PBS#:** RL-TW09

Privatization Potential: Surface barriers are used at many DOE and commercial sites to reduce water infiltration. Research will aid many waste management areas, particularly those in arid and semi-arid Western states.

Current Base Technology and Cost:

SUMMARY OF TFA RESPONSE:
The TFA tentatively rated the priority of the technical response to this need as #40 (TFA Response 98017). The TFA proposes to provide funding in FY99, given available funding.

Tanks Focus Area Site Needs

Need Title: Testing of Sand-Gravel Capillary Barrier

Site: Hanford **TFA Functional Area:** Closure
TFA Response#: 98018 **Site Need#:** RL-WT018 **Site Priority:** Low **PBS#:** RL-TW09

SITE NEED:

Need Description: Water is the driving force behind releasing contaminants from waste forms and then carrying those contaminants to groundwater. Surface moisture barriers (such as the Hanford barrier) have a design life of a 1,000 years. Yet, because of the dry conditions at Hanford, moisture infiltration should be minimized for thousands of years.

Unlike a surface barrier (which uses many of the same hydrologic principles), the capillary barrier diverts water away from the object underneath rather than storing the water until evaporation or plant transpiration removes the water. Thus the capillary barrier is expected to have a significantly longer life and be more effective than a surface barrier for moisture diversion.

Although the principles of sand-gravel capillary barriers are well established, such barriers (especially the ones the size needed for DOE applications) have not been extensively tested.

Functional Performance Requirements: Design, construct, and operate a sand-gravel capillary barrier of significant extent. A variety of water input rates (ranging from those expected from the use of a surface barrier to those expected from crop irrigation) should be applied with moisture seepage through and around the barrier being collected. Effort should be expended to identify failure mechanisms.

Schedule Requirements: Such experiments should be started as soon as possible as such a barrier is seen as a key component in the design of the low-level Hanford tank waste disposal facility.

Problem Description: A sand-gravel capillary barrier consists of a layer of fine material having high conductivity (such as sand) over a layer of coarse material having low conductivity (such as gravel). These layers are sloped in order to encourage water runoff. Experiments are needed to determine the range of application as well as technical parameters such as the slope of the layers and the optimal types of materials in the layers.

Justifications:

Technical Justification: The "Hanford Low-Level Tank Waste Interim Performance Assessment" (WHC-EP-0884) as well as earlier studies have identified the sand-gravel capillary barrier as a key component in the design of the disposal facility.

Regulatory Justification: DOE Order 5820.2A (soon to be codified as 10 CFR 834) requires a performance assessment for DOE radioactive waste disposal facilities. The infiltration of moisture into the facility is a key parameter in determining the performance.

ES&H Justification: See regulatory just above

Cultural/Stakeholder Factors: Disposal of low-activity tank waste has the largest environmental impact of any intentional Hanford action.

Cost Savings: The sand-gravel capillary barrier (if it can be shown to work in the field) is much less expensive than other facility design options (which probably will not work for the time periods needed) or requiring a significantly better performing waste form. If restrictions on waste form, then procurement costs for the waste form could be reduced by hundreds of millions of dollars.

Tanks Focus Area Site Needs

Need Title: Testing of Sand-Gravel Capillary Barrier

Site: Hanford **TFA Functional Area:** Closure
TFA Response#: 98018 **Site Need#:** RL-WT018 **Site Priority:** Low **PBS#:** RL-TW09

Other Justification:

Consequences of Not Filling Need: Other facility design option must be identified or (more likely) the specifications for Phase 2 of Hanford TWRS Privatization must be significantly tightened. The latter could add hundreds of millions of dollars to the procurement costs.

Privatization Potential: May have application to the design and construction of barriers over solid waste and especially hazardous waste landfills in the arid and semi-arid Western United States.

Current Base Technology and Cost:

SUMMARY OF TFA RESPONSE:
The TFA tentatively rated the priority of the technical response to this need as #57 (TFA Response 98018). The TFA proposes to provide funding in FY99-01, given available funding.

Tanks Focus Area Site Needs

Need Title: Getter Materials

Site: Hanford **TFA Functional Area:** Closure
TFA Response#: 98019 **Site Need#:** RL-WT019 **Site Priority:** Medium **PBS#:** RL-TW09

SITE NEED:

Need Description: In order to meet the contaminant release specifications for the disposal of Hanford low-activity tank waste, radiocontaminants are physically trapped in glass. However, only a few of these radioelements drive the performance assessment. If these key radioelements could be chemically trapped after their release from glass, then the performance of the waste disposal system could be significantly improved. Hydraulic properties of getter materials (original, loaded, and discharged) need to be measured to fully understand waste disposal performance in the presence of getters. The use of getter materials in the Savannah River Site's disposal of the Saltstone waste was an important consideration in the approval of that site's disposal of tank waste.

Functional Performance Requirements: For the conditions expected to occur in the Hanford low-level tank waste disposal facility (pH around 10, various chemical species), identify and measure the geochemical and hydraulic properties of a material that can chemically trap technetium (and preferably selenium). The material must be low in cost because large quantities could be used and the disposal site should not represent an attractive natural resource following site closure. The getter material should not introduce any additional environmental hazard.

Schedule Requirements: For use in the Hanford Low-Level Tank Waste Performance Assessments such data and testing are needed by September 2000. Preliminary versions of the performance assessments will need data by September 1998.

Problem Description: Although limited effort to identify such getter materials (Pacific Northwest and Sandia National Laboratories) has been performed, no material has had sufficient testing to be selected. Instrumentation to determine properties is available. It is the identification of the material that has proved difficult.

Justifications:

Technical Justification: If technetium (and selenium to a lesser extent) can be chemically trapped, then the requirements of the disposal facility and of the waste form can be lessened.

Regulatory Justification: DOE Order 5820.2A (soon to be codified as 10 CFR 834) requires a performance assessment for DOE radioactive waste disposal facilities.

ES&H Justification: See regulatory just above.

Cultural/Stakeholder Factors: Disposal of low-activity tank waste has the largest environmental impact of any intentional Hanford action.

Cost Savings: A better understanding of chemical interaction between radiocontaminants and the soil may allow simpler disposal facility designs, less stringent waste form performance requirements, or higher inventories. Such cost savings could exceed hundreds of millions of dollars.

Other Justification:

Consequences of Not Filling Need: This potentially very useful design option for the disposal facility will not be available. Containment of the wastes will have to be performed by physical entrapment.

Privatization Potential: Technetium is normally the most important radiocontaminant in the contamination of groundwater. Inexpensive getter materials may be an important aid in any future waste management facility.

Current Base Technology and Cost:

Tanks Focus Area Site Needs

Need Title: Getter Materials

Site: Hanford **TFA Functional Area:** Closure

TFA Response#: 98019 **Site Need#:** RL-WT019 **Site Priority:** Medium **PBS#:** RL-TW09

SUMMARY OF TFA RESPONSE:

The TFA tentatively rated the priority of the technical response to this need as #41 (TFA Response 98019). The TFA is providing funding in FY98 and proposes to provide funding in FY99-01, given available funding.

Tanks Focus Area Site Needs

Need Title: Service Integrity Testing of High-Level Waste Tanks and Piping

Site: Hanford **TFA Functional Area:** Safety

TFA Response#: 98020 **Site Need#:** RL-WT020 **Site Priority:** Medium **PBS#:** RL-TW03

SITE NEED:

Need Description: Hanford uses an aging infrastructure of single shell tanks and transfer piping for storage of high-level radioactive waste. Many systems are near or beyond their design services lives. There is presently no reliable system for determining whether a transfer system is fit for service in three critical areas: leak tightness, remaining service life, and extent of impaired service (partial plugging). The baseline methods for leak detection of transfer piping (hydrostatic testing and conductivity sensors) are prone to low sensitivity and false alarms. An improved method of leak testing is required to make operational decisions of whether or not a piping system can continue to be used, to avoid releases of radioactive waste to the Hanford soil. A piping system near failure may pass a leak tightness test yet fail while in service. An improved means of assessing remaining service life is required. Significant partial plugging of a transfer system may complete stop a waste transfer will remaining undetectable to standard integrity tests.

There is presently no volumetric leak detection method for single shell tanks. The current practice in the Hanford single shell system employs level indication in tanks with liquid surfaces and gamma probes in liquid observation wells in tanks without liquid surfaces. Neither of these methods have been evaluated for performance following regulatory and industry standard practices. Moreover, there is no current capability to evaluate remaining service life for sound tanks during retrieval operations. Such a capability is required to evaluate the suitability of using past practice sluicing to retrieve wastes from single shell tanks.

Functional Performance Requirements: Design and install equipment for testing transfer lines at the Hanford site. Conduct a service integrity test program on at least two transfer systems in each of fiscal years 1999 and 2000. Quantify the leak tightness of the transfer systems per Environmental Protection Agency (EPA) guidelines for probability of detection and probability of false alarm. Design and install leak detection equipment for service integrity testing of single shell tanks. Conduct a leak test program for at least two single shell tanks by fiscal years 2001 and 2002. Quantify leak tightness of the single shell tanks per EPA guidelines.

Schedule Requirements: Work is to be performed in fiscal years 1999, 2000, and 2001.

Problem Description: Hanford does not have a protocol for determining "fitness for use" of transfer systems and single shell tanks. In service failure results in releases of wastes to Hanford soils and programmatic delays. Transfer systems fail unpredictably from leaks and plugging. Standard hydrostatic leak tests are unreliable and cannot evaluate remaining service life. Single shell tanks have no reliable leak detection system and no means to evaluate remaining service life for retrieval operations.

Justifications:

Technical Justification: The current unquantified leak testing and leak detection practices are inadequate for making operational decisions such as whether or not to continue with a waste transfer or whether a particular tank is sound.

Regulatory Justification: Washington Administrative Code 173-303-640(2)(c)(v) requires the results of a leak test or other integrity examination when performing tank system integrity assessments. Leak tests must be capable of taking into account the effect of temperature variations, tank end deflection, vapor pockets and high water table effects.

ES&H Justification: WHC-SD-WM-OSR-005, Single-Shell Tank Interim Operational Safety Requirements, WHC-SD-WM-OSR-004, Aging Waste Facility Interim Operational Safety Requirements, and WHC-SD-WM-OSR-016, Double-Shell Tank Interim Operational Safety Requirements. These support documents contain interim operational safety requirements - administrative controls for leak detection and monitoring requirements.

Tanks Focus Area Site Needs

Need Title: Service Integrity Testing of High-Level Waste Tanks and Piping

Site: Hanford **TFA Functional Area:** Safety
TFA Response#: 98020 **Site Need#:** RL-WT020 **Site Priority:** Medium **PBS#:** RL-TW03

Cultural/Stakeholder Factors: Missed alarms can allow a leaking system to continue to leak many gallons of waste directly to the soil before being detected by external methods like drywell monitors. False alarms consume scarce resources with no productive outcome.

Cost Savings: Undetected failures create unnecessary cleanup costs and programmatic delays.

Other Justification: N/A

Consequences of Not Filling Need: Regulatory Impacts: The baseline leak detection and monitoring systems are not compliant with EPA guidelines for volumetric leak testing, and are not compliant with WAC 173-303-640.

Programmatic Impacts: The baseline system of leak detection and monitoring is unreliable in its capability to detect leaks and avoid false alarms. Delays and extra costs to programs are always involved in resolving these issues.

Privatization Potential: A private vendor will be sought to procure service integrity and monitoring services.

Current Base Technology and Cost:

SUMMARY OF TFA RESPONSE:
The TFA tentatively rated the priority of the technical response to this need as #45 (TFA Response 98020). The TFA proposes to provide funding in FY99-01, given available funding. Additionally, the TFA would satisfy a portion of this need in its response to SRS need SR-2909 (TFA Response 98067C).

Tanks Focus Area Site Needs

Need Title: Cleaning and Decontamination of Hanford Pits

Site: Hanford **TFA Functional Area:** Retrieval
TFA Response#: 98021 **Site Need#:** RL-WT021 **Site Priority:** High **PBS#:** RL-TW04

SITE NEED:

Need Description: Waste retrieved from Hanford tanks must pass through a number of pits associated with single shell tanks before it is received by the privatization contractor for disposal. Many of these pits will have to be modified before the waste can be transferred. Current methods for modifying, operating, cleaning and decontaminating these pits are labor intensive and costly and result in a high dose to workers. Currently, work associated with pits is the single largest contribution to TWRS operations dose levels. For example, the dose in the
241-C-106 pits was 40 R/hr. After investing $2 million and 5 months, the dose had been reduced to only 20 R/hr.

Functional Performance Requirements: Improved methods of pit decon must reduce setup time and in pit debris/equipment removal time and thereby lower overall cost while at the same time reducing the dose received by the workers. Cleaning and decon methods should be able to reduce the background radiation in the pits better than present methods which are only capable of a factor of 2 reduction. Specifically:

1) Reduce the dose levels at the edge of the pit to 1-2 R/hr, by a combination of trash removal and decon, in one week.
2) Remotely change out the seals in a Hanford connector in less than one shift.
3) Provide jumper and connector measurements, accurate to +/- 1/64 inch, so replacements/alternate jumpers can be fabricated without operator entry into the pit to obtain measurements.
4) Provide devices to change out and/or install alternate jumpers in less than one shift.

Schedule Requirements: The HTI project will begin decontamination of pits on tank 241-C-106 in June, 1999. New methods of pit decon will be needed on this project.

Problem Description: Technologies for remote mapping or remote handling must be adapted to the configuration and specific tasks that are required. Existing commercial equipment cannot be deployed without modification. Chemical methods to decontaminate surfaces must be demonstrated to be effective and methods must be developed to assure cleaning solutions can be contained during decontamination, and suitably disposed after the solution is loaded with contaminants.

Justifications:

Technical Justification: Existing approaches rely on highly labor intensive methods and unique job-specific tools. Improved methods can exploit technologies developed for remote handling, surface decontamination with chemicals, and mapping techniques. Small to significant adaptation may be needed.

Regulatory Justification:

ES&H Justification: Present methods require significant worker dose, particularly when manned entry is required for complicated tasks.

Cultural/Stakeholder Factors: None identified for mapping or remote systems. Ecology and tribal nations have concerns about use of chemical cleaning solutions that could escape the pit and accelerate contaminant transport in the vadose zone.

Cost Savings: Over 600 pits exist at Hanford, representing a range of contamination and complexity. Recent experience on the W-320 Project required more than $2 million for decontamination of a single pit, and was not completed sufficiently to allow manned entry.

Tanks Focus Area Site Needs

Need Title: Cleaning and Decontamination of Hanford Pits

Site: Hanford **TFA Functional Area:** Retrieval
TFA Response#: 98021 **Site Need#:** RL-WT021 **Site Priority:** High **PBS#:** RL-TW04

Other Justification:

Consequences of Not Filling Need: For HTI, about 2 million dollars has been budgeted for pit decon on pits that have already been decontaminated (at a cost of about 2 million dollars) by a predecessor project (W-320). If 67 Hanford tanks must be retrieved with a pit decontamination cost of 4 million dollars each, total costs could exceed a quarter billion dollars.

Privatization Potential: All phases of this need have potential for commercial applications.

Current Base Technology and Cost:

SUMMARY OF TFA RESPONSE:
The TFA tentatively rated the priority of the technical response to this need as #36 (TFA Response 98021). The TFA proposes to provide funding in FY99-01, given available funding.

Tanks Focus Area Site Needs

Need Title: Tank Knuckle NDE

Site: Hanford **TFA Functional Area:** Safety
TFA Response#: 98022 **Site Need#:** RL-WT022 **Site Priority:** High **PBS#:** RL-TW03

SITE NEED:

Need Description: The Tri Party Agreement (TPA) schedule requires the completion of the Double Shell Tank (DST) system Integrity Assessment Program by the end of fiscal year 1999. It is required that no fewer than 6 DSTs will undergo a non-destructive evaluation (NDE) of a portion of the tank wall, bottom knuckle, and bottom. NDE equipment must be deployed to fulfill this requirement. Fracture mechanics analysis indicates that the knuckle region of the DST that rests on the concrete foundation is the highest-stressed region of the tanks. This high-stressed region is not accessible using current ultrasonic technology. This region is accessible for examination only by propagating ultrasonic energy around a plate with a one-foot radius bend. Current inspection studies demonstrate that defects in this region can be detected. However, characterizing the length and through-wall extent of defects is not possible using current technology.

Connection to TWRS Logic: This need supports TWRS Program Logic "Maintain Authorization Basis" and "Conduct Tank Farm Safe Operation."

Functional Performance Requirements: Functional requirements for ultrasonic inspection capable of characterizing defects in the knuckle region include:
- Propagating ultrasound a distance of four feet around a plate with a one-foot radius.
- Detect cracks that exceed 0.18 inches and determine the through wall extent to an accuracy of 0.1 inch.
- Detect corrosion that exceeds 25% wall thickness and determine the through wall extent to an accuracy of 0.05inches.

Schedule Requirements: The system must be deployed in fiscal year 1999 to meet TPA milestone commitments.

Problem Description: Comprehensive NDE of DST primary and secondary tank walls is required by TPA commitment and for evaluations of remaining useful DST life. Ensuring the structural integrity of the current waste tanks while developing innovative solutions to waste management and consolidation is the main mission of contractors at the Hanford reservation. The ability to examine the inner shell of double-shell waste tanks and perform examination of the main cylinder section of a tank was demonstrated on 241-AW-103 in fiscal year 1996.

The next challenge in ensuring the integrity of the double shell tanks requires the examination of the knuckle region of the tank. This examination poses a significant technical challenge because a portion of the area that requires examination is accessible only by propagating ultrasonic energy around a plate with a one-foot radius bend. Initial studies conclude that detection of defects in the knuckle region is not a problem. However, characterizing the defect length and through wall extent presents a very difficult problem.

TSAFT imaging technology is a proven technology that provides a potential solution for characterizing defects in the knuckle region of the waste tanks. The technology needs to be adapted to the geometry of the knuckle region and sound propagation distances of up to four feet.

Justifications:

Technical Justification: Present nondestructive evaluation (NDE) techniques can only detect and characterize stress corrosion cracks (SCC), corrosion or other anomalies in the narrow slot regions at the bottom of the double-shell tanks. These slot areas only provide access to 1-2% of the high-stress region of the tanks, which is not adequate for integrity assessment. TSAFT technology, developed at PNNL for inspecting components and piping in nuclear reactor systems, has the potential for providing detailed characterization of cracking or corrosion in the entire knuckle region of the tanks.

Tanks Focus Area Site Needs

Need Title: Tank Knuckle NDE

Site: Hanford **TFA Functional Area:** Safety
TFA Response#: 98022 **Site Need#:** RL-WT022 **Site Priority:** High **PBS#:** RL-TW03

Regulatory Justification: Completion of the physical examinations of the DSTs is required by TPA commitment and as a prerequisite for obtaining Resource Conservation and Recovery Act (RCRA) Part B permit status for continued operation of the DST system.

Washington Administrative Code 173-303-640(2)(c)(iii) requires a physical examination (NDE) or leak test as a part of an integrity assessment program.

ES&H Justification: Assessing the integrity of double shell tanks helps ensure that no catastrophic leaks will occur in the double shell tanks. Early detection of any degradation of double shell tanks provides an opportunity to plan and develop corrective actions.

Cultural/Stakeholder Factors: The oversight committee on tank integrity has identified inspection of the knuckle region of double shell tanks as critical.

Cost Savings: Developing tank knuckle NDE technology will reduce the time required for examining double shell tanks by reducing the area that must be scanned for defect detection and characterization. This technology is needed to provide the quantitative information on the length and depth of the flaws of any flaws detected during the inspection of the knuckle region of the tanks. Without this technology, very conservative assumptions will have to be made about the flaw size.

Other Justification: N/A

Consequences of Not Filling Need: Regulatory Impacts: The U. S. DOE has previously entered into negotiations with the Washington State Department of Ecology (WDOE) and the U. S. Environmental Protection Agency for determination of acceptable compliance with WAC-173-303-640. Completion of DST NDE was a part of these negotiations.

Programmatic Impacts: If knuckle NDE technology is not developed, a majority of the high-stress region of the knuckle that rests on the concrete foundation can not be examined. The inability to examine critical sections of the tank creates a major knowledge gap when attempting to assess the near- and long-term integrity of the tanks. That uncertainty contributes to programmatic risk of serious delays in the TWRS program should a leak occur.

Programmatic Risks: The TWRS program needs knuckle NDE technology to avoid two serious risks:
1) Delay of the program as a consequence of a DST leak unexpectedly taking one or more tanks out of service.
2) Physical regulatory non-compliance and the resulting negative attention.

Privatization Potential: N/A

Current Base Technology and Cost:

SUMMARY OF TFA RESPONSE:
The TFA did not rate the technical response to this need separately (TFA Response 98022). The TFA intends to satisfy this need through the technical response prepared for SRS need SR-2909 (TFA response 98067A).

Tanks Focus Area Site Needs

Need Title: Prediction of Solid Phase Formation in Hanford Tank Waste Solutions

Site: Hanford **TFA Functional Area:** Pretreatment
TFA Response#: 98023 **Site Need#:** RL-WT023 **Site Priority:** High **PBS#:** RL-TW04

SITE NEED:

Need Description: Information is needed on the solubility of various components in the complex solid and liquid matrices of the Hanford tank wastes. This information is needed to predict when solids will precipitate or when gels will form in retrieval, wash, and leach solutions, and to supplement empirical water wash and caustic leach data from enhanced sludge wash testing of Hanford tank sludge and saltcake samples. Much information is available from past solubility chemistry work at Hanford and from other DOE sites. Available information needs to be
compiled for easier use, missing data need to be identified, and work performed to supply the missing data. The information will be used to support the planning for and performance of the Hanford tank waste remediation. This remediation involves pretreating almost 150,000 m3 of sludge and saltcake solids and 60,000 m3 of supernatants from 177 waste tanks (Hanlon 1996).

Functional Performance Requirements: A compilation of available solubility data in the form of charts, figures, correlations, and calculational methods that can be easily to predict solids precipitation or gel formation in processing solutions, or can be used to predict wash and leach efficiencies based on key sludge or saltcake composition data. The compilation should accurately and efficiently predict solubilities for the major problem species expected in the complex solid and liquid matrices expected in the Hanford tank wastes. Examples of problem species are aluminates, phosphates, fluorophosphates, silicates, and chromates. The information should be suitable for inclusion in the Aspen software program and the Environmental Simulation Program (ESP), both of which are in use at Hanford. The work should identify what solubility data are missing and identify what experimental work is needed to provide the missing data. The identified experiments should be performed and the resulting data included in the compilation.

Schedule Requirements: This effort needs to be initiated in FY1999 to feed the preparation of the Phase II privatization RFP (H2343). It provides needed information for specifying the interface between the Retrieval Contractor and the High-Level Waste Contractor.

The LLW outsourcing vendors feed must be less than 5 volume percent solids. These tests need to be completed by 3/99 so that the LLW plan update can incorporate these findings in FY99, any necessary field modifications such as caustic addition capabilities can be completed in FY00, feed staging can begin in FY01, and delivery of feed to the Outsourcing Contractors' feed tanks can occur prior to hot start-up in FY02.

Problem Description: Solids and gels are known to form in the Hanford tank wastes when the solution ionic strength is decreased. Transfer lines have been plugged when solids or gels inadvertently formed. Knowledge of the solubility envelope for the waste is necessary to avoid unwanted precipitation or gel formation in supernatants. Sludge washing and leaching performance and saltcake dissolution evaluations are based on empirical data extrapolated from individual tanks to groups of tanks based on waste types. Improvements in processing efficiency are expected if the wash, leach, and dissolution processes are based on an understanding of the dissolution thermodynamics and kinetics rather than just empirical data. Water usage and makeup chemical addition can also be reduced which together with the improvement in efficiency can reduce the amount of HLW glass produced.

Justifications:

Technical Justification: This effort will provide a basis for writing a meaningful RFP for Phase II.

Regulatory Justification: N/A

ES&H Justification: N/A

Cultural/Stakeholder Factors: N/A

Need Title: Prediction of Solid Phase Formation in Hanford Tank Waste Solutions

Site: Hanford **TFA Functional Area:** Pretreatment
TFA Response#: 98023 **Site Need#:** RL-WT023 **Site Priority:** High **PBS#:** RL-TW04

Cost Savings: A significant cost avoidance is expected if DOE has information that allows a more precise RFP to be written.

Other Justification: N/A

Consequences of Not Filling Need: The lack of technical understanding of Phase II wastes will cause the Phase II vendors' estimated costs to be to be higher due to an inexact RFP being written.

Privatization Potential: N/A

Current Base Technology and Cost:

SUMMARY OF TFA RESPONSE:
The TFA tentatively rated the priority of the technical response to this need as #18 (TFA Response 98023). The TFA is providing funding in FY98 and proposes to provide funding in FY99-01, given available funding.

Tanks Focus Area Site Needs

Need Title: Enhanced Sludge Washing Process Data

Site: Hanford **TFA Functional Area:** Pretreatment

TFA Response#: 98024A, B **Site Need#:** RL-WT024 **Site Priority:** High **PBS#:** RL-TW05

SITE NEED:

Need Description: Enhanced sludge wash (ESW) process data are needed to prepare enough feed to satisfy the maximum order quantity for Phase I preparation of the Phase II privatization request for proposal, and for bid evaluation of vendors proposals. A high emphasis needs to be placed on obtaining information on the Cr chemistry in the sludges and saltcakes. Chromium removal is needed to reduce the impact of Cr on the HLW glass volume. This is a continuation of the ESW testing program currently in progress. Additional data on the affect of varying temperature and caustic concentration on leach performance would be beneficial.

Functional Performance Requirements: Enhanced sludge wash process data representing 90+% of the SST sludge volume and 70+% of the DST sludge volume. An understanding of the Cr removal chemistry that allows reduction of the impact of Cr on HLW glass by 50%.

Schedule Requirements: The identification of Phase I candidate feed tanks is needed in the middle of FY 1999 to provide information to the HLW feed staging plan update in FY 1999 (H1233) and allow enough time to install the needed retrieval equipment and pretreatment equipment to extend the HLW Privatization Contractor's Phase I operation to FY 2001. This work is required to support the transfers scheduled to begin for Tank 241-AZ-101 in June, 2002 for Tank 241-AZ-102 in September, 2003, and for Tank 241-AY-102 in November, 2004. For Phase II, this effort needs to be initiated in FY 1999 to feed the preparation of the Phase II Privatization RFP (H2343) and subsequent bid evaluation.

Problem Description: Currently only about 70 to 80 percent of the maximum order quantity for phase I sludge washing has been identified. Additional feeds must be identified that can satisfy envelope D after pretreatment to ensure that the Private Contractors will be able to operate through 2011.

By March 1998 a decision will have been made whether ESW produces a reasonable number of HLW glass canisters. Assuming that ESW is successful in producing a reasonable number of glass canisters, additional data on ESW performance are required to provide a sound basis for the second phase of privatization. A strategy was developed for ESW testing based on obtaining 47 SST and 10 DST sludge samples (Kupfer 1996). Not all of that sampling and testing will have been completed before the March 1998 decision. Completion of that strategy is necessary to craft the Phase II RFP and to provide enough definitive information for a fair cost estimate for bid evaluation purposes. Currently sludge wash laboratory data to support delivery of feed for HLW immobilization in Phase 1B Privatization are limited to that work done by PNNL (Lumetta and Rapko) and LANL (Tiemers) for the HLW Project. This small scale laboratory work is at the 5 gram/test level. Data are needed to support scaling the process up to full scale (5 x 109 g); an intermediate scale test (large bench scale, small pilot scale) involving about a 15 gallon size vessel and a few hundred gallons of actual waste will provide the appropriate scale up information. Information is needed about the effects of temperature on such process steps as dilution and perhaps re-precipitation of solids, washing efficiency, leaching efficiency, and quantity of caustic needed. The various Privatization Phase 1 sludges need to be tested to support the full scale processing planned for tanks 241-AZ-101, 241-AZ-102, and 241-AY-102 (including material retrieved from tank 241-C-106). Oxidation states of some of the chemical species (e.g. chromium) may need to be altered to ensure dissolution to support overall project objectives.

Justifications:

Technical Justification: This effort will allow additional feeds to be identified as candidate feeds to the Phase I Privatization Contractor for HLW. For Phase II it provides a basis for a fair cost estimate and the writing of a meaningful RFP.

Regulatory Justification: The tests performed at the large bench scale (small pilot scale) will be extremely useful, and may be critical, for creating the safety documentation leading to full scale deployment of the in-tank sludge washing and caustic leach processes.

Tanks Focus Area Site Needs

Need Title: Enhanced Sludge Washing Process Data

Site: Hanford **TFA Functional Area:** Pretreatment
TFA Response#: 98024A, B **Site Need#:** RL-WT024 **Site Priority:** High **PBS#:** RL-TW05

ES&H Justification: N/A

Cultural/Stakeholder Factors:

Cost Savings: A significant cost avoidance is expected if DOE is armed with information that allows a more precise RFP to be written and a realistic knowledge of the phase 2 costs with which to evaluate Vendors proposals.

Other Justification:

Consequences of Not Filling Need: 1) The use of the Phase I HLW facility will be less than planned due to inadequate feed. 2) The lack of technical understanding of Phase II will cause the Phase II Vendors facilities to be more expensive due to an inexact RFP and a lack of understanding upon which to do a bid evaluation.

Privatization Potential: N/A

Current Base Technology and Cost:

SUMMARY OF TFA RESPONSE:
The TFA provided two separate responses for this need. The first is TFA's Response 98024A, which replies to the requirements for Parametric Studies for Sludge Washing. The TFA tentatively rated the priority of the technical response to this need as #26. The TFA is providing funding in FY98 and proposes to provide funding in FY99-01, given available funding.

The second response is TFA's Response 98024B, which replies to the requirements for Hanford and SRS sludge Scale-up Studies. The TFA tentatively rated the priority of the technical response to this need as #11. The TFA proposes to provide funding in FY99-01, given available funding. The TFA intends to satisfy SRS need SR-2920 (TFA Response 98065) in this response.

TFA Response#: 98024A, B
Site Need#: RL-WT024

Tanks Focus Area Site Needs

Need Title: Remote Sensing of Gas Retention in HLW Slurries

Site: Hanford **TFA Functional Area:** Safety
TFA Response#: 98025 **Site Need#:** RL-WT025 **Site Priority:** Medium **PBS#:** RL-TW04

SITE NEED:

Need Description: A method is needed to determine the extent of gases entrained in waste slurries in a waste storage tank. During waste retrieval and transfer of solids, a potential exists for the creation of "slurry growth" conditions (i.e., entrapped gases) in the receiver tank with a subsequent gas release event (GRE) similar to the behavior exhibited by Tank 101-SY.

Functional Performance Requirements: The systems and components necessary for determining entrained gas inventory must be installed in either the tank dome area or the ventilation off gas system; must comply with Hanford tank farms design requirements for flammable gas conditions and must be capable of measuring the gas volume within (+/-) 5% of the waste volume.

Schedule Requirements: The technologies required to accurately determine gas retention are needed to support the retrieval of 106-C in the FY1998/99 time frame. Beyond this period, the most significant retrieval and transfer of solids will involve SST retrieval and DST waste consolidation activities. The initial SST retrieval systems will begin the design/construction phase in FY1999, complete in FY2003 and become operational in FY2004. The DST waste consolidation will involve the transfer of 102-SY solids beginning in FY1999. Therefore, the systems
and components necessary for determining tank evaporative losses must be developed, tested and demonstrated prior to FY1999.

Problem Description: When entrapped gases are released during a GRE, the potential for a deflagration exists due to the presence of ignition sources in the tank. If the presence of entrapped gases can be detected and measured, then the retrieval activity can be managed in a way to minimize the consequences and risk of such an event.

Justifications:

Technical Justification: No technology is currently available to directly or indirectly measure the volume of gas in a slurry of inhomogeneous solids density, particle size, and liquid specific gravity.

Regulatory Justification: N/A

ES&H Justification: Accident and consequence analyses show that the deflagration of entrapped gases corresponding to more than two inches of slurry growth in a DST exceeds risk evaluation guidelines.

Cultural/Stakeholder Factors: N/A

Cost Savings: Accurate accounting of tank waste and gas inventory will allow for larger retrieval increments to be transferred, thereby reducing the total activity duration and operating cost.

Other Justification: N/A

Consequences of Not Filling Need: Potential creation of GRE tanks that require active mitigation.

Privatization Potential: N/A

Current Base Technology and Cost:

SUMMARY OF TFA RESPONSE:

The TFA tentatively rated the priority of the technical response to this need as #37 (TFA Response 98025). The TFA proposes to provide funding in FY99-00, given available funding.

Tanks Focus Area Site Needs

Need Title: Tank Leak Detection Systems for Underground Single-Shell Waste Storage Tanks (SSTs)

Site: Hanford **TFA Functional Area:** Safety
TFA Response#: 98026 **Site Need#:** RL-WT026 **Site Priority:** High **PBS#:** RL-TW04

SITE NEED:

Need Description: The use of past-practice sluicing for SST waste removal involves the addition of liquid to tanks and therefore increases the potential for waste leakage to the environment. Leak detection applies to all SST retrieval, including retrieval during Phase I and preparation of the Phase II specification. Leak detection methods are needed that can signal and quantify a leak from a tank when only a small amount of waste has escaped.

Functional Performance Requirements: The final leak detection approach and requirements will be negotiated with DOE-RL and Ecology. Candidate detection systems will be evaluated by such criteria as overall cost-benefit and risk-reduction potential, ease of use and deployment, overall effectiveness, and capability to verify effectiveness. Detection systems should address the following types of issues:
- Sensitivity to detect a minimum leak volume of not more than 2000 gallons of liquid
- Determine the quantity of leaked material to +/- 50%
- Limit the false detection of a leak to no more than 20%
- Use of hardware systems that are deployable in or around the target tank to required locations that will facilitate use as designed
- Availability and/or deployability in order to operate during the time frame of need (e.g., at the time frame of a sluicing campaign)
- Cost-benefit and risk-reduction when compared to the baseline approach and no-action scenario
- The detection tool/system must include a capability for installation verification and periodic performance verification while installed and/or in service
- The detection tool/system must utilize materials that are compatible with the waste (i.e., won't degrade), appropriate to the planned period of use, capable of "surviving" deployment

Schedule Requirements: This need supports TPA milestones for submitting annual progress reports on the development of waste tank leak detection, monitoring, and mitigation (LDMM) activities. TPA milestones M45-08A and B require presentation of the leakage mitigation approach that will be used during sluicing of SSTs, and demonstration and evaluation of those tools that prove to be viable.

Problem Description: Detection systems that improve on the capabilities of the current baseline approach are needed. The objective is to detect a minimum quantity of liquid escaping the containment of a waste tank in real time so that appropriate mitigation measures can be implemented. The tank farm areas are quite congested with underground utilities and pipelines, so instrumentation deployed deep in the ground must take into consideration the difficulty of placing the sensing probes. There are relatively few access ports (tank risers) available for
deployment of sensors inside a tank.

Justifications:

Technical Justification: Provisions for leakage detection are prerequisite to initiating actions to remove waste from leaking tanks. TPA Milestone M-45-08A requires measures for leak detection to be included in the design of the initial SST retrieval task. This effort is required to ensure that the specification for initial SST waste retrieval, and the Phase II Privatization Contract, are adequate for bidders to make informed decisions and to show a minimum cost.

Regulatory Justification: This task will contribute to the information base that is used during negotiation with Ecology and Hanford Stakeholders regarding a regulatory position for final retrieval and closure of Hanford SSTs. Leakage mitigation is a major Hanford Stakeholder value and is expressed as a concern by Ecology through the TPA milestones of the M45-08 series. In particular, milestone M45-08-T02 requests a statement of "...acceptable leak monitoring/detection and mitigation measures necessary to permit sluicing operations."

Need Title: Tank Leak Detection Systems for Underground Single-Shell Waste Storage Tanks (SSTs)

Site: Hanford **TFA Functional Area:** Safety

TFA Response#: 98026 **Site Need#:** RL-WT026 **Site Priority:** High **PBS#:** RL-TW04

ES&H Justification: Leakage must not be allowed to occur to an extent that will preclude the use of available tools and methods for remediating the contaminated soil. The establishment and technology to control leakage within allowable leakage volumes (ALVs) is an important mitigation action since that approach sets operational limits within which soil remediation and closure can still proceed even in the event that leakage may occur. A viable approach to leakage mitigation during sluicing will contribute to the capability to ensure that leakage is managed below ALVs, and to maintain overall safe operations during waste retrieval.

Cultural/Stakeholder Factors: Leakage detection and mitigation during waste retrieval are major issues of concern with Ecology and Hanford Stakeholders. This concern is reflected in TPA milestones, review of the TWRS EIS, and in other public documentation.

Cost Savings: Mitigation of leakage is directly related to the potential extent of action required for tank and tank farm closure, and the implementation of potential closure options. Mitigation and reduction of leakage can, therefore, be directly related to the cost of soil remediation, should that become necessary. A significant cost avoidance is expected if DOE can avoid this type of higher contingency factor in the Phase II Privatization bids.

Other Justification: N/A

Consequences of Not Filling Need: A position based upon current baseline detection and mitigation tools and capabilities will be negotiated with Ecology. Since current capabilities for detection are based on material balances, the inherent sensing sensitivity is a function of the sensitivity and accuracy of tank level measuring systems. However, continued effort to seek new, or enhanced old methods and tools is a major Hanford Stakeholder value that will be associated with approval to proceed. Phase II Privatization Contractors would have to put a larger contingency in their bids for retrieval of SSTs to negotiate this matter with Ecology, Hanford Stakeholders, and the public by themselves.

Privatization Potential: Demonstration of candidate mitigation tools and methods will show where industry has the capabilities to perform now and where additional technology would be helpful.

Current Base Technology and Cost:

SUMMARY OF TFA RESPONSE:
The TFA tentatively rated the priority of the technical response to this need as #27 (TFA Response 98026). The TFA proposes to provide funding in FY99, given available funding. The TFA intends to satisfy the following additional needs in its technical response:
- Hanford need RL-WT027 (TFA Response 98027)
- SRS need SR-2909 (TFA Response 98067B)

Tanks Focus Area Site Needs

Need Title: Tank Leak Mitigation Systems

Site: Hanford **TFA Functional Area:** Safety
TFA Response#: 98027 **Site Need#:** RL-WT027 **Site Priority:** High **PBS#:** RL-TW04

SITE NEED:

Need Description: The use of past-practice sluicing for SST waste removal involves the addition of liquid to tanks and therefore increases the potential for waste leakage to the environment. Leakage mitigation applies to all SST retrieval, including retrieval during Phase I and preparation of the Phase II specification. Leakage mitigation efforts and tools, that can be shown to provide cost-benefit and significant risk reduction over baseline methods, should be incorporated into retrieval system design and operating procedures. Existing mitigation techniques
(i.e., the current baseline approach) must continue to be evaluated against potential/candidate mitigating technologies to ensure that the most cost-effective, risk reducing approach is applied. Periodic identification and evaluation of potential leakage mitigation tools for possible application during SST retrieval operations is required on a continuing basis.

Functional Performance Requirements: The final leakage mitigation approach and requirements will be negotiated with DOE-RL and Ecology. Candidate mitigation systems will be evaluated by such criteria as overall cost-benefit and risk-reduction potential, ease of use and deployment, overall effectiveness, and capability to verify effectiveness. Mitigation systems should address the following types of issues:
- Maximizing in-tank and/or ex-tank opportunities to reduce or stop leakage prior to, during, or following sluicing
- Use of hardware systems that are deployable in or around the target tank to required locations that will facilitate use as designed
- Availability and/or deployability in order to operate during the time frame of need (e.g., at the time and location of a detected leak, or within the time frame of a sluicing campaign)
- Cost-benefit and risk-reduction when compared to the baseline approach and no-action scenario
- The mitigation tool/system must include a capability for installation verification and periodic performance verification while installed and/or in service
- The mitigation tool/system must utilize materials that are compatible with the waste (i.e., won't degrade), appropriate to the planned period of use, capable of "surviving" deployment
- Should not produce tank or tank waste conditions that preclude further attempts at waste retrieval or tank/tank farm closure, or that create additional, more complex retrieval problems or conditions.

Schedule Requirements: This need supports TPA milestones for submitting annual progress reports on the development of waste tank leak detection, monitoring, and mitigation (LDMM) activities. TPA milestones M45-08A and B require presentation of the leakage mitigation approach that will be used during sluicing of SSTs, and demonstration and evaluation of those tools that prove to be viable.

Problem Description: Mitigating systems that improve on the capabilities of the current baseline approach are needed. The objective is to prevent, curb, or eliminate the possibility or extent of liquid waste leakage from underground storage tanks into the surrounding soils. If cost-benefit, risk-reduction, and alternatives evaluations of new mitigating technologies determine that deployment, implementation, and operation is feasible, then further evaluation should be pursued. Such evaluations may include demonstrations and testing. Example concepts
that could be evaluated include retrieval methods which minimize the potential for leakage, leak point and potential leak point location, "seek-and-seal" devices and methods, administrative approaches that maximize the use and coordination of currently available tools and methods, sheet barriers, close-coupled grout injection barriers, and dry-air containment barriers.

Justifications:

Technical Justification: Provisions for leakage mitigation are prerequisite to initiating actions to remove waste from leaking tanks. TPA Milestone M-45-08A requires measures for leak mitigation to be included in the design of the initial SST retrieval task. This effort is required to ensure that the specification for initial SST waste retrieval, and the Phase II Privatization Contract, are

adequate for bidders to make informed decisions and to show a minimum cost.

Regulatory Justification: This task will contribute to the information base that is used during negotiation with Ecology and Hanford Stakeholders regarding a regulatory position for final retrieval and closure of Hanford SSTs. Leakage mitigation is a major Hanford Stakeholder value and is expressed as a concern by Ecology through the TPA milestones of the M45-08 series. In particular, milestone M45-08-T02 requests a statement of "...acceptable leak monitoring/detection and mitigation measures necessary to permit sluicing operations."

ES&H Justification: Leakage must not be allowed to occur to an extent that will preclude the use of available tools and methods for remediating the contaminated soil. The establishment and use of allowable leakage volumes (ALVs) is an important mitigation action since that approach sets operational limits within which soil remediation and closure can still proceed
even in the event that leakage may occur. A viable approach to leakage mitigation during sluicing will contribute to the capability to ensure that leakage is managed below ALVs, and to maintain overall safe operations during waste retrieval.

Cultural/Stakeholder Factors: Leakage detection and mitigation during waste retrieval are major issues of concern with Ecology and Hanford Stakeholders. This concern is reflected in TPA milestones, review of the TWRS EIS, and in other public documentation.

Cost Savings: Mitigation of leakage is directly related to the potential extent of action required for tank and tank farm closure, and the implementation of potential closure options. Mitigation and reduction of leakage can, therefore, be directly related to the cost of soil remediation, should that become necessary. A significant cost avoidance is expected if DOE can avoid this type of higher contingency factor in the Phase II privatization bids.

Other Justification: N/A

Consequences of Not Filling Need: A position based upon current baseline mitigation tools and capabilities will be negotiated with Ecology. However, continued effort to seek new, or enhanced old methods and tools is a major Hanford Stakeholder value that will be associated with approval to proceed. Phase II privatization Contractors would have to put a larger contingency in their bids for retrieval of SSTs to negotiate this matter with Ecology, Hanford Stakeholders, and the public by themselves.

Privatization Potential: Demonstration of candidate mitigation tools and methods will show where industry has the capabilities to perform now and where additional technology would be helpful.

Current Base Technology and Cost:

SUMMARY OF TFA RESPONSE:
The TFA did not rate the technical response to this need separately (TFA Response 98027). The TFA intends to satisfy this need through the technical response prepared for Hanford need RL-WT026 (TFA response 98026).

Tanks Focus Area Site Needs

Need Title: Waste Mobilization Enhancement

Site: Hanford **TFA Functional Area:** Retrieval
TFA Response#: 98028 **Site Need#:** RL-WT028 **Site Priority:** Medium **PBS#:** RL-TW04

SITE NEED:

Need Description: Retrieval of certain double-shell tanks (DSTs) are needed to provide adequate HLW feed to Phase 1 privatization, extended order quantity. Retrieval of DSTs using the baseline of two mixer pumps could leave a considerable amount of hard' sludge heel. While this is adequate for initial HLW feed, the program needs assurance that if the effective cleaning radius of the mixers proves insufficient, that a backup method can be deployed to mobilize enough residual waste to complete the mission. Further effort in predicting the effective cleaning radius by characterizing the shear strength, or resistance to mobilization, of the sludge is needed to plan for us of a backup method. Alternate or supplementary methods are needed to better mobilize sludge from DSTs containing HLW feed for Phase I privatization.

Functional Performance Requirements: Any device or equipment used to characterize tank wastes in situ or to modify sludge strength must be easily deployable through a 12" riser, must be constructed to be inherently safe, and must not exert forces on the tanks that could cause damage. Methods or devices to characterize the waste properties should result in a correlation between the measured property and mixer pump effectiveness. Methods or devices to weaken sludges should develop an improvement of the effective cleaning radius of at least 25%.

Schedule Requirements: Phase I privatization is expected to begin receiving waste in 2002.

Problem Description: Methods to mobilize sludges that are more effective than baseline mixer pumps are needed. Methods are needed that enhance mixer pump performance. Mixer pump have certain limitations - i.e., we have to turn the pumps off at a certain depth, and hence cannot re- mobilize solids (without adding dilution liquid) if waste is transferred in batches. Minimize planned or inadvertent water addition during mobilization. Need to determine if mixer pumps do an adequate job homogenizing the suspension for all scenarios. i.e., will there be a
problem with uniformity when the tank level is getting low? A method is needed for getting a meaningful understanding of physical properties of in situ waste so that the cleaning radius and the need for a backup system can be predicted.

Proposed concepts: A sonic probe that uses low frequency sonic vibration can effectively lower the shear strength of the sludge. By reducing the strength of the sludge, the mixer pumps will provide adequate mobilization to meet the waste removal needs. The sonic probe was originally developed as an alternate to the mixer pump technology for mitigation of tank 101-SY. Alternatively, a clean water sluicer or a few pulse-jet air-operated mixers may provide the best solution.

Justifications:

Technical Justification: This effort is required to ensure that sufficient HLW sludges are available for the Phase I Extended Order Quantity. Approximately 90 to 95% of the sludge in tanks selected to provide HLW feed for Phase I privatization must be retrieved to supply enough sludge for the Extended Order Quantity. Water addition to the tank for the purpose of retrieval or as a result of the process is limited by the cost and schedule of subsequent evaporation.

Regulatory Justification:

ES&H Justification:

Cultural/Stakeholder Factors:

Cost Savings:

Site: Hanford **TFA Functional Area:** Retrieval
TFA Response#: 98028 **Site Need#:** RL-WT028 **Site Priority:** Medium **PBS#:** RL-TW04

Other Justification:

Consequences of Not Filling Need: Sufficient HLW meeting the Phase I specification may not be available for the Extended Order Quantity.

Privatization Potential: This effort to characterize wastes would not be easily prioritized but equipment to weaken sludges should easily be provided by industry.

Current Base Technology and Cost:

SUMMARY OF TFA RESPONSE:
The TFA tentatively rated the priority of the technical response to this need as #15 (TFA Response 98028). The TFA proposes to provide funding in FY99-01, given available funding. The TFA intends to satisfy the following additional need in its technical response: SRS need SR-2915 (TFA Response 98069)

Tanks Focus Area Site Needs

Need Title: Data and Tools for Performance Assessments (Tools)

Site: Hanford **TFA Functional Area:** Closure

TFA Response#: 98029A, B **Site Need#:** RL-WT029 **Site Priority:** Medium **PBS#:** RL-TW09

SITE NEED:

Need Description: Performance assessments must be developed for all disposal actions, and the models that are used for these assessments require a defensible basis for the movement of water. Most databases describe recharge and distribution of water for non-arid conditions. The arid conditions at Hanford are not accurately represented by the existing data. This need is comprised of two elements:

1) Recharge water is the primary means for dissolution and release of contaminants from the buried waste and transport of those contaminants to the groundwater. Estimation of these rates is difficult under arid conditions because the rates are very low. In addition, there are significant questions about the adequacy of the estimated recharge rates given the heterogeneity of the environmental processes, the effect of facility features, the uncertainty of climate, and the influence of humans. Furthermore, no attempt has been made to quantify the distribution of recharge rates to enable sounder estimates of the mean and range of rates to be expected during the time of compliance of the facility.

2) Assessments of waste disposal require the knowledge of hydraulic properties in the unsaturated sediments (the vadose zone). Typically, these properties are inferred or estimated from small cores or particle size distributions obtained from a drilled borehole. Field measurements of hydraulic properties will eliminate the uncertainty when extrapolating small-scale laboratory measurements.

This Technology Needs statement has been included in the Subcon needs list.

Functional Performance Requirements: For recharge issues:

1) Identify range of factors that affect recharge
2) Develop new and innovative methods to determine recharge rates in and around subsurface disposal facilities
3) Estimate recharge rates for a subset of the range of factors and correlate estimates from multiple methods.
4) Use estimates to quantify spatial and temporal distribution of recharge rates for the spatial and temporal extent of the disposal facility.

Factors of interest that can contribute to variable recharge rates include soil type, vegetation, facility and surface cover design, human activity, climate, and time.

For hydraulic properties: Design, construct, and operate a device to measure hydraulic properties in the vadose zone. Measurement of variables such as water content
and matric potential, which are used to calculate conductivity, must be accurate and quick. The device must be portable and reusable.

Schedule Requirements: For use in the Hanford Low-Level Tank Waste Performance Assessments, such data and testing are needed by September 2000. Preliminary versions of the performance assessments will need data by September 1998.

Problem Description: Computer codes, hydraulic measurements, and tracer movement can be used to estimate recharge rates. These techniques are not often used in conjunction, and hardly ever to characterize the spatial distribution of recharge rates.

Justifications:

Technical Justification: Provide technical basis for characterizing the distribution of hydraulic properties and recharge rates in and around the Hanford Low-Level Tank Waste Disposal System. Such information will also be required for other waste management actions involving subsurface disposal.

Regulatory Justification: Performance assessments are required by DOE Order 5820.2A, soon to be revised and issued as DOE Order 435.1. Composite analyses, which also require knowledge of recharge, are required under separate guidance and are related to the soon to be issued 10 CFR 834, Radiation Protection of the Public and the Environment.

Tanks Focus Area Site Needs

Need Title: Data and Tools for Performance Assessments (Tools)

Site: Hanford **TFA Functional Area:** Closure

TFA Response#: 98029A, B **Site Need#:** RL-WT029 **Site Priority:** Medium **PBS#:** RL-TW09

ES&H Justification: Recharge water is the main means for dissolution/release of contaminants from waste and the transport of those contaminants to groundwater.

Cultural/Stakeholder Factors: Disposal of low-activity tank waste has the largest environmental impact of any intentional Hanford action.

Cost Savings: 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.

Other Justification:

Consequences of Not Filling Need: Conservative methods and data will be used in the performance assessment, likely requiring more stringent contaminant release specifications in the waste product request for proposal and requiring more expensive disposal facilities.

Privatization Potential: N/A

Current Base Technology and Cost:

SUMMARY OF TFA RESPONSE:
The TFA developed two separate replies to this need. The first, TFA Response 98029A, replied to the need for Tools for Performance Assessment. The TFA tentatively rated the priority of the technical response to this need as #48. The TFA proposes to provide funding in FY99-00, given available funding.

The second response was TFA Response 98029B, a reply to the requirement for Data for Performance Assessments. The TFA tentatively rated the priority of the technical response to this need as #56. The TFA proposes to provide funding in FY99-00, given available funding.

Tanks Focus Area Site Needs

Need Title: Contaminant Mobility Beneath Tank Farms

Site: Hanford **TFA Functional Area:** Closure
TFA Response#: 98030 **Site Need#:** RL-WT030 **Site Priority:** High **PBS#:** RL-TW03

SITE NEED:

Need Description: Tank farm leak sites and TRU soil column disposal sites are the two most significant vadose sources of potential groundwater contamination at the Hanford Site. Assessment of contaminant mobility of these sources requires site-specific information.

This Technology Needs statement also is included in the Subcon needs list.

Tank Farms. Recent borehole spectral gamma data at the Hanford Site indicate that cesium-137 has migrated deeper than previously expected at both the SX and BX tank farms. Groundwater data for several tank farm waste management areas also suggest that pathways through the vadose zone exist and could impact groundwater quality. These observation suggest that fundamental assumptions about contaminant mobility that support single shell tank cleanup options and schedules may be incorrect, a finding echoed by a recent peer review and the National Academy of Sciences. The transport mechanisms and pathways involved are of concern since other waste components not detectable by spectral gamma logging (e.g., plutonium, technetium-99, strontium-90, chromate, nitrate) may also have migrated farther than anticipated and could still be moving. Revised conceptual models coupled with supplemental geophysical and sorption (mobility) data, are needed to:
1) quantify and understand the evolution of the present distribution of contaminants and
2) to evaluate the potential mobility of the individual contaminants under all "leave or retrieve" options.

Soil Column disposal Sites (PFP Cribs.) Similar needs exist for PFP soil column disposal sites that received large quantities (~20,000 Ci) of transuranics in both a highly acidic aqueous phase and as an organic complex dissolved in an organic phase (carbon tetrachloride). The total contaminated soil volume beneath the PFP cribs is about 1,000,000 cubic meters and may extend to a depth of 40 m or more below ground surface. Some TRU may have migrated deep in the vadose zone in association with the DNAPL. The cost to package, handle and dispose of this volume of TRU (or near TRU) waste (> 100 nCi/g) could easily exceed 1 billion dollars. Excavation and personnel safety related costs would be in addition. Thus stabilization in place, to the extent possible, would be a significant cost savings. Be that as it may, evaluation of either leave or retrieve options will require detailed knowledge of the sorptive status (degree of natural soil "fixation") of the deeply distributed plutonium and americium beneath PFP cribs and trenches.

Functional Performance Requirements: The most cost efficient approach to acquisition of the needed data is to conduct the work as one integrated study of vadose zone contaminant mobility. However, there are specific requirements for the two primary study areas, noted as follows.

Tank Farms. Each tank farm is a highly complex facility consisting of many underground structures, piping, and conduits. All technology solutions must be able to work within this environment and be compatible with tank farm safety operations. Any solution seeking to quantify contaminants and temporal changes must be able to measure the entire range of chemical concentrations (i.e., as high as the 10 M in the original tank liquor) and radionuclide levels (e.g., 0.1 to 107 pCi/g cesium-137). Spectral gamma logging or geophysical methods must also be able to distinguish between interior/exterior borehole contamination versus contamination in the surrounding formation. Sample media dependent
methods (e.g., laboratory sorption and pore fluid extraction and analysis on core samples) must be capable of recovering contaminated, semi-continuous core with minimal disturbance (e.g., no drilling fluids and minimal compaction) down to a depth of 200+ ft.

TRU Soil Column Disposal Sites (PFP Cribs). Selected new core samples from beneath the PFP disposal sites are needed to address the TRU mobility issue. A building over one of the main sites (Z-9 trench) precludes direct drilling and coring through the disposal site. Thus angle drilling and coring methods must be used. The core samples must be semi-continuous all the way to groundwater and must be from directly beneath the structure to ensure passing through the main soil column contaminant plume down to groundwater. Drilling and coring operations must be compatible with on-going activities in the area (soil vapor extraction). Core samples must be minimally disturbed (no drilling fluids) and radiological containment and handling of TRU

waste (cuttings and core samples) is required. Evaluation of the sorptive status of transuranics must include "desorption" or leachability testing for which radiologically contained test equipment is required (e.g., ultracentrifuge, core sectioning glove box, etc.). Trained personnel and equipment to conduct this specialized work are unique to the Hanford Site. Thus expensive shipping and handling of TRU contaminated sample media can be avoided by conducting the work on site.

Schedule Requirements: The ER program is scheduled to begin vadose zone characterization and remediation in the 200 Areas (where the tank farms and PFP cribs are located) in 2003. The mobility data is needed at an early date to support technically sound cleanup decisions. A recent U.S. Senate inquiry (Senator Wyden, Oregon) on the same subject underscores these concerns. Requirements for long-term stabilization and/or cleanup of residual waste left in the tanks, or in the soil column beneath tanks and soil column disposal sites, are included in a recent
stakeholder-prepared document (Requirements for the Columbia River Comprehensive Impact Assessment, Part II, TPA milestone M-15-80A and B). In addition, because of uncertainty about the mobility of the contaminants, stakeholders such as the states of Oregon and Washington and Native American tribes are concerned about what is moving now.

Problem Description: Inadequate in situ contaminant mobility data exists for single shell tank leaks and major soil column transuranic disposal sites to support cleanup, closure or performance assessment related decisions.

Justifications:

Technical Justification: In situ contaminant mobility data for tank leak and TRU disposal sites is not currently available, and currently available tools for in situ characterization are inadequate.

Regulatory Justification: Needed for on-going tank farm RCRA assessments of nature and extent of the cause of groundwater contamination at nearly half the tank farm sites.

ES&H Justification: Contaminant mobility data is fundamental to prediction of environmental and human health effects (dose) due to groundwater and Columbia River exposure pathways, as called for in the CERCLA requirements document and cleanup related risk assessments.

Cultural/Stakeholder Factors: Lack of contaminant mobility data is a major concern among stakeholders as expressed in HAB communications and the CRCIA requirements document.

Cost Savings: Stabilization in place option for TRU beneath PFP cribs alone could result in a savings of over 1 billion dollars. Potential return on investment is ~1000:1.

Other Justification:

Consequences of Not Filling Need: Without knowledge about the distribution of contaminants beneath the tank farms, and without the ability in hand to predict contaminant movement, it will be impossible to assure the public that the DOE can predict:

a) the impact of leaks during sluicing of the tanks during cleanup, and
b) the impact of leaving the tanks (and their associated subsurface contamination) in place.

Furthermore, the vadose zone cleanup schedule for the 200 Areas could be delayed if the mobility status of deeply distributed transuranics is unknown, or inadequately characterized, well enough in advance. For example, if it is eventually determined that retrieval of TRU-contaminated soil down to 40 m or more beneath PFP cribs is required, the cleanup schedule could be greatly impacted due to inadequate financial planning for

excavation and handling costs that could approach 1 billion dollars or more. The sooner this issue is resolved the sooner more accurate financial and schedule forecasts can be made.

Privatization Potential: Aspects that do not require recovery and handling of highly contaminated sample media may have outsourcing potential (e.g., advanced geophysical logging). A CRADA with Schlumberger was previously in place for some of the advanced geophysical logging needs.

Current Base Technology and Cost:

SUMMARY OF TFA RESPONSE:
The TFA tentatively rated the priority of the technical response to this need as #31 (TFA Response 98030). The TFA proposes to provide funding in FY99-00, given available funding, however the TFA will make contact with the Subcon Focus Area to coordinate any active response to this need.

Tanks Focus Area Site Needs

Need Title: Technologies to Reduce Generation of or Alternative Treatments for Radioactive Liquid Waste at the ICPP

Site: Idaho **TFA Functional Area:** Retrieval

TFA Response#: 98031 **Site Need#:** ID-2.1.01 **Site Priority:** 1 of 13 **PBS#:** ID-HLW-101

SITE NEED:

Need Description: Historically, high-level waste (HLW) generated at the Idaho Chemical Processing Plant has been stored in the Tank Farm and then calcined and the calcine stored in bin sets. With the curtailment of spent nuclear fuel reprocessing in 1992, the HLW treatment methods were re-evaluated to establish a path forward for producing a final waste form from the HLW calcine and sodium bearing wastes (SBW). The baseline treatment method (until the Record of Decision on the Environmental Impact Statement is complete in 1999) is to continue calcining this waste until 2012. Processes operating at the ICPP (i.e, Fuel Processing Complex (CPP-601), Fuel Receipt and Storage Facility (CPP-603), Headend Processing Plant (CPP-640), Waste Calcine Facility (CPP-633, etc.)) generate hazardous radioactive liquid waste which is stored in the ICPP Tank Farm. Based on the current operating assumptions, the SBW cannot be calcined by the end of 2012 as required by the Idaho Settlement agreement. Additional reductions in waste generation rates and/or implementation of treatment methods other than calcination for certain waste streams will be required to meet the 2012 Settlement Agreement requirement.

Several areas of improvement are being pursued.
- Reduction of waste (radioactive and mixed) from decontamination activities.
- Reduction of wastes (radioactive and mixed) generated by optimizing processes.
- Reduction of precipitation runoff into contaminated areas.
- Alternative treatments for radioactive waste streams (primarily water) from fuel storage basins, well monitoring activities and precipitation runoff (which may or may not also contain some RCRA hazardous waste codes).

Functional Performance Requirements: Need area:
Alternative treatments for radioactively contaminated water and alternative treatments for radioactively contaminated water containing cadmium.
- This treatment shall remove radioactive/hazardous components in the water allowing free release to the environment or shall provide an alternate disposal path.
- This treatment shall not include use of the evaporator system currently in place at the ICPP.

Alternatives for disposal of a variety of analytical wastes
- This alternative shall provide cost effective, environmentally safe disposal paths for waste generated from analytical processes.

Methods to prevent in-leakage of precipitation runoff into utility tunnels and sumps.
- This method shall reduce or eliminate runoff of water into utility tunnels, sumps and other radioactively/hazardous contaminated areas within the ICPP.

Schedule Requirements: The current schedule requires a 35% reduction in the waste going to the tank farm within the next 5 years. A special emphasis on the non-process related streams is to eliminate sending them to the tank farm by 2005.

Problem Description: The High Level Waste (HLW) Program's challenge is to treat, store, and disposition high level waste in an environmentally acceptable and safe manner. There are currently 1.7 million gallons of liquid radioactive waste and 3,800 cubic meters of high level waste calcine to treat and store while meeting Idaho, DOE and other requirements. DOE and the State of Idaho have a Settlement Agreement that requires the calcination of all radioactive liquid waste contained in the ICPP tank farm be completed by 2012.

Current Baseline Technology: Cleaning is currently done primarily with water, chemicals, steam sprays, CO2 pellet blasting and liquid abrasive blasting. Slightly contaminated water is treated the same as highly radioactive hazardous solutions by evaporation then calcination. All water is not evaporated due to equipment constraints.

Need Title: Technologies to Reduce Generation of or Alternative Treatments for Radioactive Liquid Waste at the ICPP

Site: Idaho **TFA Functional Area:** Retrieval
TFA Response#: 98031 **Site Need#:** ID-2.1.01 **Site Priority:** 1 of 13 **PBS#:** ID-HLW-101

Current baseline Assumptions:
1. (ASSUM.70) No Mixed-Waste Generation By HLW Pilot Plants: The HLW Process Technology pilot plants will not generate any mixed-waste. Source: WBS Dictionary For High Level Process Technology (WBS # 1.6.01.2.T0)
2. (ASSUM.95) New Decontamination Methods Will Be Implemented: Radioactive Liquid Waste Reduction Development will result in new decontamination methods which will be implemented. Source: WBS Dictionary For Decontaminated Equipment (WBS # 1.6.01.5.02)
3. (ASSUM.TYP.12) 35% Waste Reduction Required & Possible: A 35% decrease in previously predicted future waste generation rates is required and possible. Source: INEL TYP Draft 2/97 (Vol. II/Part B/Attachment C/ID-HLW-01/C.3/No. 6/Pg. C-16)

Justifications:

Technical Justification: More efficient decontamination technologies and alternative operating techniques are currently being investigated as part of the EM-30 funded HLW Development Program (WBS # 1.6.01.8.P0 and 1.6.01.8.T0, ADS 1008). However, the reductions must be greater and sooner to meet the goals. Currently 100,000 to 150,000 gallons of additional waste (after evaporation) are added to the tank farm each year. In addition, much of this waste contains high sodium or potassium levels that create solutions that must be diluted with cold chemicals to allow calcination thus increasing final waste volumes.

Specific need areas include: alternative treatments for radioactively contaminated water, alternative treatments for radioactively contaminated water containing cadmium, alternatives for disposal of a variety of analytical wastes, methods to prevent in-leakage of precipitation runoff into utility tunnels and sumps.

Regulatory Justification: External Requirements:
1. (EIS.2) Minimize High-Activity Waste: DOE will develop a treatment that minimizes high-activity waste at the INEL. Source: INEL Site Environmental Impact Statement of Spring 1995 (Vol.2/Summary/Pg.19)
2. (SA.7) Complete SBW Calcination: DOE shall complete calcination of SBW by Dec. 31, 2012. Source: Settlement Agreement (Pg.7/E.5)

Derived Requirements:
1. (HLW.3) HLW Facilities Will Treat Waste From Planned D&D Activities: The storage and treatment facilities of HLLW shall handle the HLLW, if any, resulting from the D&D activities of the following facilities: 1) Central Liquid Waste Processing Facility, 2) Engineering Test Reactor, 3) Materials Test Reactor, 4) Fuel Processing Complex (CPP-601), 5) Fuel Receipt and Storage Facility (CPP-603), 6) Headend Processing Plant (CPP-640), 7) Waste Calcine Facility (CPP-633), 8) Auxiliary Reactor Area, and 9) Boiling Water Reactor Experiment.

External Requirement Trace:
1. (ROD.25) Major D&D Plans. Source: INEL Site Record of Decision of 6/1/95, (Pg.20)
2. (ROD.26) D&D Projects That Will Continue. Source: INEL Site Record of Decision of 6/1/95, (Pg.20). External Documents Trace: INEL Site Record of Decision of 6/1/95.

ES&H Justification: Waste Minimization/Pollution Prevention. The ICPP tank farm contains RCRA hazardous waste but is not compliant with RCRA double containment requirements.

Cultural/Stakeholder Factors:

Cost Savings: Penalties would be high if the Settlement Agreement is not met. Also, a recent evaluation on the cost of processing decontamination solutions indicated a difference of about $2500 to process 100 gallons of some types of chemicals and $50,000 for others due to the waste treatment process limitations and final waste

volumes which must be treated and stored. Also, another calcine bin set may have to be built if reductions in the liquid waste generated are not high enough.

A reduction of 35% of two million gallons future radioactive liquid reduction would be equal to 700,000 gallons in the tank farm. At an estimated cost of $156/gal (per Brent Palmer), this reduction would result in a $109 million dollar cost savings.

Other Justification: Cost Requirements: The currently proposed EM-30 budget to identify the alternatives is shown in the table below. Implementation or project cost of the alternatives are not included.

LMITCO WBS 1.6.01.8
FY-98 Cost Estimate - $877.9K
FY-99 Cost Projection - $849K
FY-00 Cost Projection - $849K
FY-01 Cost Projection - $849K
FY-02 Cost Projection - $749K
FY-03 Cost Projection - $849K
FY-04 Cost Projection - $711K
FY-05 Cost Projection - $711K
FY-06 -FY12 - $711K/yr

Consequences of Not Filling Need: May not meet Settlement Agreement milestone dates. Also additional costs in processing and storing the extra waste generated.

Privatization Potential:

Current Base Technology and Cost: An evaluation on the cost of processing decontamination solutions indicated a difference of about $2500 to process 100 gallons of some types of chemicals and $50,000 for others due to the waste treatment process limitations and final waste volumes which must be treated and stored.

SUMMARY OF TFA RESPONSE:
The TFA did not rate the technical response to this need separately (TFA Response 98031). The TFA intends to satisfy this need through the technical response prepared for SRS need SR-2907 (TFA response 98058).

Tanks Focus Area Site Needs

Need Title: Process Flowsheet to Calcine Sodium-Bearing Waste

Site: Idaho **TFA Functional Area:** Pretreatment
TFA Response#: 98032 **Site Need#:** ID-2.1.02 **Site Priority:** 3 of 13 **PBS#:** ID-HLW-101

SITE NEED:

Need Description: Radioactive liquid waste containing large quantities of sodium has accumulated over the years and is stored in the ICPP tank farm. This waste is referred to as sodium-bearing waste (SBW) and was generated as a result of extraction system solvent cleanup and decontamination efforts. Sodium nitrate and potassium nitrate are major components of the SBW. SBW is difficult to calcine due to agglomeration and caking of molten sodium nitrate and potassium nitrate that persist in the calcine product. The pure component decomposition temperatures for sodium nitrate and potassium nitrate are 380C and 400C, respectively. However, the thermal decomposition of the nitrates is not fully achieved by calcination at 500C (the normal operating temperature of the NWCF) due to mass transfer and kinetic limitations and due to the formation of eutectic phases during drying. Section E5 of the Settlement Agreement with the State of Idaho requires that the SBW be calcined by 2012. This commitment cannot be met using the established SBW calcination flowsheet due to the copious quantity of aluminum nitrate that is required. Therefore, alternative calcination schemes must be investigated to meet objectives of increased throughput, reduced waste volumes, and reduced cost.

Development of alternative calcination flowsheets is needed to efficiently process the ICPP tank farm SBW. The existing flowsheet cannot efficiently calcine SBW due to incomplete conversion of the nitrates to oxides at the 500C operating temperature of the NWCF, resulting in agglomeration of particles. The new flow sheet must denitrate the waste more effectively to prevent agglomeration and be efficient by increasing throughput, reducing waste volumes, and reducing cost. The net throughput of waste must increase by a minimum of 30% to be able to meet the commitment date in the Settlement Agreement.

Functional Performance Requirements: The SBW calcination flowsheet shall use the existing NWCF process, with minimal modifications required. The operating temperature shall not be greater than 600C. The flowsheet shall process all of the SBW in the ICPP tank farm by December 31, 1997; approximately 30% improvement to the baseline throughput is required. The flowsheet shall comply with safety and environmental regulations applicable to the NWCF. The flowsheet shall produce a well-fluidized bed that does not agglomerate. The calcine generated shall fit in existing available storage bin space. The calcine generated shall be pneumatically transportable and retrievable. The calcine generated shall be compatible with flowsheets for subsequent processing and treatment for final disposal (i.e., calcine dissolution/radionuclide separations, LAW fraction grouting, and HAW fraction vitrification).

Schedule Requirements: Section E5 of the Settlement Agreement with the State of Idaho requires that the SBW be calcined by December 31, 2012. This requires that the NWCF be modified and operational by FY-06. Process flowsheet development is expected to continue through FY-02 to support the full-scale project for NWCF modification.

Problem Description: The INEEL has operated nuclear facilities to support national interests for several decades including, since 1953, the development of technologies for the storage and reprocessing of spent nuclear fuel (SNF) and the resultant radioactive wastes. The decision to discontinue reprocessing of SNF left nearly 289 metric tons heavy metal (MTHM) of SNF in storage at the INEEL with unspecified plans for future disposition. Additionally, 1.8 million gallons of radioactive liquid wastes (1.5 million gallons of radioactive sodium-bearing liquid wastes and 0.3 million gallons of high-level liquid wastes (HLLW)) and 3800 cubic meters of calcine waste are in inventory at the Idaho Chemical Processing Plant (ICPP). These facts, along with increased environmental awareness within the Department of Energy (DOE) and among its contractors and stakeholders, mandate operation of existing and future facilities in an environmentally responsible manner and require satisfactory resolution of radioactive waste issues resulting from past activities. The High Level Waste (HLW) Program will, ultimately, recommend and implement technologies and processes to facilitate the conditioning and certification of radioactive wastes for permanent disposal. The primary scope and objectives are to meet compliance with the Site Treatment Plan (STP) and the Settlement Agreement with the State of Idaho. Success will be measured in terms of safety, life-cycle cost, regulatory compliance, and pollution prevention.

Tanks Focus Area Site Needs

Need Title: Process Flowsheet to Calcine Sodium-Bearing Waste

Site: Idaho **TFA Functional Area:** Pretreatment
TFA Response#: 98032 **Site Need#:** ID-2.1.02 **Site Priority:** 3 of 13 **PBS#:** ID-HLW-101

Current Baseline Technology: The current baseline technology for treating SBW is to calcine it by blending it with HLW raffinates. However, all of the HLW raffinates will be depleted by June 1998, at which time there will still exist approximately 1.5 million gallons of SBW. Calcining SBW by blending it with aluminum nitrate to act as a surrogate for HLW raffinates, is also technically feasible. However, because of the copious quantity of chemicals that must be added, the net processing rate of SBW is decreased significantly enough that the Settlement Agreement with the State of Idaho cannot be met. Additionally, the added chemicals will significantly increase the volume of calcine generated beyond the point of that which will fit in existing storage bins. The increased volume also results in increases to subsequent treatment and disposal costs.

Current Baseline Assumptions: Sufficient HLW raffinates would be available from continued fuel reprocessing to blend with SBW for calcination. There were no commitment dates for "cease use" of the ICPP tank farm tanks nor for calcining the SBW.

Justifications:

Technical Justification: A flowsheet is needed to process the SBW because traditional flow sheets are not effective at calcining SBW. SBW cannot be calcined in the traditional manner as high level waste, because of the high concentration of sodium and potassium nitrates. These constituents melt at the normal calcination temperature of 500C, rather than converting to oxides. Therefore, the particles agglomerate and prevent fluidization of the bed. In the past, SBW was blended with larger volumes of high level waste raffinates, to effectively dilute the nitrates and eliminate agglomeration. However, in 1992, it was decided that the ICPP would no longer reprocess fuel, thereby, eliminating the source of HLW raffinates for blending with SBW. It is possible to substitute surrogates (eg, aluminum nitrate) for the HLW raffinates, however, blending with cold chemicals significantly decreases the net throughput of waste, increases the volume of high level waste, and increases the costs for further treatment and disposal of HLW. The decrease in net waste processing is significant enough that the Settlement Agreement commitment cannot be made under this processing scenario. In addition, the waste volume generated would require additional calcine storage space, which does not currently exist nor is planned. Therefore, a SBW flowsheet is needed that will increase net waste throughput to meet the Settlement Agreement and decrease waste volume so that the calcine generated will fit in existing storage bins and minimize subsequent waste treatment and disposal costs.

Regulatory Justification: Section E5 of the Settlement Agreement between the DOE, State of Idaho, and the US Navy requires that the sodium-bearing waste in the ICPP tank farm be calcined by December 31, 2012. The existing concept of processing the SBW by blending it with aluminum nitrate decreases the net processing of waste through the calciner due to the addition of chemicals to the waste feed. This decrease is significant enough that the agreement date cannot be met by processing with a blend of aluminum nitrate. Calcination with chemical additives would require the NWCF to run through the year 2020 to process all of the SBW; assuming 10 campaign cycles of 18 months of operation and 12 months downtime.

ES&H Justification: In June of 1989, an INEEL site inspection was performed by the EPA and the State of Idaho charging that neither the tank farm vaults nor some of the lines and valve boxes in the tank farm met Resource Conservation and Recovery Act (RCRA) requirements for secondary containment. The inspection resulted in a January 29, 1990 Notice of Noncompliance (NON). Subsequently, a NON Consent Order was issued April 3, 1992, requiring DOE to permanently cease use of tanks with pillar and panel vaults by March 31, 2009, and the remaining tanks by June 30, 2015. These dates were subsequently accelerated by the Settlement Agreement with the State of Idaho to require calcination of the SBW in the ICPP tank farm by December 31, 2012. An improved flowsheet will also result in minimizing the volume of calcine waste generated.

Cultural/Stakeholder Factors: An improved flowsheet for calcining SBW will allow the ICPP to "cease use" of the tank farm sooner, alleviating Stakeholder concerns about storing liquid radioactive waste in tanks, over the Snake River Aquifer, which do not comply with seismic and/or RCRA requirements.

Need Title: Process Flowsheet to Calcine Sodium-Bearing Waste

Site: Idaho **TFA Functional Area:** Pretreatment
TFA Response#: 98032 **Site Need#:** ID-2.1.02 **Site Priority:** 3 of 13 **PBS#:** ID-HLW-101

Cost Savings: Significant cost savings will be realized by implementing an improved flowsheet for calcining SBW. A more efficient flowsheet will reduce the operating costs by shortening the operating time needed to calcine the SBW; reduce calcine storage space needs; reduce the volume of calcine requiring subsequent treatment for final disposition; and reduce final repository space requirements.

Other Justification: Cost Requirements: The end user shall spend $642K towards developing this technology in FY-98; additional development will be required in subsequent years, with associated costs unknown at this time.

Consequences of Not Filling Need: The Settlement Agreement with the State of Idaho will not be met. This will significantly reduce the trust and credibility that the DOE and INEEL have with Stakeholders. Additionally, their concerns about storing liquid radioactive wastes in tanks, over the Snake River Aquifer, which do not comply with seismic and/or RCRA requirements will continue to grow. The life-cycle cost to process the SBW will be significantly greater than with a more efficient flowsheet. This will adversely affect taxpayers who fund the work at the INEEL.

Privatization Potential:

Current Base Technology and Cost: The cost related specifically to calcination of the waste is difficult to define and would not provide an accurate comparison on a life-cycle basis, because calcination is only an intermediate step to the entire treatment process.

SUMMARY OF TFA RESPONSE:
The TFA tentatively rated the priority of the technical response to this need as #29 (TFA Response 98032). The TFA is providing funding in FY98 and proposes to provide funding in FY99-00, given available funding.

Tanks Focus Area Site Needs

Need Title: Method to Separate Undissolved Solids from Sodium-Bearing Waste & Dissolve Calcine

Site: Idaho **TFA Functional Area:** Pretreatment

TFA Response#: 98033 **Site Need#:** ID-2.1.04 **Site Priority:** 20 **PBS#:** ID-HLW-103

SITE NEED:

Need Description: Methods to remove undissolved solids from tank waste and dissolved calcine are needed. The solids must be removed to ensure the separation processes can achieve NRC Class A LLW criteria. The solids contain high levels of radioactivity which, if not removed, will result in greater that Class A LLW and may also upset separation process operation.

Functional Performance Requirements: Unknown at this time.

Schedule Requirements: Need by 2007 to support title design of production facility

Problem Description: Undissolved solids present in tanks and from calcine dissolution processes must be removed to achieve LLW specifications from separations processes. The solids contain high levels of radioactivity which, if not removed, will result in greater that Class A LLW and may also upset separation process operation.

Justifications:

Technical Justification: Undissolved solids present in tanks and from calcine dissolution processes must be removed to achieve LLW specifications from separation processes. The solids contain high levels of radioactivity which, if not removed, will result in greater that class A LLW and may also upset separation process operation.

Regulatory Justification: Necessary to meet Settlement Agreement (court order) between DOE, State of Idaho and Navy.

ES&H Justification:

Cultural/Stakeholder Factors: Unknown.

Cost Savings: None.

Other Justification:

Consequences of Not Filling Need: Failure to meet Settlement Agreement.

Privatization Potential: High, within 3-5 years.

Current Base Technology and Cost: Unknown.

SUMMARY OF TFA RESPONSE:

The TFA screened out this need (TFA Response 98033). Work activities addressing the need are underway and scheduled to be completed by the end of FY98. The need for continued efforts has not beed adequately defined.

Tanks Focus Area Site Needs

Need Title: Dissolution of ICPP Calcines

Site: Idaho **TFA Functional Area:** Pretreatment
TFA Response#: 98034 **Site Need#:** ID-2.1.05 **Site Priority:** 21 **PBS#:** ID-HLW-103

SITE NEED:

Need Description: Methods to dissolve calcine are needed. The calcine must be dissolved to put it in a form readily amenable to aqueous separation technologies.

Functional Performance Requirements: Unknown at this time.

Schedule Requirements: Need by 2007 to support title design of production facility.

Problem Description: Calcine must be dissolved to put it in a form that is compatible with radionuclide separation technologies. Parameters affecting dissolution efficiency must be defined and scale-up and design of a calcine dissolver must be completed.

Justifications:

Technical Justification: Calcine must be dissolved to put it in a form that is compatible with radionuclide separation technologies. Parameters affecting dissolution efficiency must be defined and scale-up and design of a calcine dissolver must be completed

Regulatory Justification: Necessary to meet Settlement Agreement (court order) between DOE, State of Idaho and Navy.

ES&H Justification:

Cultural/Stakeholder Factors: Unknown.

Cost Savings: $17.7 M potential cost savings.

Other Justification:

Consequences of Not Filling Need: Failure to meet Settlement Agreement.

Privatization Potential: Moderate, within 5-7 years.

Current Base Technology and Cost:

SUMMARY OF TFA RESPONSE:

The TFA tentatively rated the priority of the technical response to this need as #25 (TFA Response 98034). The TFA proposes to provide funding in FY99-01, given available funding.

Need Title: Solvent Extraction and Ion-Exchange to Remove TRU, Sr, Tc, and Cs from ICPP Tank Farm

Site: Idaho **TFA Functional Area:** Pretreatment

TFA Response#: 98035 **Site Need#:** ID-2.1.06 **Site Priority:** 22 **PBS#:** ID-HLW-103

SITE NEED:

Need Description: Removal of TRU, Sr, and Cs from tank waste and dissolved calcine. Solvent extraction and ion-exchange technologies must be demonstrated on actual INEL radioactive waste streams to ensure full-scale processes will adequately recover the active constituents to convert the bulk of the waste to LLW.

Functional Performance Requirements: TRU:<10nCi/g, Sr:<0.04Ci/m3, Cs:<1Ci/m3.

Schedule Requirements: Need by 2007 to support title design of production facility.

Problem Description: TRU's, Cs and Sr comprise less than one percent of the total INEL radioactive waste volume. If these elements can be removed from the bulk (inert) elements in the waste, a significant reduction in the volume of HLW would be realized.

Justifications:

Technical Justification: TRU's, Cs and Sr comprise less than one percent of the total INEL radioactive waste volume. If these elements can be removed from the bulk (inert) elements in the waste, a significant reduction in the volume of HLW would be realized.

Regulatory Justification: Necessary to meet Settlement Agreement (court order) between DOE, State of Idaho and Navy.

ES&H Justification:

Cultural/Stakeholder Factors: Unknown.

Cost Savings: >$1.15 B potential cost savings.

Other Justification:

Consequences of Not Filling Need: Failure to meet Settlement Agreement.

Privatization Potential: High, within 3-5 years.

Current Base Technology and Cost:

SUMMARY OF TFA RESPONSE:

The TFA tentatively rated the priority of the technical response to this need as #24 (TFA Response 98035). The TFA is providing funding in FY98 and proposes to provide partial funding in FY99, given available funding.

Tanks Focus Area Site Needs

Need Title: Develop Technology to Stabilize/Solidify ICPP Low-Activity Waste

Site: Idaho **TFA Functional Area:** Immobilization

TFA Response#: 98036 **Site Need#:** ID-2.1.07 **Site Priority:** 24 **PBS#:**

SITE NEED:

Need Description: Technology is required for grouting the low-activity waste (LAW) generated at ICPP. These wastes include the LAW from separations operations, facility decontamination solutions, and low-activity process equipment wastes. LAW from the separation of high activity wastes will be acidic and high in nitrates. Both of these are detrimental to grout chemistry; thus, basic research is needed to develop grout formulations that will solidify and stabilize these wastes. Annually, about 100,000 to 150,000 gallons of liquid waste are added to the tank farm inventory from decontamination and process equipment wastes, much of which could be grouted. Grout formulations and qualified waste forms are also needed for these waste streams.

Current EM-30 budgets are limited and will not be sufficient to meet the Settlement Agreement schedule. Additional funding is needed to accelerate the research program to support the Environmental Impact Statement process and to meet design input for the proposed Waste Treatment Facility.

Functional Performance Requirements: The grouted "product" will be low-activity and/or mixed low-activity waste. The waste must meet the stability requirements of 10 CFR Part 61 as noted in the Nuclear Regulatory Commission Low-Level Waste Management Branch Technical Position on Waste Form, January 1991, for structural stability and leach resistance of radionuclides. The waste must also meet the requirements of 40 CFR Part 268 for leach resistance of hazardous components.

Schedule Requirements: Research data needed by 2007 to support title design of the immobilization facility.

Problem Description: The low-activity wastes from the separations process will be acidic and high in nitrates, both of which are detrimental to grout chemistry. The LAW at other DOE sites is basic; therefore, their grout formulations are not applicable to ICPP LAW. Due to the high acidity and nitrates in the waste, waste conditioning is necessary prior to grouting. Grout formulation consists of blending and proportioning the waste with cements such as ordinary portland cement, blast furnace slag, and coal power plant fly ash. Once the grout formulation is developed for a specific LAW stream, extensive waste form qualification is required to document grout stability and leach resistance. Waste form qualification includes compressive strength after initial curing, immersing, and thermal cycling and leach tests for radionuclides and hazardous components. This is an iterative research process between waste conditioning, grout formulation, and waste form qualification. Equipment is needed to condition the simulated waste, mix grout, prepare full-size waste forms, core drill waste form, and conduct thermal cycle tests.

Technology Needs/Opportunities Statement Outline #2.1.14 notes the need for waste preconditioning technology. Evaporation and thermal calcination will be studied to solidify the waste and destroy the nitrates to provide a solid product for grouting. Once the preconditioning study is complete, the "product" will need to be evaluated to determine if it can be grouted successfully. This may be an iterative process between the separations processes, preconditioning processes, and the grouting process.

Justifications:

Technical Justification: Grout formulations, mixing processes and equipment, and waste form qualification are needed for ICPP LAW treatment/disposal.

Regulatory Justification: DOE Order 5820.2a - Radioactive Waste Management, 10 CFR Part 61 - Licensing Requirements for Land Disposal of Radioactive Waste, and 40 CFR Part 268 - Land Disposal Restrictions must be met for grouted LAW generated at ICPP.

ES&H Justification: The LAW form must meet the environmental standards contained in the regulations noted above. The grouting process and facility must maintain the safety and health of the operators and the public.

Tanks Focus Area Site Needs

Need Title: Develop Technology to Stabilize/Solidify ICPP Low-Activity Waste

Site: Idaho **TFA Functional Area:** Immobilization

TFA Response#: 98036 **Site Need#:** ID-2.1.07 **Site Priority:** 24 **PBS#:**

Cultural/Stakeholder Factors: An area of public concern is the liquid wastes stored at ICPP. Grouting LAW is an internationally accepted process and will solidify the liquid wastes and will stabilize the hazardous material by meeting leach requirements.

Cost Savings: The volume of high activity waste could be significantly reduced by grouting the decontamination and process equipment waste rather mixing them with the high activity waste (no estimate available). Separating the high activity waste and grouting of the low-activity waste reduces the volume of high activity vitrified waste to be sent to a geological repository; thus reducing costs (savings included in separations estimates). The waste conditioning process, denitration, reduces the waste-to-grout volume by 3 to 8 times which will save in LAW storage costs -- potential savings of $10.5M over 15 years. This assumes average volume reduction of 5 and an operating cost of $3.2M/yr. Denitration could reduce non-labor materials by 30% and labor costs by 20% for an operating cost of $2.5M/yr.

Other Justification: This Technology Needs Statement covers LAW grout formulation, mixing, and curing processes. Technology Needs Statement #2.1.14 discusses preconditioning processes to prepare LAW prior to grouting.

Consequences of Not Filling Need: The Batt Settlement Agreement will not be met. Liquid waste will continue to accumulate.

Privatization Potential:

Current Base Technology and Cost: Baseline cost from 1997 to 2002 totals about $5 million. The pilot plant construction estimate is $5 million. Pilot plant operational costs for chemicals, grout, other materials, and labor have not been determined.

SUMMARY OF TFA RESPONSE:
The TFA tentatively rated the priority of the technical response to this need as #28 (TFA Response 98036). The TFA is providing funding in FY98 and proposes to provide funding in FY99-00, given available funding.

Tanks Focus Area Site Needs

Need Title: Develop Technology/Process for the Immobilization of High Activity Waste

Site: Idaho **TFA Functional Area:** Immobilization

TFA Response#: 98037 **Site Need#:** ID-2.1.08 **Site Priority:** 26 **PBS#:** ID-HLW-102

SITE NEED:

Need Description: Technology is needed to develop a process that immobilizes the HAW fraction from ICPP calcine dissolution and radionuclide separation. Vitrification is considered the "Best Demonstrated Available Technology" (40CFR268, Federal Register/Vol. 57, No. 101, pgs 22046-22047, May 26, 1992) for immobilizing highly radioactive wastes. Precedents are established for the use of a vitrification process to immobilize highly radioactive wastes by the operation of the Defense Waste Processing Facility at the Savannah River site and the West Valley Demonstration Plant at the West Valley site. Exact vitrification technologies from these sites cannot be transferred for use at the INEL because of the unique composition of the HAW wastes. Thus variations in the vitrification process need to be incorporated in order to make the HAW "road ready" by year 2035 as required in section E. 6 of the Batt Settlement Agreement.

Cost Requirements ($M):

Vitrification Plant, Total Capital	501
Vitrification Plant, Total Operating	328
Vitrified Waste Storage, Total Capital	22
Vitrified Waste Storage, Total Operating	15
Total	866

Functional Performance Requirements: 1) The initial major performance requirement for immobilization is to determine that the HAW composition can be vitrified. Thus vitrification formulation development must first be interfaced with separations development to demonstrate that the HAW product can be vitrified to a useful glass. This synergism may require not only alterations in the vitrification formulation, but also in the HAW product composition meaning consequent alteration of the separations process. Useful vitrification of the HAW product will be achieved when such a product meets all waste form performance specifications for repository storage as established in the 1993 DOE-EM Waste Acceptance Product Specifications (WAPS).
2) The next major performance requirement is that a process must be developed to produce the acceptable vitrified product on a production scale. The quality assurance record that documents the development of this process will be established in accordance with DOE/RW-0333P. The product of this process must also meet all the performance specifications established in the WAPS. These include specifications for waste forms, canisters, canistered waste forms, quality assurance and documentation. Production records will also be maintained of the production of canistered vitrified waste to characterize it as specified in the WAPS.

Schedule Requirements: 1) Section E.6 of the Batt Settlement Agreement requires that all calcined wastes and liquid sodium bearing wastes will be rendered ready (immobilized) for transport to a suitable repository by December 31, 2035.
2) This requires that DOE evaluate means to suitably immobilize these wastes and issue by the end of year 2009 a treatment plan for meeting the 2035 date.

Problem Description: The HAW product generated by the separations process will be of unique chemical compositions. These compositions will range from those consisting of zirconia, calcium stabilized zirconia, phosphates and fluorides to those consisting mainly of alumina. Thus, although immobilization of high activity radioactive wastes exists as a production scale technology, no vitrifying formulations are readily available for the HAW composition. A technology to develop vitrifying formulations has been defined through years of high-level waste management experience at the ICPP. This technology must be applied in order to define vitrifying formulations that can be used in a full scale process to accomplish the basic requirement of Section E.6 of the Batt Settlement Agreement that all HAW will be rendered ready for transport to a suitable repository by the end of year 2035.

Justifications:

Technical Justification: Immobilization process not developed for ICPP HAW compositions.

Need Title: Develop Technology/Process for the Immobilization of High Activity Waste

Site: Idaho **TFA Functional Area:** Immobilization

TFA Response#: 98037 **Site Need#:** ID-2.1.08 **Site Priority:** 26 **PBS#:** ID-HLW-102

Regulatory Justification: Section E.6 of the Batt Settlement Agreement requires that calcined wastes be rendered ready for transport to a permanent or interim storage repository by the end of year 2035.

ES&H Justification: Eliminate potential for SBW to leak from tanks, immobilize calcine stored in geologically unsound Bin set 1.

Cultural/Stakeholder Factors: Batt Settlement Agreement is that HLW will be road-ready by year 2035. This removes storage of highly radioactive wastes from over the Snake River Aquifer, especially those in Bin set 1 which does not comply to seismic requirements.

Cost Savings: Significant cost savings can be realized by vitrifying the HAW fraction of calcine when compared to total calcine vitrification. This cost savings takes place because of the approximately ten-fold reduction in volume in vitrifying the HAW fraction meaning significantly reduced transport and repository storage costs.

Other Justification:

Consequences of Not Filling Need: Violate Batt Settlement Agreement, Section E.6.

Privatization Potential:

Current Base Technology and Cost: EM-30: $850K, EM-50: $300K.

SUMMARY OF TFA RESPONSE:
The TFA did not rate the technical response to this need separately (TFA Response 98037). The TFA intends to satisfy this need through the technical responses prepared for SRS needs SR-2906 (TFA Response 98059) and SR-2910 (TFA Response 98062).

TFA Response#: 98037
Site Need#: ID-2.1.08

Tanks Focus Area Site Needs

Need Title: Remove and Transport Calcine

Site: Idaho **TFA Functional Area:** Retrieval
TFA Response#: 98038 **Site Need#:** ID-2.1.09 **Site Priority:** 27 **PBS#:** ID-HLW-103

SITE NEED:

Need Description: An efficient system for retrieving radioactive calcine from storage bins and transferring it to a future calcine treatment facility must be developed. Retrieval must be performed remotely, due to the high radiation fields generated by the calcine. The equipment required to accomplish this task has not been designed and retrieval was not a major consideration during the design of the storage bins. Calcine retrieval development is needed to support operation of a full scale treatment facility in 2020, as determined through the INEL EM Integration Effort to meet the court ordered Batt Settlement Agreement.

Functional Performance Requirements: Major performance objectives that must be achieved to develop a calcine retrieval system are: 1) determine the characteristics of the calcine in the storage bins (e.g. is it all free flowing?); 2) determine design parameters for a calcine retrieval system such as air flow requirements, mechanical functions, line and nozzle sizes, etc; and 3) determine an efficient way to remotely make new penetrations into bins.

Schedule Requirements: The Batt Settlement Agreement requires that a full-scale calcine treatment facility be in operation by 2020. The first calcine retrieval system must also be operable by that time. Development work should be completed by 2010 to support design.

Problem Description: Radioactive calcine, currently stored in bins, must be retrieved for subsequent treatment and disposal. Retrieval must be performed remotely due to the high radiation levels. The equipment required to accomplish this task has not been designed since retrieval was not a major consideration during design of the storage bins.

Justifications:

Technical Justification: Initial tests have demonstrated a simple method for retrieving free flowing calcine, but more tests are needed to gather detailed design data, and remote mechanical systems must be developed. No determination has been made as to whether the calcine in the bins is free flowing. Samples from CSSF 2 showed that it was free flowing, but laboratory tests have shown that under more severe conditions, some calcines will form a cake. Retrieval of caked calcine has never been demonstrated.

Regulatory Justification: Calcine retrieval must be implemented to support operation of a full-scale facility by 2020 in order to meet the Batt Settlement Agreement commitments for calcine treatment.

ES&H Justification: Development of a simple, efficient retrieval system will minimize radiation exposure to workers and minimize radioactive waste generation during calcine retrieval.

Cultural/Stakeholder Factors: Treatment of calcine would reduce the risk of calcine escaping from storage facilities which are located over the Snake River aquifer. In particular CSSF 1 does not meet current design requirements for seismic or static loads.

Cost Savings: Millions of dollars can potentially be saved by developing a simple retrieval system. Savings may result from minimizing the number of penetrations into bins and by minimizing the complexity of remote mechani-cal systems required. The total cost of retrieval is estimated to be $250 million. The goal of calcine retrieval technology development is to save at least 10% of this cost. How Long it will Take: Investigation into retrieving calcine from CSSF 1 demonstrated the potential to save several months.

Other Justification:

Consequences of Not Filling Need: May not meet Batt Settlement Agreement milestone dates. Costs of calcine retrieval will be higher, more waste will be generated during retrieval, and workers will receive more radiation exposure.

Tanks Focus Area Site Needs

Need Title: Remove and Transport Calcine

Site: Idaho **TFA Functional Area:** Retrieval

TFA Response#: 98038 **Site Need#:** ID-2.1.09 **Site Priority:** 27 **PBS#:** ID-HLW-103

Privatization Potential: There are companies which specialize in cleaning caked material out of storage bins and silos. This work is often performed remotely to avoid the hazards associated with physically entering a bin filled with caked material, so it is likely that existing technology could be adapted for removing caked calcine from a bin. It is also likely that techniques developed for calcine retrieval could be adapted to other industries where it is becoming more important to reduce emissions of particulate and hazardous materials.

Current Base Technology and Cost:

SUMMARY OF TFA RESPONSE:

The TFA tentatively rated the priority of the technical response to this need as #52 (TFA Response 98038). The TFA proposes to provide funding in FY99-01, given available funding.

Tanks Focus Area Site Needs

Need Title: Develop Technology to Characterize Tank Farm Heel Residues

Site: Idaho **TFA Functional Area:** Characterization

TFA Response#: 98039 **Site Need#:** ID-2.1.10 **Site Priority:** 25 **PBS#:** ID-HLW-103

SITE NEED:

Need Description: When the ICPP high activity tanks are emptied, a heel may remain. It is proposed to grout any such heel in place upon tank closure. Technology is required to characterize tank farm heel residuals to allow development of grout formulations. The heel characterization must take place in highly radioactive and limited access environments. Methodologies and platforms for deploying heel retrieval equipment are needed for heel mixing, hose deployment, ventilation, shielding, containment, heel sampling, etc.

Cost Requirements: Current EM-30 budgets are limited and will not be sufficient to meet the Settlement Agreement schedule. Additional funding is needed to accelerate the research program to support the Environmental Impact Statement process and to meet design input for the proposed Waste Treatment Facility.

Functional Performance Requirements: Sufficient samples must be taken to provide representa-tive components for grout development. Sampling must be done under ALARA considerations.

Schedule Requirements: Need by 2005 to support tank heel grouting.

Problem Description: The tanks are underground and are highly radioactive. No heel sampling or mixing capabilities are installed. If any remaining heel is to be grouted in place, the nature of the heel must be known to provide a grout that will incorporate the heel and set up as a stable solid. The liquids in the tanks are known to be acidic and are high in nitrates, both of which are detrimental to grout chemistry. Other potential problem constituents are borates, phosphates, permanganates, and sulfates. These anions have been specifically identified by vendors as having the potential to cause problems with cement solidification of low-level wastes (see technical reference noted below). Knowledge of the heel composition and physical state is needed to develop a grout that will mix with the heel, solidify, and remain stable.

Justifications:

Technical Justification: Heel characterization is needed to develop a grout that will solidify and remain stable. A list of waste constituents that may cause problems with cement solidification is noted on page A-20 of the U.S. Nuclear Regulatory Commission Low-Level Waste Management Branch Technical Position on Waste Form, January 1991.

Regulatory Justification: RCRA requirements for tank closure must be met.

ES&H Justification:

Cultural/Stakeholder Factors: The grouting of the tanks and leaving the tanks and any heels will need to be presented to the public and approved by the State of Idaho.

Cost Savings: Grouting the tanks in place rather than complete decontamination and decommissioning will save significant costs that would be associated with treating additional wastes generated from the tank decontamination and decommissioning activities (estimate not developed).

Other Justification:

Consequences of Not Filling Need: Grouted heel may not be stable, i.e., the grout may not "set up." This may allow the grout/heel sludge to corrode the tank.

Privatization Potential: Grout mixing and transport to the tanks could be privatized. Internal heel characterization must be done prior to privatization.

Current Base Technology and Cost: None known.

Tanks Focus Area Site Needs

Need Title: Develop Technology to Characterize Tank Farm Heel Residues

Site: Idaho **TFA Functional Area:** Characterization

TFA Response#: 98039 **Site Need#:** ID-2.1.10 **Site Priority:** 25 **PBS#:** ID-HLW-103

SUMMARY OF TFA RESPONSE:

The TFA tentatively rated the priority of the technical response to this need as #20 (TFA Response 98039). The TFA is providing funding in FY98 and proposes to provide funding in FY99, given available funding.

Tanks Focus Area Site Needs

Need Title: Characterize & Remove RCRA Listed Wastes from High & Low Activity Fractions

Site: Idaho **TFA Functional Area:** Pretreatment

TFA Response#: 98040 **Site Need#:** ID-2.1.11 **Site Priority:** 23 **PBS#:** ID-HLW-103

SITE NEED:

Need Description: Removal of RCRA metals from tank waste and dissolved calcine. Solvent extraction and ion-exchange technologies must be demonstrated on actual INEL radioactive waste streams to ensure full-scale processes will adequately recover the active constituents to meet RCRA treatment requirements.

Functional Performance Requirements: Unknown at this time.

Schedule Requirements: Need by 2007 to support title design of production facility.

Problem Description: RCRA metals have BDAT treatment technologies specified. In order to meet the BDAT treatment requirements, and to produce high and low activity waste fractions that will not be classified as mixed waste, RCRA metals must be separated from the radioactive wastes.

Justifications:

Technical Justification: RCRA metals have BDAT treatment technologies specified.
In order to meet the BDAT treatment requirements, and to produce high and low activity waste fractions that will not be classified as mixed waste, RCRA metals must be separated from the radioactive wastes.

Regulatory Justification: Necessary to meet RCRA requirements.

ES&H Justification:

Cultural/Stakeholder Factors: Unknown.

Cost Savings: None identified, but will be required by RCRA facility permit.

Other Justification:

Consequences of Not Filling Need: Failure to meet Settlement Agreement.

Privatization Potential:

Current Base Technology and Cost:

SUMMARY OF TFA RESPONSE:
The TFA screened out this need. The TFA Response is 98040. The performance requirements for RCRA component characterization are removal have not been adequately defined to support development of a technical response.

Tanks Focus Area Site Needs

Need Title: Denitrate and Solidify High Activity Waste for Transport

Site: Idaho **TFA Functional Area:** Immobilization

TFA Response#: 98041 **Site Need#:** ID-2.1.12 **Site Priority:** 7 of 41 **PBS#:** ID-HLW-103

SITE NEED:

Need Description: Radioactive liquid waste containing large quantities of sodium has accumulated over the years and is stored in the ICPP tank farm. This waste is referred to as sodium-bearing waste (SBW) and was generated as a result of extraction system solvent cleanup and decontamination efforts. Sodium nitrate and potassium nitrate are major components of the SBW. SBW is difficult to calcine due to agglomeration and caking of molten sodium nitrate and potassium nitrate that persist in the calcine product. The pure component decomposition temperatures for sodium nitrate and potassium nitrate are 380C and 400C, respectively. However, the thermal decomposition of the nitrates is not fully achieved by calcination at 500C (the normal operating temperature of the NWCF) due to mass transfer and kinetic limitations and due to the formation of eutectic phases during drying. Section E5 of the Settlement Agreement with the State of Idaho requires that the SBW be calcined by 2012. This commitment cannot be met using the established SBW calcination flowsheet due to the copious quantity of aluminum nitrate that is required. Therefore, to meet the objectives of increased throughput, reduced waste volumes, and reduced cost, alternative treatment methods must be investigated.

One such scheme is to partition the radionuclides from SBW and dissolved calcine to generate a small volume of high activity waste (HAW) to be vitrified and disposed to a HLW repository and a large volume of sodium-rich low activity waste (LAW) to be grouted. The vitrification could take place at either the ICPP or at an off-site location. In the case that vitrification is performed off-site, a means of preparing the waste for transport between locations is necessary.

Functional Performance Requirements: The process shall be capable of processing the various HAW compositions that result from radionuclide separation of SBW and dissolved calcine. The product shall be a solid which can be placed in moveable storage/shipping containers; transportable in NRC-certified shipping casks to an alternate treatment site; retrievable from the containers; and be compatible with HLW immobilization formulations capable of meeting repository waste acceptance criteria.

Schedule Requirements: A denitration/solidification technology is needed by 2007 to support Title Design of a production facility, if solidification for off-site shipment and immobilization is the chosen alternative.

Problem Description: The INEEL has operated nuclear facilities to support national interests for several decades including, since 1953, the development of technologies for the storage and reprocessing of spent nuclear fuel (SNF) and the resultant radioactive wastes. The decision to discontinue reprocessing of SNF left nearly 289 metric tons heavy metal (MTHM) of SNF in storage at the INEEL with unspecified plans for future disposition. Additionally, 1.8 million gallons of radioactive liquid wastes (1.5 million gallons of radioactive sodium-bearing liquid wastes and 0.3 million gallons of high-level liquid wastes (HLLW)) and 3800 cubic meters of calcine waste are in inventory at the Idaho Chemical Processing Plant (ICPP). These facts, along with increased environmental awareness within the Department of Energy (DOE) and among its contractors and stakeholders, mandate operation of existing and future facilities in an environmentally responsible manner and require satisfactory resolution of radioactive waste issues resulting from past activities. The High Level Waste (HLW) Program will, ultimately, recommend and implement technologies and processes to facilitate the conditioning and certification of radioactive wastes for permanent disposal. The primary scope and objectives are to meet compliance with the Site Treatment Plan (STP) and the Settlement Agreement with the State of Idaho. Success will be measured in terms of safety, life-cycle cost, regulatory compliance, and pollution prevention.

Justifications:

Technical Justification: HAW produced from radionuclide separation of SBW and dissolved calcine must be solidified for safe, efficient transportation to an off-site treatment facility.

Tanks Focus Area Site Needs

Need Title: Denitrate and Solidify High Activity Waste for Transport

Site: Idaho **TFA Functional Area:** Immobilization

TFA Response#: 98041 **Site Need#:** ID-2.1.12 **Site Priority:** 7 of 41 **PBS#:** ID-HLW-103

Regulatory Justification: Section E5 of the Settlement Agreement between the DOE, State of Idaho, and the US Navy requires that the sodium-bearing waste in the ICPP tank farm be calcined by December 31, 2012. Section C3 requires that all HLW be treated so that it is ready for disposal by 2035.

ES&H Justification: If the HAW is to be transported to an off-site facility for vitrification, the waste must be denitrated and solidified to ensure safe, efficient handling and shipment of the waste.

Cultural/Stakeholder Factors: An improved waste processing scheme for treating SBW and calcine will allow the ICPP to "cease use" of the tank farm sooner, alleviating Stakeholder concerns about storing liquid radioactive waste in tanks, over the Snake River Aquifer, which do not comply with seismic and/or RCRA requirements.

Cost Savings: Cost savings may be realized by transporting the HAW off-site to an existing vitrification facility, rather than building a new treatment facility at the INEEL. In addition, a new, more efficient overall process scheme reduces the lifecycle cost for treating the SBW and calcine and preparing them for final disposition.

Other Justification: None.

Consequences of Not Filling Need: The Settlement Agreement with the State of Idaho will not be met. This will significantly reduce the trust and credibility that the DOE and INEEL have with Stakeholders. Additionally, their concerns about storing liquid radioactive wastes in tanks, over the Snake River Aquifer, which do not comply with seismic and/or RCRA requirements will continue to grow. The life-cycle cost to treat the SBW and calcine will be significantly greater than with a more efficient process scheme. This will adversely affect taxpayers who fund the work at the INEEL.

Privatization Potential:

Current Base Technology and Cost:

SUMMARY OF TFA RESPONSE:
The TFA did not rate the technical response to this need separately (TFA Response 98041). The TFA intends to satisfy this need through the technical responses prepared for Idaho need ID-2.1.08 (TFA Response 98037), and SRS needs SR-2906 (TFA Response 98059) and SR-2910 (TFA Response 98062).

TFA Response#: 98041
Site Need#: ID-2.1.12

Tanks Focus Area Site Needs

Need Title: Washable Metal HEPA Filters

Site: Idaho **TFA Functional Area:** Safety

TFA Response#: 98042 **Site Need#:** ID-2.1.13 **Site Priority:** **PBS#:** ID-HLW-101

SITE NEED:

Need Description: Numerous facilities in the DOE Complex use High Efficiency Particulate HEPA filters to remove radioactive particulate from process off-gas streams. Currently, the HEPA filters are constructed of a corrugated glass fiber media with a stainless steel housing which must be permanently disposed of when they are no longer useable due to partial wetting. At the INEEL, the NWCF's spent filters are temporarily stored before leaching the filter media to remove transuranic substances and heavy metals. The leaching process destroys the filters and generates a significant amount of radioactive liquid waste that must be stored in the tank farm and subsequently calcined.

A better system would be to use recyclable filters, wash them, and reuse them. Current treatment methods for the high number of HEPA filters results in significant cost. It is estimated that there are approximately 31,000 HEPA filters needing final disposal and the costs for this disposal will have a major impact on budgets. The use of recyclable metal HEPA filters would greatly reduce this.

Cost Requirements: The estimated cost for this project are as follows: $511K in FY-98; $366K in FY-99; $366K in FY-00; $366K in FY-01; $454K in FY-02; and $406K in FY-03 (totaling $2470K over 6 years). EM-50 TDI will provide funding as follows: $271K in FKY-98; $114K in FY-99; $102K in FY-00; $88K in FY-01; $162K in FY-02; and $100K in FY-03 (totaling $838K over 6 years), with EM-30 funding the balance of the cost.

Functional Performance Requirements: The washable metal HEPA filter shall meet performance criteria for removal efficiency of 99.97% for particles of 0.3 micometers at a flowrate of 1000cfm. The filter shall demonstrate good reuse characteristics. The filter shall have a demonstrated longer service life by maintaining their media integrity after accumulating moisture and being less susceptible to tearing than the glass fiber corrugated HEPA filter. Installation of the filter in the prefilter stage at NWCF shall extend the service life of the downstream filters by 25%, due to its improved ability to handle moisture accumulation and its resistance to tearing. The filters shall be commercially available and available for procurement in the needed array. It shall be possible to retrofit the filter into the existing 2'X2' x1' HEPA filter frame.

Schedule Requirements: The washable HEPA filters shall be ready to deploy in FY-98.

Problem Description: The INEEL has operated nuclear facilities to support national interests for several decades including, since 1953, the development of technologies for the storage and reprocessing of spent nuclear fuel (SNF) and the resultant radioactive wastes. The decision to discontinue reprocessing of SNF left nearly 289 metric tons heavy metal (MTHM) of SNF in storage at the INEEL with unspecified plans for future disposition. Additionally, 1.8 million gallons of radioactive liquid wastes (1.5 million gallons of radioactive sodium-bearing liquid wastes and 0.3 million gallons of high-level liquid wastes (HLLW)) and 3800 cubic meters of calcine waste are in inventory at the Idaho Chemical Processing Plant (ICPP). These facts, along with increased environmental awareness within the Department of Energy (DOE) and among its contractors and stakeholders, mandate operation of existing and future facilities in an environmentally responsible manner and require satisfactory resolution of radioactive waste issues resulting from past activities. The High Level Waste (HLW) Program will, ultimately, recommend and implement technologies and processes to facilitate the conditioning and certification of radioactive wastes for permanent disposal. The primary scope and objectives are to meet compliance with the Site Treatment Plan (STP) and the Settlement Agreement with the State of Idaho. Success will be measured in terms of safety, life-cycle cost, regulatory compliance, and pollution prevention.

Justifications:

Technical Justification: The NWCF is an ideal candidate to use washable metal HEPA filters. The washable filters will be used as prefilters in the process off-gas system with minimum configuration changes and no impact to the safety basis for the facility.

Tanks Focus Area Site Needs

Need Title: Washable Metal HEPA Filters

Site: Idaho **TFA Functional Area:** Safety
TFA Response#: 98042 **Site Need#:** ID-2.1.13 **Site Priority:** **PBS#:** ID-HLW-101

Regulatory Justification: Section E5 of the Settlement Agreement between the DOE, State of Idaho, and the US Navy requires that the sodium-bearing waste in the ICPP tank farm be calcined by December 31, 2012. In order to meet this commitment, the throughput of SBW to the calciner must be significantly increased and the amount of additional liquid waste to the tank farm significantly decreased. Washable metal HEPA filters will eliminate the need for filter leach and the liquid waste associated with that process.

ES&H Justification: In June of 1989, an INEEL site inspection was performed by the EPA and the State of Idaho charging that neither the tank farm vaults nor some of the lines and valve boxes in the tank farm met Resource Conservation and Recovery Act (RCRA) requirements for secondary containment. The inspection resulted in a January 29, 1990 Notice of Noncompliance (NON). Subsequently, a NON Consent Order was issued April 3, 1992, requiring DOE to permanently cease use of tanks with pillar and panel vaults by March 31, 2009, and the remaining tanks by June 30, 2015. These dates were subsequently accelerated by the Settlement Agreement with the State of Idaho to require calcination of the SBW in the ICPP tank farm by December 31, 2012. Washable metal HEPA filters will reduce the amount of additional liquid waste generated that requires calcination, thereby accelerating the effort to calcine the SBW by 2012.

Cultural/Stakeholder Factors: Reducing liquid waste generation to the tank farm will allow the ICPP to "cease use" of the tank farm sooner, alleviating Stakeholder concerns about storing liquid radioactive waste in tanks, over the Snake River Aquifer, which do not comply with seismic and/or RCRA requirements.

Cost Savings: Currently, over 400 filters are waiting to be leached at the ICPP, with an estimated 30 more expected to be added during the next NWCF campaign. Replacing the prefilters with washable metal filters would reduce the amount of waste filters generated by more than half. Thus, the reduction of treatment and disposal for these filters at the NWCF will result in a cost savings of $1.3M. The cost savings resulting from additional implementation is projected to be $3.9 over the baseline.

Other Justification: None.

Consequences of Not Filling Need: The Settlement Agreement with the State of Idaho may not be met. This will significantly reduce the trust and credibility that the DOE and INEEL have with Stakeholders. Additionally, their concerns about storing liquid radioactive wastes in tanks, over the Snake River Aquifer, which do not comply with seismic and/or RCRA requirements will continue to grow. Significant cost savings will not be passed onto the taxpayers that fund the work at the INEEL.

Privatization Potential:

Current Base Technology and Cost: The cost associated with the currently used glass fiber corrugated non-reusable HEPA filters are as follows: $899K in FY-98; $944K in FY-99; $991K in FY-00; $1041K in FY-01; $1093K in FY-02 and $1148K in FY-03 (totaling $6116K over 6 years).

SUMMARY OF TFA RESPONSE:
The TFA did not rate the technical response to this need separately (TFA Response 98042). The TFA intends to satisfy this need through the technical responses prepared for SRS need SR-2901 (TFA Response 98061).

Need Title: Develop Technology for Preconditioning ICPP High-Activity and Low-Activity Wastes

Site: Idaho **TFA Functional Area:** Pretreatment

TFA Response#: 98043 **Site Need#:** ID-2.1.14 **Site Priority:** **PBS#:** ID-HLW-103

SITE NEED:

Need Description: Technology is required for preconditioning the high-activity waste (HAW) and the low-activity waste (LAW) generated at ICPP by separations processes which are proposed for treatment of the ICPP tank farm and calcine wastes. In addition, low-activity process wastes will be generated at the ICPP by facility decontamination and as process equipment effluents. Although the solute composition of the HAW and LAW solutions will vary significantly, they will all be acidic (mainly nitric acid) and contain ionic nitrate salts. In order to immobilize either the HAW or LAW streams, it may be cost-beneficial to concentrate, neutralize, dry, and possibly denitrate or calcine the waste streams to economize the HAW melter and the LAW grouting equipment. An evaluation of practical equipment to condition the waste streams is needed to perform trade-off studies to assess the economics of waste preconditioning alternatives. The technical feasibility of the proposed operations needs to be established with basic laboratory experiments and bench-scale/pilot-plant scale scoping and demonstration studies.

Cost Requirements: Current EM-30 budgets are limited and will not be sufficient to meet the Settlement Agreement schedule. Additional funding is needed to accelerate the research program to support the Environmental Impact Statement process and to meet design input for the proposed Waste Treatment Facility.

Functional Performance Requirements: Functional Performance Requirements:
Separate needs statements have been submitted for HAW vitrification and LAW grouting. The waste preconditioning process steps are complementary to the functional requirements of these processes. Therefore, the functional requirements must be established by analysis of the overall processes. As a minimum, the following functional requirements need to be developed and evaluated to provide an optimum process design.

1. It is expected that both the HAW and the LAW should be concentrated to (a) reduce the size and duty of the glass melter, and (b) to reduce the grout volume produced. Several evaporator technologies are available. Selection of the best evaporator requires investigation of the solution behavior during concentration. Due to wide composition variations among the HAW and LAW streams, the evaporator must be flexible and robust. A high-throughput is anticipated; therefore, the evaporator must be efficient and optimize energy consumption. The HAW evaporator will require remote operation while the LAW evaporator may possibly be operated as a contact-handled facility.

2. The next step in the waste preconditioning process is stream neutralization. This would involve either (a) stripping the nitric and mineral acids from the waste stream or (b) destroying the acids via an oxy-reduction reaction (viz., electro-chemical, organic-addition, inorganic-addition, or stream reconstitution/re-evaporation). A portion of the acids will be volatilized during evaporation; however, the formation of an H2O-nitric azeotrope ultimately prevents volatilization of all the acids. It is necessary to resort to other measures to neutralize the wastes. LAW neutralization could be important to promote grout setting and to improve grout leach resistance. HAW neutralization could decrease melter corrosion rates and help reduce melter offgas treatment requirements.

3. Solution drying may help economize the HAW melter design by eliminating the need to evaporate the moisture of the influent stream. This in turn would eliminate the water-glass melt interface, which promotes melter corrosion and offgas entrainment of fines with subsequent deposition in the offgas lines. In the case of the LAW, drying may not be essential, except to provide a product, which can be transported to the grout mixing facility. If the LAW evaporator/drying are decoupled processes, then interim storage of a dry product is plausible.

4. Denitration and or calcination of the HAW and LAW streams has several technical merits. Higher waste loadings will translate to a decrease in the final waste volume. The main advantage for the LAW is higher effective waste loadings and improved leach resistance. Nitrates are readily leached from grouts and adversely affect the leach rates of coordinating species. This in turn leads to increased pore volume in the grout and consequently higher leach rates of other waste constituents encapsulated in the grout. Denitration of the HAW

will all but eliminate offgasing from the melter, resulting in a significant reduction in the deposition of fines in the offgas system.

5. Feed mixing is yet another function that can be accomplished prior to vitirification of the HAW and grouting of the LAW. Viable options need to be jointly explored with the waste immobilization development personnel.

An interface with the Separations process (waste pretreatment) development team, as well as the HAW and LAW immobilization teams, must be observed. As the pretreatment process is refined, the composition of the HAW and LAW streams will change with resultant impact on respective waste immobilization. Stream preconditioning is the link between HAW and LAW separations and waste immobilization processes. Therefore, this activity must coordinate the waste preconditioning processes with the immobilization groups to optimize the overall process and waste formulations.

The grouted "product" will be low-activity and/or mixed low-activity waste. The waste must meet the stability requirements of 10 CFR Part 61 as noted in the Nuclear Regulatory Commission Low-Level Waste Management Branch Technical Position on Waste Form, January 1991, for structural stability and leach resistance of radionuclides. The waste must also meet the requirements of 40 CFR Part 268 for leach resistance of hazardous components. The vitrified product will a highly radioactive, mixed waste and will have to meet WASRD system lead requirements for emplacement in a Federally licensed repository.

The evaporation, drying, and denitration/calcination process requirements for both LAW and HAW preconditioning will likely be similar, although there will be differences in equipment size and operating parameters. However, the research equipment and facilities used for experimental investigations will likely be shared during development activities performed with surrogate materials. Subsequent verification activities for HAW pretreatment will require shielded facilities.

Schedule Requirements: Research data needed by 2007 to support title design of the immobilization facility.

Problem Description: The high-activity and low-activity waste streams produced by separations will be extremely dilute and will contain nitric acid and nitrate salts. Evaporation, and possible drying, and denitration of the HAW will reduce the size of the glass melter and the respective offgas system, and could decrease corrosion rates. The ICPP HAW composition is unique from other wastes in the DOE complex and necessitates a fresh approach to the vitrification process. Technology trade-off studies for the ICPP HAW vitrification process should be completed to select the optimum combination of HAW preconditioning, waste vitrification, and off-gas treatment equipment. Trade-off studies for the LAW stream preconditioning/grouting process are similarly necessary to identify the optimum operation. To this end, process design data needs to be obtained to support technology evaluation and selection.

The dilute low-activity wastes from the separations process will be acidic and high in nitrates, both of which are detrimental to grout chemistry. The LAW at other DOE sites is basic; therefore, their grout formulations are not applicable to ICPP LAW. Due to the high acidity and nitrates in the waste, waste conditioning is necessary to provide a solid waste aggregate for grouting.

Current research utilizes thermal evaporation, drying, and calcination to solidify the waste and destroy the nitrates in both the HAW and LAW streams. This denitration process produces significant amounts of off-gas which must be handled. Evaporation, drying, and denitration equipment must be specified, procured, and tested. The corrosive nature of the off-gas must be investigated and materials of construction determined. EM-30 funding covers the basic grout and glass formulation work; however, other funding is needed to research the stream preconditioning process.

Tanks Focus Area Site Needs

Need Title: Develop Technology for Preconditioning ICPP High-Activity and Low-Activity Wastes

Site: Idaho **TFA Functional Area:** Pretreatment

TFA Response#: 98043 **Site Need#:** ID-2.1.14 **Site Priority:** **PBS#:** ID-HLW-103

Justifications:

Technical Justification: Preconditioning processes and equipment are needed for HAW and LAW at ICPP.

Regulatory Justification: DOE Order 5820.2a - Radioactive Waste Management, 10 CFR Part 61 - Licensing Requirements for Land Disposal of Radioactive Waste, and 40 CFR Part 268 - Land Disposal Restrictions must be met for vitrified HAW and grouted LAW generated at ICPP.

ES&H Justification: The LAW and HAW wasteforms must meet the environmental standards contained in the regulations noted above. The waste processes and facilities must maintain the safety and health of the operators and the public.

Cultural/Stakeholder Factors: An area of public concern is the liquid wastes stored at ICPP. Grouting LAW and vitrifying HAW are internationally accepted processes and will solidify the liquid wastes and will stabilize the hazardous material by meeting leach requirements.

Cost Savings: Evaporation of the HAW stream, followed by solids denitration will significantly reduce the size of the vitrification system and will help control corrosion rates. This should decrease the frequency of melter change-out, as well as overall vitrification operation costs. The volume of high activity waste could be significantly reduced by grouting the decontamination and process equipment waste rather mixing them with the high activity waste (no estimate available). Separating the high activity waste and grouting of the low-activity waste reduces the volume of high activity vitrified waste to be sent to a geological repository; thus reducing costs (savings included in separations estimates). The waste conditioning process, denitration, reduces the waste-to-grout volume by 3 to 8 times which will save in LAW storage costs -- potential savings of $10.5M over 15 years. This assumes average volume reduction of 5 and an operating cost of $3.2M/yr. Denitration could reduce non-labor materials by 30% and labor costs by 20% for an operating cost of $2.5M/yr. Consolidation of the LAW and HAW preconditioning development studies would result in $1M savings in pilot plant equipment and/or vendor testing.

Other Justification:

Consequences of Not Filling Need: The Batt Settlement Agreement will not be met. Liquid waste will continue to accumulate.

Privatization Potential: A commercial grout facility is feasible for the mixed LAW. The grout formulations should allow sufficient tolerance that vendors could meet the waste conditioning and grout mixing performance specifications. Privatization of the vitrification facility is less likely because of the high capital costs associated with construction of shielded facilities.

Current Base Technology and Cost: The baseline cost (EM-30) from 1998 to 2002 is about $10.5 million for HAW preconditioning and wasteform qualification. Baseline cost (EM-30) from 1998 to 2002 totals about $7.5 million for LAW. The grout pilot plant construction estimate is $5 million in 2003-2004. Grout pilot plant and vitrification pilot plant operational costs for chemicals, grout, other materials, and labor have not been determined. NOTE: These values are planned baseline amounts, not the actual annual budgets which have been lower.

SUMMARY OF TFA RESPONSE:
The TFA tentatively rated the priority of the technical response to this need as #33 (TFA Response 98043). The TFA proposes to provide funding in FY99-01, given available funding.

Tanks Focus Area Site Needs

Need Title: Oak Ridge National Laboratory Tank Waste Characterization

Site: Oak Ridge **TFA Functional Area:** Characterization
TFA Response#: 98044A, B **Site Need#:** TK-01 **Site Priority:** 6 **PBS#:** OR-38112, OR-38113, OR-43201, OR-43203

SITE NEED:

Need Description: Waste storage tanks must be emptied, and the tanks must be characterized for closure or return to active service. Characterization technologies are needed to determine the quantity of sludge in the tanks before and after emptying. Characterization technologies are also needed to determine the levels of contamination on tank walls if they are being remediated and to determine the structural integrity if they are to be returned to long-term service.

Corrosion-related degradation, specifically pitting and stress corrosion cracking, is the most likely failure mode for the ORNL active underground storage tanks. TFA developed corrosion monitors offer more corrosion data, in a more timely fashion for a more cost effective price than the baseline technology - floating and sunk corrosion coupons. Corrosion coupons do not give real-time data, and coupon retrieval and analysis are expensive. On-line corrosion monitoring would solve both these problems.

Waste stream: TRU Waste, Mixed Waste; Gunite and Associated Tanks, Old Hydrofracture Tanks, Bethel Valley Evaporator Service Tanks, Melton Valley Storage Tanks.

Functional Performance Requirements: A CERCLA treatability study is underway to obtain characterization data and to demonstrate and evaluate alternative retrieval techniques for the Gunite tanks. The results of the treatability study will be used to determine the functional requirements for remediation and closure of the tanks through the CERCLA process. Closure requirements for the Old Hydrofracture Tanks will also be determined by the CERCLA process.

The systems must be easy to operate and must be operated remotely. They must be able to reach all areas of the tanks using existing limited access ports. They must not further deteriorate the structural integrity of the tanks. Minimization of secondary waste and worker exposure are key in an effective technique. Complete portable characterization equipment including samplers, sensors, controls, analyzers, and data output devices are desirable. Sludge/debris surface mapping equipment capable of profiling surfaces below the supernatant liquid is also needed.

Provide online corrosion monitoring for the Melton Valley Capacity Increase Tanks (MVCIT) with real-time data monitoring at the central Waste Operations Control Center. Corrosion monitoring technology should be capable of detecting the onset of pitting and corrosion and stress corrosion cracking and providing real-time corrosion rates.

Schedule Requirements: Sludge mapping and structural integrity assessments for the Bethel Valley Evaporator Service Tanks and Melton Valley Storage Tanks will be needed between 1997 and 2000. Old Hydrofracture Tank Sludge Characterization will be needed in 1997//98. Gunite Tank wall characterization will be needed between 1998 and 2001.

Structural integrity monitoring:
Calibrate corrosion monitoring technology by 8/98
Deploy corrosion monitoring system by 10/98
Compare coupon and corrosion monitor results by 3/00

Problem Description: ORNL has 50 year old vertical concrete tanks. The largest tank is 50 ft in diameter, 12 ft high at the walls, and 18 ft high at the dome. The tank is buried under approximately 6 ft of overburden which is contaminated. After the sludges are removed, the amount of contamination in the concrete walls must be determined before closure requirements can be defined.
The OHF tanks are 5 horizontal carbon steel tanks which are rubber lined and not in vaults. They have one 18-in. manhole in the center and a 27-in. manhole on each end. They contain 6,000 gal. of RH-TRU sludge. The

amount of sludge which is removed by retrieval operations must be determined in order to define closure requirements.

Oak Ridge has 150,000 gal of RH-TRU sludge stored in thirteen 50,000-gal horizontal stainless steel tanks (BVEST and MVST) which are located in vaults. The tanks are 12 ft in diameter and 61.5 ft long. They have one 19-in. manhole which is located 17 ft from one end and a multitude of internal obstructions located down the center of the tank. The waste from the Gunite and Old Hydrofracture Tanks will be consolidated in these tanks prior to treatment via privatization. The amount of sludge in inventory for private sector treatment needs to be better defined. Methods for accurately determining the amount of sludge remaining in the tanks after retrieval are needed. Technologies are needed to determine the structural integrity of the tanks prior to and after sludge retrieval by the private sector in order for the tanks to be put back into active service. Operating conditions include:
- Tanks of questionable structural integrity.
- Supernatant liquid usually several feet to 12 ft deep.
- Equipment ingress to tanks with limited access and small existing risers.

Supernatants are mixed wastes, primarily sodium carbonate and nitrate at pH 8-12. Sludges are mixed low level and TRU waste, primarily sodium, uranium and aluminum nitrate. Known contaminants include alpha, Cd, Co, Cr, Hg, Pu, Ru, transuranics (TRU), and U.

Justifications:

Technical Justification: Technologies are not presently available to perform the characterization activities in tanks of this size with limited access ports and internal obstructions.

Regulatory Justification: - Federal Facilities Agreement Implementation Plan, Department of Energy/Oak Ridge (DOE/OR) 01 1276 & D2
- Tennessee Department of Environment and Conservation (TDEC) Commissioner's Order for the Oak Ridge Reservation (ORR) Site Treatment Plan (STP)
- DOE Order 5820.2A requiring treatment of transuranic (TRU) waste for disposal at the Waste Isolation Pilot Plant (WIPP)
- Comprehensive Environmental Response, Compensation, and Liability Act of 1980, (CERCLA)

ES&H Justification: Reduce worker exposure during tank characterization activities.

Cultural/Stakeholder Factors:

Cost Savings:

Other Justification:

Consequences of Not Filling Need: Unnecessary remediation activities may be performed on the Gunite Tanks to meet regulatory requirements for tank closure due to poor characterization data. Poor sludge characterization data given to the vendors for privatized treatment of tank sludges may result in improper treatment of waste or costly subcontract penalties. Lack of structural integrity data may result in MVST having to be replaced because they can not be returned to service.

Privatization Potential: Equipment will be provided by the private sector. It could be considered for use in privatized treatment of tank wastes at DOE sites.

Current Base Technology and Cost:

Tanks Focus Area Site Needs

Need Title: Oak Ridge National Laboratory Tank Waste Characterization

Site: Oak Ridge **TFA Functional Area:** Characterization

TFA Response#: 98044A, B **Site Need#:** TK-01 **Site Priority:** 6 **PBS#:** OR-38112, OR-38113, OR-43201, OR-43203

SUMMARY OF TFA RESPONSE:

The TFA developed two separate replies to this need. The first, TFA Response 98044A, replied to the need for ORNL Tank Waste Characterization (Sludge Mapping). The TFA tentatively rated the priority of the technical response to this need as #49. The TFA proposes to provide funding in FY99-00, given available funding.

The second response was TFA Response 98044B, a reply to the requirement for structural integrity testing. The TFA did not rate the technical response to this need separately. The TFA intends to satisfy this need through the technical responses prepared for SRS need SR-2909 (TFA Response 98067A) and for Hanford needRL-WT04 (TFA Response 98004).

Tanks Focus Area Site Needs

Need Title: Oak Ridge National Laboratory Tank Solid Waste Retrieval

Site: Oak Ridge **TFA Functional Area:** Retrieval

TFA Response#: 98045 **Site Need#:** TK-02 **Site Priority:** 1 **PBS#:** OR-43203

SITE NEED:

Need Description: Vertical concrete storage tanks must be remediated. Process heels, hard sludge, and debris from the inside of old concrete storage tanks must be removed in order to remediate the tanks. Concrete walls which are contaminated from contact with radiological materials must be cleaned.

Waste stream: TRU Waste, Mixed Waste; Gunite and Associated Tanks

Functional Performance Requirements: A CERCLA treatability study is underway to obtain characterization data and to demonstrate and evaluate alternative retrieval techniques. The results of the treatability study will be used to determine the functional requirements for remediation and closure of the tanks through the CERCLA process. Systems are needed for:
- Removal of soft sludge heels.
- Removal of hard sludge heels.
- Removal of debris, hardware, and concrete chunks a system is needed.
- Removal/cleaning of contaminated wall and floor segments a system is needed.
- Decontamination of in tank hardware needs to be considered.

The systems must be easy to operate and must be operated remotely. They must be able to reach all areas of the tanks using existing limited access ports. They must not further deteriorate the structural integrity of the tanks. Waste must be conditioned to meet pipeline transport requirements. Minimization of secondary waste and worker exposure are key in an effective technique.

Schedule Requirements: - Treatability Study and Characterization activities are in progress and are to be completed by FY 1998.
- Waste retrieval is to begin in FY 1998, and tanks will be closed by 2002.

Problem Description: ORNL has 50 year old vertical concrete tanks. The first tanks to be remediated are unlined gunite tanks. These tanks contain transuranic (TRU) and non TRU wastes. The tanks are located on Central Avenue in Waste Area Group 1. This is a high traffic, highly populated area. The largest tank is 50 feet in diameter, 12 feet high at the walls and 18 feet high at the dome. The tank is buried under approximately 6 feet of overburden which is highly contaminated.

In the early 1980's approximately 90% of the sludge was removed from these tanks by sluicing. A several foot deep supernatant layer of liquid overs the sludge in all but one tank. The total volume of sludge is less than 50,000 gallons. The sludge ranges from very soft silt texture to blocks as hard as concrete. A small amount of debris, hardware, spalled concrete, and chunks of concrete, inside of the tanks also need to be retrieved. Videos indicate a crystalline structure on the top of the sludge. Contaminated equipment in the risers will also have to be retrieved.

Justifications:

Technical Justification: Operational drivers include improved efficiency and reduced secondary waste generation over conventional technologies such as single point sluicing. Conventional technologies are not expected to be able to meet regulatory requirements for removal of sludge heels and concrete contamination for tank remediation.

Regulatory Justification: - Federal Facilities Agreement Implementation Plan, Department of Energy/Oak Ridge (DOE/OR) 01 1276 & D2
- Tennessee Department of Environment and Conservation (TDEC) Commissioner's Order for the Oak Ridge Reservation (ORR) Site Treatment Plan (STP)

- DOE Order 5820.2A requiring treatment of transuranic (TRU) waste for disposal at the Waste Isolation Pilot Plant (WIPP)
- Comprehensive Environmental Response, Compensation, and Liability Act of 1980, (CERCLA)

ES&H Justification: Reduced worker exposure and minimization of secondary waste requiring treatment and disposal.

Cultural/Stakeholder Factors:

Cost Savings:

Other Justification:

Consequences of Not Filling Need: Programmatic goals will not be met to have this waste available for treatment by the private sector, and it will not be available in time to be shipped to WIPP to meet the FFCA. Fines from CERCLA violations could result.

Privatization Potential: Equipment will be provided by the private sector. It could be considered for use in privatized treatment of tank wastes at DOE sites.

Current Base Technology and Cost:

SUMMARY OF TFA RESPONSE:
The TFA tentatively rated the priority of the technical response to this need as #6 (TFA Response 98045). The TFA is providing funding in FY98 and proposes to provide funding in FY99-00, given available funding. The TFA intends to satisfy the following additional need in its technical response: ORR need TK-04 (TFA Response 98047)

Tanks Focus Area Site Needs

Need Title: Oak Ridge National Laboratory Sludge Mixing and Mobilization

Site: Oak Ridge **TFA Functional Area:** Retrieval

TFA Response#: 98046 **Site Need#:** TK-03 **Site Priority:** 2 **PBS#:** OR-38113, OR-43201, OR-43203

SITE NEED:

Need Description: Systems to mix and mobilize bulk quantities of sludge in ORNL horizontal steel underground tanks with limited access are needed to support waste treatment programs and in some cases to remediate the tanks.

Waste stream: TRU Waste, Mixed Waste; Bethel Valley Evaporator Service Tanks and Old Hydrofracture Tanks

Functional Performance Requirements: In general, the systems must be easy to operate and must be operated remotely. They must be able to reach all areas of the tanks using existing access ports. They must not deteriorate the structural integrity of the tanks. Minimization of secondary waste and worker exposure are key in an effective technique.

For the OHF tanks, the detailed functional requirements for remediation and closure of the tanks will be defined through the CERCLA process.

For the BVEST, the goal is to remove >90% of the sludges from the tanks and maintain the structural integrity so that the tanks can remain in long-term use.

Schedule Requirements: - Retrieval will begin in 1997 and continue through 2000.
- Treatment will begin in 2002.

Problem Description: Mixing and mobilization systems are needed to remove bulk quantities of sludge form ORNL horizontal 50,000-gal stainless steel underground storage tanks which have limited access and internal obstructions (Bethel Valley Evaporator Service Tanks). Systems are also needed to remove bulk quantities of sludge form horizontal 13,000 - 25,000 carbon steel tanks (Old Hydrofracture Tanks). The BVEST will remain in service and the OHF tanks will be remediated after the sludges are retrieved for treatment and disposal.

Oak Ridge has 150,000 gal of RH-TRU sludge stored in thirteen 50,000-gal horizontal stainless steel tanks (BVEST and MVST) which are located in vaults. The tanks are 12 ft diameter and 61.5 ft long. They have one 19-in. manhole which is located 17 ft from one end and a multitude of internal obstructions located down the center of the tank. The OHF tanks are 5 horizontal carbon steel tanks which are rubber lined and not in vaults. They have one 18-in. manhole in the center and a 27-in. manhole on each end. They contain 6,000 gal of RH-TRU sludge.

Supernatants are mixed wastes, primarily sodium carbonate and nitrate at pH 8-12. Sludges are mixed low level and TRU waste, primarily sodium, uranium and aluminum nitrate. Known contaminants include alpha, Cd, Co, Cr, Hg, Pu, Ru, transuranics (TRU), and U.

Justifications:

Technical Justification: Operational drivers include the need to empty tanks which are filling to the maximum operational levels, increase efficiency to reduce the amount of secondary waste generated by the operation, minimize penetrations into the tank, and have low maintenance because the system will be in a highly contaminated environment. No retrieval technology has been demonstrated to date which is capable of being inserted through one small access port and can reach all locations in the 50,000-gal tanks.

Regulatory Justification:
- Federal Facilities Agreement Implementation Plan, Department of Energy/Oak Ridge (DOE/OR) 01 1276 & D2
- Tennessee Department of Environment and Conservation (TDEC) Commissioner's Order for the Oak Ridge Reservation (ORR) Site Treatment Plan (STP)

- DOE Order 5820.2A requiring treatment of transuranic (TRU) waste for disposal at the Waste Isolation Pilot Plant (WIPP)

ES&H Justification: Reduced worker exposure and minimization of secondary waste requiring treatment and disposal.

Cultural/Stakeholder Factors:

Cost Savings: $4M for BVEST.

Other Justification:

Consequences of Not Filling Need: Programmatic goals to have this waste available for treatment by the private sector will not be met, and waste may not be treated in time to be shipped to WIPP to meet the Commissioner's Order.

Privatization Potential: Equipment will be provided by the private sector and may be operated by the private sector at ORNL for retrieval of waste from the BVEST and OHF. Technologies may be useful in privatized retrieval/treatment of tank wastes at DOE sites such as Hanford, Idaho, and the ORNL Melton Valley Storage Tanks.

Current Base Technology and Cost:

SUMMARY OF TFA RESPONSE:
The TFA did not rate the technical response to this need separately (TFA Response 98046). The TFA understands the submitting site has withdrawn this need.

Tanks Focus Area Site Needs

Need Title: Oak Ridge National Laboratory Sludge Mixing and Slurry Transport

Site: Oak Ridge **TFA Functional Area:** Characterization
TFA Response#: 98047 **Site Need#:** TK-04 **Site Priority:** 4 **PBS#:** OR-38112, OR-38113, OR-43201, OR-43203

SITE NEED:

Need Description: A system to transport bulk quantities of sludge from ORNL underground tanks through miles of pipeline to consolidation tanks and treatment facilities is needed. Monitoring is required to eliminate plugging and ensure slurry content.

Waste stream: TRU Waste, Mixed Waste; Gunite and Associated Tanks, Old Hydrofracture Tanks, and Bethel Valley Storage Tanks

Functional Performance Requirements: Operating parameters for slurry transport of waste include specific gravity, slurry viscosity, solid content, particle size, and transport velocity. Solids monitors must be able to monitor these parameters for the range of conditions in the tank farms at the various sites with slurry contents of up to 20% wt percent solids. Pipeline monitors and/or insitu tank monitors are of potential use. The slurry monitors will also have to be able to withstand radiations fields up to 100 rad/hr.

Schedule Requirements: - Retrieval will begin in 1997 and continue through 2000.
- Treatment will begin in 2002.

Problem Description: Activities are underway at Oak Ridge and Hanford to retrieve and transport millions of gallons of radioactive sludges and slurries from radioactive waste tanks. At Oak Ridge 90,000 gal of sludge will be transported through a two-inch diameter line for miles to central storage and treatment facilities over a 2 year period. The lines will be susceptible to plugging if the percent solids loading or size of solids are too large. In-line solids monitors can be used to reduce the risk of plugging transport lines and allow the percent solids in the transport slurries to be increased, thereby reducing the amount of secondary liquid waste generated during transport.

Supernatants are mixed wastes, primarily sodium carbonate and nitrate at pH 8-12. Sludges are mixed low level and TRU waste, primarily sodium, uranium, and aluminum nitrate. Known contaminants include alpha, Cd, Co, Cr, Hg, Pu, Ru, transuranics (TRU), and U.

Justifications:

Technical Justification: Previous evaluations of commercially available monitors indicated that no monitors were available which could quantitatively measure particle size distribution of vol % solids.

Regulatory Justification: - Federal Facilities Agreement Implementation Plan, Department of Energy/Oak Ridge (DOE/OR) 01 1276 & D2
- Tennessee Department of Environmental and Conservation (TDEC) Commissioner's Order for the Oak Ridge Reservation (ORR) Site Treatment Plan (STP)
- DOE Order 5820.2A requiring treatment of transuranic (TRU) waste for disposal at the Waste Isolation Pilot Plant (WIPP)
- Comprehensive Envirionmental Response, Compensation, and Liability Act of 1980, (CERCLA)

ES&H Justification: Reduced worker exposure, reduced risk for plugging transfer pipelines, and minimization of secondary waste requiring treatment and disposal.

Cultural/Stakeholder Factors:

Cost Savings: Primarily risk reduction driver, not cost savings.

Tanks Focus Area Site Needs

Need Title: Oak Ridge National Laboratory Sludge Mixing and Slurry Transport

Site: Oak Ridge **TFA Functional Area:** Characterization

TFA Response#: 98047 **Site Need#:** TK-04 **Site Priority:** 4 **PBS#:** OR-38112, OR-38113, OR-43201, OR-43203

Other Justification:

Consequences of Not Filling Need: If concentrated slurries are transported with existing technologies, the one pipeline which is available for transport of legacy sludges and newly-generated waste to ORNL storage/treatment facilities may be plugged. Programmatic goals would not be met to have this waste available for treatment by the private sector, and it may not be available in time to be shipped to WIPP to meet the Commissioner's Order.

Privatization Potential: Equipment will be provided by the private sector. Savannah River, Hanford, and Oak Ridge tanks programs and private sector companies could utilize this technology to retrieve waste from underground storage tanks.

Current Base Technology and Cost:

SUMMARY OF TFA RESPONSE:
The TFA did not rate the technical response to this need separately (TFA Response 98047). The TFA intends to satisfy this need through the technical responses prepared for ORR need TK-02 (TFA Response 98045).

Tanks Focus Area Site Needs

Need Title: Oak Ridge National Laboratory Tank Sludge and Supernatant Separations

TFA Response#: 98048
Site: Oak Ridge
Site Need#: TK-05
TFA Functional Area: Pretreatment
Site Priority: 5
PBS#: OR-38112, OR-38113, OR-43201, OR-43203

SITE NEED:

Need Description: There is a need to manage the excess water generated during sludge retrieval operations. Sludges and supernate/sluice water must be separated in a fast, cost-effective manner during waste transfer and treatment operations.

Waste stream: TRU Waste, Mixed Waste; Gunite and Associated Tanks (GAAT), Bethel Valley Evaporator Service Tanks (BVEST), Melton Valley Storage Tanks (MVST), Old Hydrofracture Tanks (OHF).

Functional Performance Requirements: This system must be have the capabilities to be remotely operated and must be on-line equipment. It must have a minimum processing rate of 5 gal/min filtrate and must operate with minimal backwashing and maintenance. It must minimize secondary waste generation and worker exposure. It must effectively separate particulates over the tank sludge particle size range and must be able to treat waste containing 5-20% wt percent solids. It must operate under moderate pressure (20-40 psi).

Schedule Requirements: Waste consolidation will begin in 1997, and treatment will begin in 2002.

Problem Description: Oak Ridge has approximately 180,000 gal of mixed RH-TRU sludge stored in underground tanks. This waste in the GAAT, BVEST, and OHF must be retrieved, consolidated in the MVST, and immobilized to meet transportation and disposal requirements for WIPP or the Nevada Test Site. Solid liquid separations equipment will be required to manage the excess water generated during sluicing of waste between tank farms and/or to maintain the desired feed composition for the treatment facility.

Supernatants are mixed wastes, primarily sodium carbonate and nitrate at pH 8-12. Sludges are mixed low level and TRU waste, primarily sodium, uranium, and aluminum nitrate. Known contaminants include alpha, Cd, Co, Cr, Hg, Pu, Ru, transuranics (TRU), and U.

Justifications:

Technical Justification: Operational drivers include improving efficiency for handling of secondary wastewater generated during sludge transfer/treatment operations, minimizing the volume of waste which must be treated for disposal at expensive sites, and maintaining solids content at the desired level in slurries for pipeline transport or for feed to treatment facilities.

Regulatory Justification: - Federal Facilities Agreement Implementation Plan, Department of Energy/Oak Ridge (DOE/OR) 01 1276 & D2
- Tennessee Department of Environment and Conservation (TDEC) Commissioner's Order for the Oak Ridge Reservation (ORR) Site Treatment Plan (STP)
- DOE Order 5820.2A requiring treatment of transuranic (TRU) waste for disposal at the Waste Isolation Pilot Plant (WIPP)
- Comprehensive Environmental Response, Compensation, and Liability Act of 1980, (CERCLA)

ES&H Justification: Minimization of worker exposure and secondary waste generated for additional treatment and disposal.

Cultural/Stakeholder Factors:

Cost Savings: $5M at Oak Ridge.

Tanks Focus Area Site Needs

Need Title: Oak Ridge National Laboratory Tank Sludge and Supernatant Separations

TFA Response#: 98048 **Site:** Oak Ridge **Site Need#:** TK-05 **TFA Functional Area:** Pretreatment **Site Priority:** 5 **PBS#:** OR-38112, OR-38113, OR-43201, OR-43203

Other Justification:

Consequences of Not Filling Need: Without solid liquid separations capabilities, TRU sludge may be inadvertently transferred to inappropriate facilities. The schedule for transfer of sludges to centralized storage tanks may be delayed past the privatization schedule and the dates required for treatment to meet the Commissioner's Order.

Privatization Potential: Hanford, Idaho, Savannah River, and Oak Ridge tanks programs and private sector companies could utilize this technology for treatment of waste from underground storage tanks.

Current Base Technology and Cost:

SUMMARY OF TFA RESPONSE:
The TFA tentatively rated the priority of the technical response to this need as #3 (TFA Response 98048). The TFA is providing funding in FY98 and proposes to provide funding in FY99-01, given available funding. The TFA intends to partially satisfy the following additional need in its technical response: SRS need SR-2908 (TFA Response 98057).

Tanks Focus Area Site Needs

Need Title: Oak Ridge National Laboratory Tank Sludge and Supernatant Immobilization

TFA Response#: 98049 **Site:** Oak Ridge **Site Need#:** TK-06 **TFA Functional Area:** Immobilization **Site Priority:** 3 **PBS#:** OR-38112, OR-38113, OR-43201, OR-43203

SITE NEED:

Need Description: The ORNL tank waste must been immobilized and certified to meet the transportation and disposal waste acceptance criteria for Nevada Test Site or the Waste Isolation Pilot Plant.

Waste stream: TRU Waste, Mixed Waste; Gunite and Associated Tanks (GAAT), Bethel Valley Evaporator Service Tanks (BVEST), Melton Valley Storage Tanks (MVST), Old Hydrofracture Tanks (OHF).

Functional Performance Requirements: Waste formulations for Oak Ridge RH-TRU sludges are needed which will handle the wide range of waste compositions in the ORNL inventory and which will meet waste acceptance criteria at WIPP or the Nevada Test Site. Orphan waste forms can not be produced. These waste forms should also meet RCRA Land Disposal Restriction requirements. They should maximize waste loadings to minimize waste transportation and disposal costs. Equipment for on line monitoring, process control, and product verification are also needed. The product verification equipment should be nondestructive assay systems which are remotely operated and require low maintenance. They must be able to characterize waste in 55-gal drums and distinguish between TRU waste and high activity non-TRU waste components, such as Cf-252.

Schedule Requirements: Treatment will begin in 2002 by the private sector. Data for use in the privatization process are needed beginning in 1997.

Problem Description: Oak Ridge has approximately 180,000 gal and 800,000 gal of mixed RH-TRU sludge and supernate, respectively, stored in underground tanks. The waste from the GAAT, BVEST, and OHF will be consolidated in the MVST, and this waste must be immobilized to meet transportation and disposal requirements for WIPP or the Nevada Test Site. The process selected for treatment of the waste must be able to handle the wide ranges of waste compositions in the ORNL tank inventory. An important element of the planning for the packaging, shipment, and disposal of remote-handled transuranic (RH-TRU) for WIPP includes the development of an accurate and reliable nondestructive assay (NDA) system. Presently, no NDA capability exists in the DOE for the characterization of RH-TRU waste stored in 55-gallon drums.

Supernatants are mixed wastes, primarily sodium carbonate and nitrate at pH 8-12. Sludges are mixed low level and TRU waste, primarily sodium, uranium, and aluminum nitrate. Known contaminants include alpha, Cd, Co, Cr, Hg, Pu, Ru, transuranics (TRU), and U.

Justifications:

Technical Justification: Operational drivers include defining the operationing envelops for waste forms which will meet waste acceptance criteria for the range of waste compositions at Oak Ridge, validating simulants which private sector vendors can use for treatability studies, and providing waste certification data needed for disposal sites.

Regulatory Justification: - Federal Facilities Agreement Implementation Plan, Department of Energy/Oak Ridge (DOE/OR) 02 1276 & D2
- Tennessee Department of Environment and Conservation (TDEC) Commissioner's Order for the Oak Ridge Reservation (ORR) Site Treatment Plan (STP)
- DOE Order 5820.2A requiring treatment of transuranic (TRU) waste for disposal at the Waste Isolation Pilot Plant (WIPP)
- Comprehensive Environmental Response, Compensation, and Liability Act of 1980, (CERCLA)

ES&H Justification: Minimize volume of waste generated for ultimate disposal. Reduce risk to workers and public during processing and disposal of waste.

Tanks Focus Area Site Needs

Need Title: Oak Ridge National Laboratory Tank Sludge and Supernatant Immobilization

TFA Response#: 98049 **Site:** Oak Ridge **Site Need#:** TK-06 **TFA Functional Area:** Immobilization **Site Priority:** 3 **PBS#:** OR-38112, OR-38113, OR-43201, OR-43203

Cultural/Stakeholder Factors:

Cost Savings: Cost savings are assumed to be in reduced risk until additional information becomes available.

Other Justification:

Consequences of Not Filling Need: Simulants used by the private sector to develop their waste treatment processes may not be valid representations of actual waste. Full-scale waste forms may not meet disposal site waste acceptance criteria, causing Oak Ridge to miss the Commissioner's Order to ship mixed TRU waste to WIPP in 2002.

Privatization Potential: Sludge immobilization technology information could be directly applied to Oak Ridge privatized sludge treatment. Potential use of an RFQ-based waste characterization system at all DOE RH-TRU waste generator and storage sites creates an excellent opportunity for commercial development of the assay system. WIPP, ORNL TRU program, and other DOE sites with RH-TRU wastes are potential end users. Also, this technology can be converted to non-TRU high level waste forms as well.

Current Base Technology and Cost:

SUMMARY OF TFA RESPONSE:
The TFA tentatively rated the priority of the technical response to this need as #32 (TFA Response 98049). The TFA is providing funding in FY98 and proposes to provide funding in FY99, given available funding.

Tanks Focus Area Site Needs

Need Title: Oak Ridge National Laboratory Tank Closure

Site: Oak Ridge **TFA Functional Area:** Closure
TFA Response#: 98050A, B **Site Need#:** TK-09 **Site Priority:** 7 **PBS#:** OR-43201, OR-43203

SITE NEED:

Need Description: Old deteriorating waste storage tanks exist which contain sludge heels that have been determined to be of negligible risk to health, safety, and environment. However, it will be very costly to remove the waste from tanks with limited access ports. Residual waste in the concrete walls and liners of the waste tanks may also dictate the need for tank closure. A technology is needed to in situ stabilize these sludge heels as part of tank closure. Fill material which can meet acceptance criteria for tank closure is also required.

Waste stream: TRU Waste, Mixed Waste; Gunite and Associated Tanks, Old Hydrofracture Tanks

Functional Performance Requirements: Tank closure processes may include enhanced stabilization processes for residual contaminants, such as in situ heel grouting and/or fill material to structurally stabilize the tanks. Tank closure systems include:
- Equipment to fill tanks, piping and systems.
- Monitors to control the filling process.
- Monitors to verify the filled tank system.

Schedule Requirements: The first tank closures begin in 1998, and those requiring in situ stabilization of sludge heels begin in 1999.

Problem Description: ORNL has 50 yr old vertical concrete tanks. The largest tank is 50 ft in diameter, 12 ft high at the walls and 18 ft high at the dome. The tank is buried uder approximately 6 ft of overburden which is highly contaminated. The OHF tanks are 5 horizontal carbon steel tanks which are rubber lined nd not in vaults. They have one 18-in. manhole in the center and a 27-in. manhole on each end. They contain 6,000 gal of RH-TRU sludge. The sludge remaining in the tanks after retrieval operations may require additional stabilization in order to meet tank closure requirements. Small gunite tanks containing low activity waste may be eligible for in situ stabilization without any sludge removal.

Justifications:

Technical Justification: Techniques are not presently available to remove the sludge heels from these tanks or to stabilize them in situ.

Regulatory Justification: - Federal Facilities Agreement Implementation Plan, Department of Energy/Oak Ridge (DOE-OR) 01 1276 & D2
- Tennessee Department of Environment and Conservation (TDEC) Commissioner's Order for the Oak Ridge Reservation (ORR) Site Treatment Plan (STP)
- DOE Order 5820.2A requiring treatment of transuranic (TRU) waste for disposal at the Waste Isolation Pilot Plant (WIPP)
- Comprehensive Environmental Response, Compensation, and Liability Act of 1990, (CERCLA)

ES&H Justification: Reduced worker exposure and minimization of secondary waste generated during sludge retrieval.

Cultural/Stakeholder Factors:

Cost Savings: $20M for Oak Ridge.

Other Justification:

Consequences of Not Filling Need: Oak Ridge Tanks may not meet closure requirements.

Tanks Focus Area
Site Needs

Need Title: Oak Ridge National Laboratory Tank Closure

Site: Oak Ridge **TFA Functional Area:** Closure
TFA Response#: 98050A, B **Site Need#:** TK-09 **Site Priority:** 7 **PBS#:** OR-43201, OR-43203

Privatization Potential: Equipment will be provided by the private sector. It could be considered for use in privatized treatment of tank wastes at DOE sites.

Current Base Technology and Cost:

SUMMARY OF TFA RESPONSE:
The TFA developed two separate replies to this need. The first, TFA Response 98050A, replied to the need for Oak Ridge/SRS Tank Closure. The TFA tentatively rated the priority of the technical response to this need as #1. The TFA is providing funding in FY98 and proposes to provide funding in FY99-00, given available funding. The TFA intends to partially satisfy the following additional need in its technical response: SRS need SR-3022 (TFA Response 98075).

The second response was TFA Response 98050B, a reply to the requirement for Small, Horizontal, Limited Access Tank Retrieval. The TFA tentatively rated the priority of the technical response to this need as #5. The TFA proposes to provide funding in FY99-00, given available funding. The TFA intends to satisfy the following additional need in its technical response: SRS need SR-2912 (TFA Response 98071A).

Tanks Focus Area Site Needs

Need Title: Oak Ridge National Laboratory Remediated Tank Isolation and Removal

Site: Oak Ridge **TFA Functional Area:** Closure

TFA Response#: 98051 **Site Need#:** TK-10 **Site Priority:** 9 **PBS#:** OR-43201, OR-43203

SITE NEED:

Need Description: Remediated tank isolation and removal techniques are needed. Remediated tank/system isolation and removal techniques, which can meet closure acceptance criteria are needed. Isolation of pipelines entering the tanks is needed to eliminate inleakage and meet closure requirements. Surrounding contaminated soils and excavation issues need to be considered.

Waste stream: TRU Waste, Mixed Waste; Gunite and Associated Tanks, Old Hydrofracture Tanks

Functional Performance Requirements: A CERCLA treatability study is underway to obtain characterization data and to demonstrate and evaluate alternative retrieval techniques for the Gunite tanks. The results of the treatability study will be used to determine the functional requirements for remediation and closure of the tanks through the CERCLA process. Closure requirements for the Old Hydrofracture Tanks will also be determined by the CERCLA process.

Schedule Requirements: Tank closures are scheduled from 1998 to 2002.

Problem Description: ORNL has 50 yr old vertical concrete tanks. The largest tank is 50 ft in diameter, 12 ft high at the walls and 18 ft high at the dome. The tank is buried under approximately 6 ft of overburden which is contaminated. The tanks are located on Central Avenue in Waste Area Group 1. This is a high traffic, highly populated area. The OHF tanks are 5 horizontal carbon steel tanks which are rubber lined and not in vaults. They have one 18-in. manhole in the center and a 27-in. manhole on each end. They contain 6,000 gal of RH-TRU sludge. After the sludges are removed, the tanks must be isolated to meet closure requirements. Pipelines entering the tanks must be isolated to eliminate inleakage back into the tanks.

Justifications:

Technical Justification:

Regulatory Justification: - Federal Facilities Agreement Implementation Plan, Department of Energy / Oak Ridge (DOE/OR) 01 1276 & D2
- Tennessee Department of Environment and Conservation (TDEC) Commissioner's Order for the Oak Ridge Reservation (ORR) Site Treatment Plan (STP)
- DOE Order 5820.2A requiring treatment of transuranic (TRU) waste for disposal at the Waste Isolation Pilot Plant (WIPP)
- Comprehensive Environmental Response, Compensation, and Liability Act of 1980, (CERCLA)

ES&H Justification:

Cultural/Stakeholder Factors:

Cost Savings:

Other Justification:

Consequences of Not Filling Need: Tanks may not meet CERCLA closure criteria.

Privatization Potential:

Current Base Technology and Cost:

Tanks Focus Area Site Needs

Need Title: Oak Ridge National Laboratory Remediated Tank Isolation and Removal

Site: Oak Ridge **TFA Functional Area:** Closure

TFA Response#: 98051 **Site Need#:** TK-10 **Site Priority:** 9 **PBS#:** OR-43201, OR-43203

SUMMARY OF TFA RESPONSE:

The TFA tentatively rated the priority of the technical response to this need as #13 (TFA Response 98051). The TFA is providing funding in FY98 and proposes to provide funding in FY99, given available funding.

Tanks Focus Area Site Needs

Need Title: Oak Ridge National Laboratory Tank Sludge and Supernatant Pretreatment

Site: Oak Ridge
TFA Functional Area: Pretreatment
TFA Response#: 98052
Site Need#: TK-11
Site Priority: 8
PBS#: OR-38112, OR-38113, OR-43201, OR-43203

SITE NEED:

Need Description: The baseline plan for treatment of ORNL tank waste is to remove cesium from the supernate by ion exchange and grout the wate for disposal at the Nevada Test Site (NTS), and to solidify sludge (most likely by grout or vitrification) for disposal at the NTS or the Waste Isolation Pilot Plant (WIPP). However, pretreatment to remove certain radionuclides and/or to reduce the volume of high-activity transuranic (TRU) waste may be required, particularly if WIPP does not gain approval to accept remote-handled TRU waste.

Waste stream: TRU Waste, Mixed Waste; Gunite and Associated Tanks (GAAT), Bethel Valley Evaporator Service Tanks (BVEST), Melton Valley Storage Tanks (MVST), Old Hydrofracture Tanks (OHF).

Functional Performance Requirements: This waste stream is planned for privatized treatment. The detailed performance requirements will not be known until privatization efforts are further along. However, in general terms, the products from pretreatment processes must meet waste acceptance criteria for on-site disposal at ORNL or disposal at approved waste disposal sites such as NTS, WIPP, or high-level waste repositories. Any pretreatment process considered for ORNL flowsheets must reduce the life cycle costs and/or schedule for treatment and disposal of tank waste compared to the baseline plans in the DOE Ten Year Plan. Emphasis is on the efficiency of the pretreatment process, minimization of secondary waste, stabilization of the separated contaminants, and minimization of total volume of waste requiring disposal.

Schedule Requirements: This waste stream is planned for privatized treatment. The detailed performance requirements will not be known until privatization efforts are further along. However, in general terms, the products from pretreatment processes must meet waste acceptance criteria for on-site disposal at ORNL or disposal at approved waste disposal sites such as NTS, WIPP, or high-level waste repositories. Any pretreatment process considered for ORNL flowsheets must reduce the life cycle costs and/or schedule for treatment and disposal of tank waste compared to the baseline plans in the DOE Ten Year Plan. Emphasis is on the efficiency of the pretreatment process, minimization of secondary waste, stabilization of the separated contaminants, and minimization of total volume of waste requiring disposal.

Problem Description: Oak Ridge has approximately 180,000 gal of mixed RH-TRU sludge and 800,000 gal of mixed non-TRU supernate stored in underground tanks. The GAAT, OHF, and BVEST waste must be retrieved, consolidated in the MVST, and immobilized to meet transportation and disposal requirements for WIPP or the NTS. The supernate has been historically treated by grouting the waste for disposal, presumably, at the Nevada Test Site. Increasing levels of cesium in the waste (from new research activities and concentration of legacy waste) requires that cesium be removed prior to solidification. A cesium removal demonstration using imporved ion exchange materials developed by EM-50 is presently uderway. Sludges have not been treated since hydrofracture (deep well injection of grouted waste) was discontinued in 1984. The baseline plan for sludge treatment is to solidify (most likely by grout or vitrification) to meet RCRA Land Disposal Restriction requirements for disposal at the NTS or WIPP. However, the sludge compositions vary considerably from tank farm to tank farm. Pretreatment of some waste streams may be required to meet the feed requirements for the solidification process. In addition, pretreatment to remove certain radionuclides and/or to reduce the volume of high-activity TRU waste may be required, particularly if the WIPP does not gain approval to accept remote-handled TRU waste.

Justifications:

Technical Justification: Operational drivers include improving efficiency for handling of waste in downstream immobilization processes, minimizing the volume of waste which must be treated for disposal at expensive sites, and minimizing the risk associated with handling of large volumes of high-activity TRU waste during treatment, transportation, and disposal processes.

Tanks Focus Area Site Needs

Need Title: Oak Ridge National Laboratory Tank Sludge and Supernatant Pretreatment

TFA Response#: 98052 **Site:** Oak Ridge **Site Need#:** TK-11 **TFA Functional Area:** Pretreatment **Site Priority:** 8 **PBS#:** OR-38112, OR-38113, OR-43201, OR-43203

Regulatory Justification: - Federal Facilities Agreement Implementation Plan, Department of Energy/Oak Ridge (DOE-OR) 01 1276 & D2
- Tennessee Department of Environment and Conservation (TDEC) Commissioner's Order for the Oak Ridge Reservation (ORR) Site Treatment Plan (STP)
- DOE Order 5820.2A requiring treatmentof transuranic (TRU) waste for disposal at the Waste Isolation Pilot Plant (WIPP)
- Comprehensive Environmental Response, Compensation, and Liability Act of 1990, (CERCLA)

ES&H Justification: Reduced worker exposure.

Cultural/Stakeholder Factors:

Cost Savings: Up to $150M for ORNL waste.

Other Justification:

Consequences of Not Filling Need: Waste may not meet feed requirements for solidification processes for baseline treatment plans, or waste may not meet waste acceptance criteria for disposal if WIPP does not accept RH-TRU waste. Considerable cost savings will potentially be lost.

Privatization Potential: Hanford, Savannah River, and Oak Ridge tanks programs and private sector companies could utilize this technology for treatment of waste from underground storage.

Current Base Technology and Cost:

SUMMARY OF TFA RESPONSE:
The TFA tentatively rated the priority of the technical response to this need as #38 (TFA Response 98052). The TFA proposes to provide funding in FY99-01, given available funding.

Tanks Focus Area Site Needs

Need Title: Tank Heel Removal/Closure Technology

Site: SRS **TFA Functional Area:** Retrieval
TFA Response#: 98053 **Site Need#:** SR-2911 **Site Priority:** 11 of 20 **PBS#:** SR-HL03

SITE NEED:

Need Description: Residual heels of sludge and debris remain on the bottoms of some of the waste tanks after bulk waste removal is performed. The tanks are one (1) million gallon nominal capacity with a diameter of 75 to 85 feet depending on the type of tank. The types of debris and residual waste include the following:

- Hardened sludge
- Zeolite
- Silica
- Reel Tapes

Conventional waste removal techniques utilizing slurry pumps and transfer jets/ pumps do not suspend and remove this type of waste. As much as 40,000 gallons of residue can remain after a conventional waste removal campaign.

Methods must be explored and developed to successfully remove these heels. The older style tanks are committed to be closed within the next twenty (20) years. Bulk waste removal is scheduled to facilitate those goals, however, options to remove the final residue have not been fully considered. Tank closure is not possible unless this residue is removed. For example, Tank 19 is scheduled for closure during FY1999, however, a 25,000 gallon (estimated) residual zeolite heel remains which prevents immediate closure activities.

Functional Performance Requirements: The residual heel must be removed completely from each tank, i.e., no visible evidence of waste. Debris such as pipes and reel tapes may either be removed or cleaned "in place."

Schedule Requirements: Prototypical methods will be developed by September 1998. Successful removal by September 1999.

Problem Description: The waste heels can be comprised hardened sludge, zeolite, and silica. The heels are generally hardened or compacted insoluble particulates with relatively rapid settling velocities. Chemical dissolution generally involves acid cleaning which is not readily compatible with the carbon steel storage tanks or the vitrification process, and raises criticality concerns when acid is deposited into other waste tanks. Mechanical or remote cleaning techniques are hampered by numerous interferences created by a network of 2" diameter cooling coils laced within the interior of the tanks. Tank access is largely limited to two foot diameter openings for the tank tops, however, the newer tanks have larger openings. The heels must be removed in such a manner to leave no waste in the source tank and be transferred ultimately to the Extended Sludge Processing (ESP) Facility. Residual waste heel volumes must be determined to a high degree of certainty to support regulatory requirements for closure. Current visual techniques are hampered by a lack of precise physical indicators in the tanks as well as barriers from liquid and debris.

Justifications:

Technical Justification: Residual heels of sludge and debris remain on the bottoms of some of the waste tanks after bulk waste removal is performed. The tanks are one (1) million gallon nominal capacity with a diameter of 75 to 85 feet depending on the type of tank.

The waste heels can be comprised hardened sludge, zeolite, and silica. The heels are generally hardened or compacted insoluble particulates with relatively rapid settling velocities. Conventional waste removal techniques utilizing slurry pumps and transfer jets/pumps does not suspend and remove this type of waste. As much as 40,000 gallons of residue can remain after a conventional waste removal campaign.

Chemical dissolution generally involves acid cleaning which is not readily compatible with the carbon steel storage tanks due to corrosions concerns. Additional concerns that must be addressed with the introduction of acid into the HLW system are criticality issues due to potential for concentration of fissile material and the incompatibility of acids in the waste vitrification process. . Mechanical or remote cleaning techniques are hampered by numerous interferences created by a network of 2" diameter cooling coils laced within the interior

of the tanks. Tank access is largely limited to two foot diameter openings for the tank tops, however, the newer tanks have larger openings. The heels must be removed in such a manner to leave no waste in the source tank and be transferred ultimately to the Extended Sludge Processing (ESP) Facility.

Methods must be explored and developed to successfully remove these heels. The older style tanks are committed to be closed within the next twenty (20) years. Bulk waste removal is scheduled to facilitate those goals, however, no known technologies to remove the final residue have been identified. Tank closure is not possible unless this residue is removed. For example, Tank 19 is scheduled for closure during FY1998, however, a 25,000 gallon (estimated) residual zeolite heel remains which prevents immediate closure activities.

Residual heel removal technology (equipment and processes) currently being evaluated include ducted turbine pumps (mixers), air piston pumps, and remotely operated equipment with multiple end effectors (high pressure water nozzles, sluicing and vacuum/pumping systems).

Regulatory Justification: Removal of the tank heel is desired to meet performance requirements set forth by the Site Tank Closure Program. The Tank Farms are permitted under the South Carolina Pollution Control Act, therefore, closure activities are governed by South Carolina Regulation R.61-82, "Proper Closeout of Wastewater Treatment Facilities." Refer to the Federal Facility Agreement between the U.S. Environmental Protection Agency Region IV, the U.S. Department of Energy, and the South Carolina Department of Health and Environmental Control Docket No. 89-05-FF, August 16, 1993.

ES&H Justification: Removal of the tank heels will significantly reduce the potential for environmental injury and aid in meeting the performance objectives for fate and transport modeling (as dictated by the closure process). Without heel removal, tanks cannot be closed. Closing of the tank will reduce surveillances, repairs, etc. of tank and tank equipment. High in worker safety and health due to significant reduction in personnel exposure and high in environmental due to significant reduction in waste disposal.

Cultural/Stakeholder Factors: Tank closure and tank cleaning has been discussed at the local level including public meetings and hearings with the Citizens Advisory Board (CAB). High cultural impact due to significance of first of a kind operation to remove tank heel waste that supports tank closure. Greatly reduces the catastrophic damage to social, cultural, political, and economic conditions that could be caused by tank failure.

Cost Savings: Technology developed can be used to remove known heels throughout the DOE complexes. Estimated cost of removing waste from a high level waste storage tank is $8,000,000 per tank at Savannah River Site. Potential cost savings of $5,000,000 per tank. This is accomplished by utilizing fixed priced contractors and immediate tank closure activity using technology (equipment and processes) specifically designed for residual heel removal.

Other Justification:

Consequences of Not Filling Need: The DOE, EPA, and SCDHEC have agreed under the FFA, to eventually close both F- and H-Area Tank Farms with most of the older tanks to be emptied and cleaned first and closed under an accelerated schedule. Most of these tanks have been in existence for 35 to 40 years. These tanks are physically degrading and are in need of expeditious stabilization. Failure to approve funding for this effort could further delay specific waste removal and closure activities.

Privatization Potential: Privatization of technology development and deployment is highly viable and encouraged. There are numerous vendors and firms capable of performing this work to meet the functional requirements and schedule demands.

Current Base Technology and Cost:

Tanks Focus Area Site Needs

Need Title: Tank Heel Removal/Closure Technology

Site: SRS **TFA Functional Area:** Retrieval

TFA Response#: 98053 **Site Need#:** SR-2911 **Site Priority:** 11 of 20 **PBS#:** SR-HL03

SUMMARY OF TFA RESPONSE:

The TFA tentatively rated the priority of the technical response to this need as #14 (TFA Response 98053). The TFA is providing funding in FY98 and proposes to provide funding in FY9901, given available funding.

Tanks Focus Area Site Needs

Need Title: Alternate Waste Removal Techniques

Site: SRS **TFA Functional Area:** Retrieval
TFA Response#: 98054 **Site Need#:** SR-2902 **Site Priority:** 2 of 20 **PBS#:** SR-HL03

SITE NEED:

Need Description: This need statement combines FY98 need submissions SR-2002 (Salt Removal), SR-2005 (Tank 16 Annulus Cleaning), and scope for alternative sludge removal.

Saltcake is formed through successive evaporation cycles of alkali waste. Total waste volume is reduced during storage of waste in a less mobile form. However, the saltcake must be redissolved and transferred to the In-Tank Precipitation (ITP) Facility for further processing. Traditional salt removal involves installing large 150 HP slurry pumps into the tank to vigorously mix the contents into solution. The tanks are one (1) million gallon nominal capacity with a diameter of 75 to 85 feet depending on the type of tank. The secondary wall extends approximately two (2) feet beyond the primary wall. The secondary containment concrete wall is lined with welded steel plate to a height of five (5) feet for Type I and II tanks. Ventilation duct work is routed around the bottom of each annulus. The ventilation ducts occupy much of the lower space of the annulus, thereby limiting access to the annulus floor.

It costs approximately $6-10 million dollars per tank to perform salt removal on a waste tank using slurry pump method. It is desired to consider less cost intensive and less invasive methods to re-dissolve the salt.

Salt waste is also formed in the annular space between the primary and secondary containment tank walls when waste is leaked from the primary wall in some of the type I and II tanks. Before closing the tank, waste from the annulus must be removed and the space cleaned.

Functional Performance Requirements: Salt must be removed from the tank and annulus space leaving only a residual heel.

Schedule Requirements: Prototypical methods must be presented and tested during FY1998. The first viable technique must be tested successfully during FY1999.

Problem Description: Saltcake is comprised of sodium nitrate salts interspersed with sodium nitrite, potassium nitrate, and cesium salts. Cesium-137 is the primary isotope yielding the greatest radioactivity; however, long-lived isotopes have the most significatn impact on fate and transport modeling for tank closure. Controlled salt dissolution using the density gradient methods (or enhanced using water jets, steam spargers, submersible ducted turbine pumps, etc.) must be fully studied and field tested for viability.

Saltcake has also formed were waste has leaked into the annulus from some of the Type I and II tanks. For example, Tank 16 has saltcake in its annulus to a height of about two (2) feet. This waste must be dissolved and pumped to an acceptable waste tank.

Justifications:

Technical Justification: Saltcake is formed through successive evaporation cycles of alkali waste. Saltcake is comprised of sodium nitrate salts interspersed with sodium nitrite, potassium nitrate, and cesium salts. Cesium-137 is the primary isotope yielding the greatest radioactivity; however, long-lived isotopes have the most significatn impact on fate and transport modeling for tank closure. Total waste volume is reduced during storage of waste in a less mobile form. However, the saltcake must be redissolved and transferred to the In-Tank Precipitation (ITP) Facility for further processing. Traditional salt removal involves installing large 150 HP slurry pumps into the tank to vigorously mix the contents into solution.

Saltcake has also formed were waste has leaked into the annulus from some of the Type I and II tanks. For example, Tank 16 has saltcake in its annulus to a height of about two (2) feet. This waste must be dissolved and pumped to an acceptable waste tank. Before closing the tank, waste from the annulus must be removed and the space cleaned. There are no proven methods of removing radioactive saltcake from this type of geometry.

Tanks Focus Area Site Needs

Need Title: Alternate Waste Removal Techniques

Site: SRS **TFA Functional Area:** Retrieval
TFA Response#: 98054 **Site Need#:** SR-2902 **Site Priority:** 2 of 20 **PBS#:** SR-HL03

It costs approximately $6-10 million dollars per tank to perform salt removal on a waste tank using slurry pump method. It is desired to consider less cost intensive and less invasive methods to re-dissolve the salt. Controlled salt dissolution using the density gradient method (or enhanced using water jets, steam spargers etc.) must be fully studied and field tested for viability.

Regulatory Justification: The Tank Farms are permitted under the South Carolina Pollution Control Act. Waste removal schedules were discussed and agreed to the FFA. Refer to the Federal Facility Agreement between the U.S. Environmental Protection Agency Region IV, the U.S. Department of Energy, and the South Carolina Department of Health and Environmental Control Docket No. 89-05-FF, August 16, 1993.

ES&H Justification: An alternative salt removal method could potentially reduce personnel radiation exposure and reduce the potential for contamination.

Cultural/Stakeholder Factors: Waste Removal, tank closure, and tank cleaning has been discussed at the local level including public meetings and hearings with the Citizens Advisory Board (CAB). Significant impact by reducing solid waste disposal land and cost of equipment operation.

Cost Savings: Slurry Pump Method: $6,000,000/tank
Alternative Method: $2,000,000/tank
Savings: $4,000,000/tank

Other Justification:

Consequences of Not Filling Need: The DOE, EPA, and SCDHEC have agreed under the FFA, to eventually close both F- and H-Area Tank Farms with most of the older tanks to be emptied and cleaned first and closed under an accelerated schedule. Most of these tanks have been in existence for 35 to 40 years. These tanks are physically degrading and are in need of expeditious stabilization. Failure to approve funding for this effort could further delay specific waste removal and closure activities.

Privatization Potential: Privatization of technology development and deployment is highly viable and encouraged. There are numerous vendors and firms capable of performing this work to meet the functional requirements and schedule demands.

Current Base Technology and Cost:

SUMMARY OF TFA RESPONSE:
The TFA tentatively rated the priority of the technical response to this need as #17 (TFA Response 98054). The TFA is providing funding in FY98 and proposes to provide funding in FY99-00, given available funding.

Tanks Focus Area Site Needs

Need Title: In-situ Methods for Characterization of Tank Wastes

Site: SRS **TFA Functional Area:** Characterization

TFA Response#: 98055 **Site Need#:** SR-2918 **Site Priority:** 18 of 20 **PBS#:** SR-HL01, SR-HL02

SITE NEED:

Need Description: Develop in-situ methods that provide characterization information without physically removing and transporting material from the waste tanks. Characterization for corrosion chemistry control (i.e., nitrate, nitrite, hydroxide, chloride, floride, sulfate, PO4, AlOH4, C2O4, CO3) is one need. Characterization for retrieval and waste pre treatment is also needed (e.g., fissile isotopes of U and Pu, Cs-137, Sr-90, Na+, K+, density and weight percent solids). In addition, in-situ methods for measurement of weight percent solids is needed to monitor the feed to HLW evaporator systems.

Cost:
Identify technique (s) to develop - FY 98 cost of $250,000
Develop techniques and demonstrate accuracies and precision in varying concentrations - FY 99 cost of $1.5 million
Design equipment to utilize technique in field application - FY 99 cost of $750,000
Test equipment in simulated waste - FY 99 cost of $250,000
Develop deployment mechanism - FY 2000 cost of $250,000
Demonstrate in-situ characterization - FY 2000 cost of $250,000

How Long Will It Take: 4 years to 6 years

Functional Performance Requirements: In-situ methods need to be able to function in a radiation field and a highly alkaline environment saturated with nitrate, nitrite, carbonate, and aluminate. The solution being characterized may not be colorless and may contain undissolved solids. Target accuracies and precision are ±10% for solution species present in concentrations =0.1 mole/L, for Cs-137 and Sr-90, density and weight percent solids and ±25% for solution species present at <0.1 mole/L. Tank corrosion chemistry measurements have to provide chemical species results in varying concentrations of OH, NO2, and NO3 (.001 molar to 10 molar).

Schedule Requirements: Identify technique (s) to develop - FY 98
Develop techniques and demonstrate accuracies and precision in varying concentrations - FY 99
Design equipment to utilize technique outside laboratory - FY 99
Test equipment in simulated waste - FY 99
Develop deployment mechanism - FY 2000
Demonstrate in-situ characterization - FY 2000

Problem Description: Characterization of waste tank constituents for corrosion chemistry is important due to the waste being stored in carbon steel tanks. Failure to control the corrosion chemistry can result in tank failure and potential for an environmental release. Failure of a tank would also severely impact operation of the HLW facilities resulting in large production/utility costs.

Sample results of non-corrosion chemistry constituents for characterization purposes impacts ability to process.

Justifications:

Technical Justification: Develop a device that provides characterization information without physically sampling material in the Waste Tanks. Characterization for corrosion chemistry control, cold chemical constituents, and radio nuclide characterization is needed. Current sampling and analytical methods for liquid phase characterization are very time consuming and do not provide real-time results.

Regulatory Justification: Safe storage of radioactive waste regulated by Federal, State or local laws with potential for significant fines. DOE commitment with FFA requires tank to maintain structural integrity and removal deadlines and also has potential for significant fines.

Tanks Focus Area Site Needs

Need Title: In-situ Methods for Characterization of Tank Wastes

Site: SRS **TFA Functional Area:** Characterization

TFA Response#: 98055 **Site Need#:** SR-2918 **Site Priority:** 18 of 20 **PBS#:** SR-HL01, SR-HL02

ES&H Justification: Pulling current samples result in personnel exposure, creation of low level radioactive waste, and cost associated with handling and analysis. High in worker safety and health due to significant reduction in personnel exposure and high in environmental due to significant reduction in contaminated waste disposal.

Cultural/Stakeholder Factors: Significant impact by reducing solid waste disposal land use.

Cost Savings: Potential to save $2,000,000/year if sampling could be eliminated completely. Complex application would produce additional savings in tens of millions per year.

Other Justification:

Consequences of Not Filling Need: Continued analytical cost and personnel exposure and waste generation.

Privatization Potential:

Current Base Technology and Cost:

SUMMARY OF TFA RESPONSE:
The TFA tentatively rated the priority of the technical response to this need as #46 (TFA Response 98055). The TFA is providing funding in FY98 and proposes to provide funding in FY99-00, given available funding. This need will be partly addressed in the TFA Response 98004 to Hanford need RL-WT04. The TFA intends to satisfy the following additional need in its technical response: SRS need SR-2919 (TFA Response 98072B).

Tanks Focus Area Site Needs

Need Title: Methods to Unplug Waste Transfer Lines

Site: SRS **TFA Functional Area:** Retrieval

TFA Response#: 98056 **Site Need#:** SR-2913 **Site Priority:** 13 of 20 **PBS#:** SR-HL01, SR-HL02, SR-HL04

SITE NEED:

Need Description: As the tank clean-out and decommissioning program becomes active at SRS, there is an increasing potential that the transfer lines which are in place will become plugged (unable to facilitate waste transfer from one tank to another or from tankage to the DWPF ITP, or Saltstone, etc.

Cost :
Identify methods to unplug lines - FY99 cost of $50,000
Identify methods to detect the location of the pluggage in the transfer line in FY99 cost of $50,000
Prototype equipment for unplugging the line and detecting the location of the pluggage- FY99 cost of $250,000
Demonstrate line unplugging - FY00 cost of $250,000
Demonstrate detection equipment in FY00 cost of $75,000

How Long Will It Take: Final design will be available in FY98.

Functional Performance Requirements: Currently, each tank includes transfer lines for the purpose of emptying the tank. Most transfer lines are permanently installed 3" stainless steel pipes within its own carbon steel secondary containment pipe. Most tanks are equipped with 30 to 75 gpm steam operated transfer jets. Some tanks use long shaft electrically driven transfer pumps. In other cases the waste flows by gravity. Transfer lines have to be unplugged with devices that will not damage the lines. The method has to also provide contamination control and radiation exposure protection. Accessibility to the transfer lines is limited to openings through Hanford connectors in diversion boxes.

Another requirement is to provide equipment to detect the location of the pluggage. In lines more than 10s of feet long the location of the pluggage will be a factor in the method used to remove the pluggage.

Schedule Requirements: Identify methods to unplug lines - FY99
Identify methods to detect the location of the pluggage in the transfer line in FY 99
Prototype equipment for unplugging the line and detecting the location of the pluggage- FY99
Demonstrate line unplugging - FY 99
Demonstrate detection equipment in FY 99
Deployment of line unplugging system and detection equipment - FY 00

Problem Description: Transfer systems will potentially become plugged if the solids concentration of the material being transferred increases beyond the capacity of the prime mover which could be a jet or a pump. This can happen due to the solids settling out within the pipe.

Justifications:

Technical Justification: Pluggage to date has been approached via "brute force", such as the use of water via a high pressure low flow pump.

Regulatory Justification: FFCA, FFA - In order to recover from a tank leakage situation, it is required that the means exist to remove waste form each of our tanks. Tank cleanout for retirement requires that the means exist to transfer waste out of each of the 51 waste tanks.

ES&H Justification: Excavation of a line for the purpose of unplugging may be impossible due to the high radiation expected at the point of pluggage.
ALARA/OSHA/EPA Concerns: High pressure forcing of pluggage has demonstrated potential to contaminate.

Cultural/Stakeholder Factors: The potential for reducing exposure to workers is considerable.

Cost Savings: Savings would be in tens of millions of dollars due to replacement cost of transfer lines. The complex would benefit from this method and the savings would increase significantly.

Other Justification:

Consequences of Not Filling Need: Long time delays will be the results of inability to free a plugged transfer line. Permanent pluggage could require replacement of the line or the installation of alternative means of waste removal.

Privatization Potential: May be other industries pumping clay, sludge iron ore, etc. who may have already solved this problem.

Current Base Technology and Cost:

SUMMARY OF TFA RESPONSE:
The TFA tentatively rated the priority of the technical response to this need as #21 (TFA Response 98056). The TFA is providing funding in FY98 and proposes to provide funding in FY99-01, given available funding. The TFA intends to satisfy the following additional needs in its technical response: Hanford need RL-WT13 (TFA Response 98013D) and SRS need SR-2909 (TFA Response 98067C).

Tanks Focus Area Site Needs

Need Title: Second Generation Salt Feed Preparation

Site: SRS **TFA Functional Area:** Pretreatment
TFA Response#: 98057 **Site Need#:** SR-2908 **Site Priority:** 8 of 20 **PBS#:** SR-HL04

SITE NEED:

Need Description: The use of the tetraphenylborate (TPB-) ion for precipitation of radioactive cesium from High Level Waste (HLW) yields high generation of benzene. Other methods of removing radioactive cesium from HLW that avoid use of TPB would eliminate benzene generation. Alternative cesium removal agents and/or technologies may also eliminate the acid hydrolysis and Late Wash processes in the Defense Waste Processing Facility.

Background/general information: Previous studies examined the use of alternative cesium precipitating agents. The research focused on carbaborane compounds such as the cobalt dicarbollide ion (CDC-). Numerous closely related compounds were also examined. The research was terminated when it was discovered that the solubility of the cesium salt of CDC was approximately ten times higher than that of TPB and that the CDC decomposed in strong caustic. Decomposition of CDC limited the temperature and processing windows. Issues identified at the end of the research program that remain unresolved include: cost of the material, possible hydrogen gas generation at high temperature (>400 C), and compatibility with the DWPF glass formulation.

A derivative of CDC that acts as an ion exchange material was identified during the research program. This material, "poly-CDC" is an insoluble, stable inorganic solid that preferentially exchanges cesium for sodium and potassium. Optimization of the synthesis of this material was not completed, but decontamination factors similar to those for crystalline silicotitanate were observed with the preliminary material. The poly-CDC material should exhibit a high solubility in DWPF glass. It is unlikely that poly-CDC could be used as a "batch-and-stir" additive to HLW, but could be useful in an ion exchange column. Although significant fundamental research is needed on this material, WSRC is pursuing a patent.

Other ion exchange materials that would remove cesium from HLW fall into two categories: elutable and non-elutable. Elutable resins, such as resorcinol-formaldehyde resin and several other organic polymer resins, are available. Non-elutable resins, such as crystalline silicotitanate (CST) show high efficiency for treatment of HLW. The CST would be used in a "once-through" mode until saturated with cesium. The CST would then be mixed directly with the DWPF sludge and vitrified. The current limitation is the extremely high radiation field on the loaded resin (>3000 Ci/gal Cs-137) and the solubility of titania in the DWPF glass. Modifying the formulation of the DWPF glass may permit higher titania limits, reducing the required loading of cesium on the CST and the radiation field of the loaded resin. It is impractical to use CST in a "batch-and-stir" mode due to the need to repeatedly contact the HLW to achieve the high decontamination factor (40,000). The use of CST would require construction of ion exchange columns, but would not require the expensive elution equipment. Sluicing equipment would be needed to remove the resin from the columns. The HLW would also require pre-filtration to remove insoluble solids prior to treatment. The current In-Tank Precipitation filter equipment could not be used for this prefiltration unless significant shielding is added to the filtrate piping and the filtrate routed to the ion exchange columns.

Ongoing/Approved Program: The use of CST for treatment of HLW at SRS has been under study for two years, funded by the DOE Office of Science and Technology, Efficient Separations and Processes Crosscutting Program. The material was first developed as a fine powder and then as an engineered inorganic "resin" for use in ion exchange columns. Initial tests with the powdered form of CST indicated that cesium was selectively removed from simulated SRS waste. Testing has not yet been completed on the engineered form of CST. This process remains under study at SRS in FY98, although the primary focus of the research shifts to another waste stream (DWPF recycle).

Additional Technology Development Needs:
Additional technology development is desired for the following areas:
- Develop in-riser or in-line precipitation process to reduce the amount of excess NaTPB required to achieve the desired decontamination.
- Design a flow-sheet for the CST process.
- Develop and evaluate a flow-sheet that incorporates a small tank ITP.

- Evaluate an electrochemical separation pretreatment.
- Continue evaluating alternative precipitating agents.
- Evaluate the complexation and nano-filtration of radionuclides as an alternate decontamination method for high level waste.

Magnitude of the Problem: There are over 35 million gallons of HLW at SRS requiring treatment.

Functional Performance Requirements: A cesium-specific precipitating agent is needed. Using a precipitating agent avoids the need for system reconfiguration required for ion exchange. The precipitating agent must exhibit a cesium salt solubility at ambient temperature sufficient to produce a decontamination factor of 40,000. The decontamination factor must be achieved using a solution that is initially 30 mg/L cesium, 500 mg/L potassium, and 5.0 M sodium ions. Less than 10% of the precipitated solids can be sodium salts, but the potassium may be precipitated and carried with the cesium solids. The precipitating agent must not significantly impact the Saltstone process. The precipitating agent must be stable in strong caustic (1 M hydroxide ion), nitrate (3 M), and nitrite ions (1 M) to 65 C for a period of at least 60 days. The agent must tolerate radiation fields exceeding 10 Ci/L of Cs-137 for two years. The solids formed must be filterable at reasonable flow rates (0.25 gpm/ft2 at 30 psi with 1 wt % solids) and semi-soluble in dilute oxalic acid to permit filter cleaning. The precipitating agent must decompose by a process readily adaptable to a highly radioactive environment or prove compatible with DWPF vitrification.

Schedule Requirements: No applicable schedule tie.

Problem Description: Benzene can form deflagrable mixtures with air. Technical Safety Requirements in place are cumbersome and costly to administer.

Justifications:

Technical Justification: The use of the tetraphenylborate (TPB-) ion for precipitation of radioactive cesium from High Level Waste (HLW) yields high generation of benzene. Other methods of removing radioactive cesium from HLW that avoid use of TPB would eliminate benzene generation. Alternative cesium removal agents and/or technologies may also eliminate the acid hydrolysis and Late Wash processes in the Defense Waste Processing Facility.

Regulatory Justification: The facility operates under permit of the South Carolina Pollution Control Act. Refer to the Federal Facility Agreement between the U.S. Environmental Protection Agency Region IV, the Department of Energy, and the South Carolina Department of Health and Environmental Control Docket No. 89-05-FF, August 16, 1993.

ES&H Justification: Improvements in the process will reduce benzene emissions, thereby decreasing pollution and health hazards for the immediate employee and the local population.

Cultural/Stakeholder Factors: Extensive interactions with the Defense Nuclear Facility Safety Board, with the Department of Energy, with numerous external consultants and with the local public occur. These interactions ensure the safe operation of the facility.

Cost Savings: Alternative precipitation agents or ion exchange media may simplify the safety systems resulting in significant savings. For instance, annual nitrogen costs could decrease by $2 million.

Other Justification: None identified.

Consequences of Not Filling Need: Timely completion of waste removal activities for the Savannah River Site centers on success of this program.

Tanks Focus Area Site Needs

Need Title: Second Generation Salt Feed Preparation

Site: SRS **TFA Functional Area:** Pretreatment
TFA Response#: 98057 **Site Need#:** SR-2908 **Site Priority:** 8 of 20 **PBS#:** SR-HL04

Privatization Potential: Department of Energy encourages efforts by commercial firms to treat waste of this nature. Advances in individual program elements offer high potential for commercialization.

Current Base Technology and Cost:

SUMMARY OF TFA RESPONSE:
The TFA tentatively rated the priority of the technical response to this need as #8 (TFA Response 98057). The TFA proposes to provide funding in FY99-01, given available funding.
- The TFA intends to satisfy the following additional needs in its technical response: SRS need SR-2904 (TFA Response 98060) and part of ORR need TK-11(TFA Response 98052).
- Part of this need will be addressed in the TFA's response to ORR need TK-05 (TFA Response 98048).

Tanks Focus Area Site Needs

Need Title: Provide Alternative Processing and/or Concentration Methods for DWPF Recycle Aqueous Streams

Site: SRS **TFA Functional Area:** Pretreatment

TFA Response#: 98058 **Site Need#:** SR-2907 **Site Priority:** 7 of 20 **PBS#:** SR-HL05

SITE NEED:

Need Description: At design rates, DWPF recycles about 7.5 gpm aqueous stream to the tanks farms for evaporation. The stream consists of the following average composition: H2O-94.7%; NaOH 4.0%; NaNO3 0.3%; NaNO2 0.6%; NH3 300 PPM; Misc. inorganics 0.3%; Misc. Organics 700 PPM. In addition, the stream contains sludge solids and glass particulates from melter offgas fines and from process sample recycle. The gamma curie content is approximately 2 curies/gal. primarily Cs-137. Incremental cost of processing this material in the Tank Farm is ~78 cents per gal not including ITP batching costs. However, if ITP does not startup on schedule at reasonable attainment levels, tank farm storage capacity in new style tanks will become critical and may cause DWPF to stop operations.

Functional Performance Requirements: The above DWPF recycle stream must be processed in such a manner that approximately 95% of the stream is decontaminated to a level of ~2X10-4 curies/gal (a df of approximately 104) so that it can be processed by the Effluent Treatment Facility. The remaining 5% will be transferred to the high level waste tank farm.

Schedule Requirements: Critical if ITP does not startup on schedule and restrictions on use of old style tanks continue. A system would have to be installed in the next 2 to 3 years to continue to support DWPF sludge-only operations if ITP does not startup.

Problem Description: An aqueous recycle stream (approx. 7.5gpm) from DWPF will be separated into two streams:

	FEED	A(To Tank Farm)	B(To ETF)
Flow	7.5 gpm	0.4 gpm	7.1 gpm
g Curie Content	2 Ci/gal	37.5 Ci/gal	2X10-4 Ci/gal
g Curie/min.	15	15	14.2X10-4
Wt% Solids	0.1 to 5 wt%	100%	0%

Justifications:

Technical Justification: At design rates, DWPF recycles about 7.5 gpm aqueous stream to the tanks farms for evaporation. The stream consists of the following wt% average composition: H2O-94.7%; NaOH 4.0%; NaNO3 0.3%; NaNO2 0.6%; NH3 300 PPM; Misc. inorganics 0.3%; Misc. Organics 700 PPM. The gamma curie content is approximately 2 Ci/gal. primarily from Cs-137. The recycle stream was recently discovered to have glass fines which are suspected to have caused problems in the tank farm with silicate deposits in the 242-16H evaporator gravity drain line which required an extensive outage to cleanout. Incremented cost of processing this material in the Tank Farm is ~78 cents per gal. Loss of storage capacity at the Tank Farm or extended outage of tank evaporators will cause DWPF to stop operations.

Regulatory Justification: N/A

ES&H Justification: Reducing the volume of DWPF recycle will reduce the storage and processing burden on the tank farm and ITP.

Cultural/Stakeholder Factors: None identified.

Cost Savings: There is a cost reduction and cost avoidance potential. The incremental cost of processing this stream is ~78 cents/gal. At design rates and 75% attainment, DWPF produces approximately 3 million gal/yr of this stream. There is a significant cost if DWPF were forced to cease operations due to tank farm volume restrictions. Additionally, diverting this waste stream will reduce the number of ITP batches and support tank closure activities.

Other Justification: None identified.

Tanks Focus Area Site Needs

Need Title: Provide Alternative Processing and/or Concentration Methods for DWPF Recycle Aqueous Streams

Site: SRS **TFA Functional Area:** Pretreatment

TFA Response#: 98058 **Site Need#:** SR-2907 **Site Priority:** 7 of 20 **PBS#:** SR-HL05

Consequences of Not Filling Need: Higher costs will be incurred if potentially lower cost treatment methods are not utilized. Worst Case - DWPF may be forced to discontinue operations.

Privatization Potential: Potential solution may be applicable to other high-level and low-level aqueous waste at WSRC and other DOE sites.

Current Base Technology and Cost:

SUMMARY OF TFA RESPONSE:
The TFA tentatively rated the priority of the technical response to this need as #9 (TFA Response 98058). The TFA is providing funding in FY98 and proposes to provide funding in FY99-01, given available funding. The TFA intends to satisfy the following additional needs in its technical response: part of Idaho need ID-2.1.01 (TFA Response 98031) and part of ORR need TK-11(TFA Response 98052).

Tanks Focus Area Site Needs

Need Title: Optimize Melter Glass Chemistry

Site: SRS **TFA Functional Area:** Immobilization
TFA Response#: 98059 **Site Need#:** SR-2906 **Site Priority:** 6 of 20 **PBS#:** SR-HL05

SITE NEED:

Need Description: This need statement contains the FY98 need submission SR-2001 for glass waste loading and includes a need for optimizing melter chemistry to minimize noble metal effects.

The total number of canisters required to vitrify all of the current and future inventory of SRS High Level Waste can be reduced by reducing the uncertainty of models used to ensure the glass produced meets all quality and processing constraints. DWPF control program is based on statistical process control and narrowing the error bands on the constraints will allow the waste / glass former blends at compositions nearer to the constraints.

Functional Performance Requirements: Provide new or improved version of exiting property models for Liquidus Temperature and Durability. Identify the model tolerances. These models should be applicable to the entire range of plausible glass compositions produced from glass formers (frits) and washed sludge waste ("sludge only glass") or glass formers, sludge and processed washed precipitate ("PHA" or precipitate hydrolysis aqueous).

Schedule Requirements: No applicable schedule tie.

Problem Description: DWPF's complies with Waste Acceptance Product Specifications and process control requirements control by demonstrating, to a high confidence, that melter feed will produce glass meeting all quality and processing requirements. This method requires that uncertainties associated with sampling, sample analysis and models used to estimate properties be determined and that sufficient allowance is made for these uncertainties when controlling feed composition.

The existing model for liquidus temperature has a large uncertainty associated and its application has led to reduction in allowable waste loading. Some constraints on the application of the durability model can cause acceptable feed batches to be rejected, because the durability is indeterminate (i.e., the applicability of the model is not certain).

Justifications:

Technical Justification: The total number of canisters required to vitrify all of the current and future inventory of SRS High Level Waste can be reduced by reducing the uncertainty of models used to ensure the glass produced meets all quality and processing constraints. DWPF control program is based on statistical process control and narrowing the error bands on the constraints will allow the waste / glass former blends at compositions nearer to the constraints. Reducing uncertainty in the Liquidus Model and increasing the range of applicability of the durability model will result in larger acceptable composition ranges and increased waste loadings.

Regulatory Justification: A reduction in total canisters produced will favorably impact regulatory concerns.

ES&H Justification: Potential for reducing number of canisters sent to repository.

Cultural/Stakeholder Factors: No known concerns.

Cost Savings: Improvement in waste loading will reduce the total number of canisters from the 6000 projected. This improved margin appears to be about 5%, but is still about 300 canisters over the life cycle of DWPF. This is a potential savings in emplacement cost alone of ~$100 million.

TFA Response#: 98059 **Site:** SRS **Site Need#:** SR-2906 **TFA Functional Area:** Immobilization **Site Priority:** 6 of 20 **PBS#:** SR-HL05

Other Justification:

Consequences of Not Filling Need: If these improvements are not made, the increase in the false rejection and subsequent costly remediation of feed batches and missed opportunity to increase waste loading in canister with the concomitant reduction in canisters produced to vitrify the HLW inventory.

Loss of production due to false rejection of a good feed batch is about 3 days (of 14) per batch. Avoiding this could increase the DWPF attainment by about 2%-5% per year. The improvement in the liquidus model could increase waste loading by up to 5 %, with the same reduction in total canister produced to vitrify the HLW inventory (~~ 300 canister over the DWPF life cycle with over $100 million emplacement cost in the Federal Waste Repository. This also would enable DWPF to shut down sooner and reduce ingredient cost).

Privatization Potential: These studies can be performed by outside laboratories.

Current Base Technology and Cost:

SUMMARY OF TFA RESPONSE:
The TFA tentatively rated the priority of the technical response to this need as #7 (TFA Response 98059). The TFA is providing funding in FY98 and proposes to provide funding in FY99-01, given available funding. The TFA intends to satisfy the following additional needs in its technical response: Idaho need ID-2.1.08 (TFA Response 98037) and Hanford need RL-WT06 (TFA Response 98006).

SITE NEED:

Need Description: The In-Tank Precipitation (ITP) process uses sodium tetraphenylborate (NaTPB) to remove cesium from the high level waste stream. Monosodium titanate is used to remove strontium and plutonium from the waste stream. Prior to ITP initial operations, the tetraphenylborate precipitates generated in ITP were thought to be stable. The excess NaTPB was also thought to be stable.

During ITP Batch 1, excessive benzene was generated as a result of decomposition of TPB. Subsequent investigation revealed that all of the excess NaTPB added to the process had decomposed.

Ongoing research at SRTC has determined that under certain conditions, the TPB will decompose to form benzene and/or phenol. The decomposition reaction is catalyzed by Pd found either in the sludge or as a soluble fraction of the supernate.

The decompositon and related benzene generation may impact the throughput of the ITP facility. The limitations imposed on the ITP process as a result of the decomposition of TPB may not allow the ITP facility to meet required production goals for coupled (sludge and precipitate) operations at DWPF.

Technology development is desired in the following areas:
- Develop technologies to remove solids from the ITP feed. Reductions in benzene generation rates as specified above are desirable.

Functional Performance Requirements: The overall benzene generation rate for the ITP facility and subsequent processing in the Late Wash Facility should be reduced to less than 1 mg/l/hr.

Schedule Requirements: Technology and systems to pretreat ITP feed to reduce or eliminate degradation reactions is needed in FY99.

Problem Description: The benzene generation rates produced by the catalytic decomposition of TPB has resulted in modifications to the ITP flowsheet which reduce the production capacity of the facility. Methods are needed to return the ITP to its design capacity. .

Justifications:

Technical Justification: The In-Tank Precipitation (ITP) process uses sodium tetraphenylborate (NaTPB) to remove cesium from the high level waste stream. Monosodium titanate is used to remove strontium and plutonium from the waste stream. Prior to ITP initial operations, the tetraphenylborate precipitates generated in ITP were thought to be stable. The excess NaTPB was also thought to be stable.

During ITP Batch 1, excessive benzene was generated as a result of decomposition of TPB. Subsequent investigation revealed that all of the excess NaTPB added to the process had decomposed.

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The decompositon and related benzene generation may impact the throughput of the ITP facility. The limitations imposed on the ITP process as a result of the decomposition of TPB may not allow the ITP facility to meet required production goals for coupled (sludge and precipitate) operations at DWPF.

Technology development is desired in the following areas:
- Develop technologies to remove solids from the ITP feed. Reductions in benzene generation rates as specified above are desirable.

Tanks Focus Area Site Needs

Need Title: ITP Feed Solution Pretreatment

Site: SRS
TFA Functional Area: Pretreatment
TFA Response#: 98060
Site Need#: SR-2904
Site Priority: 4 of 20
PBS#:

Regulatory Justification: The facility operates under permit of the South Carolina Pollution Control Act. Refer to the Federal Facility Agreement between the U.S. Environmental Protection Agency Region IV, the Department of Energy, and the South Carolina Department of Health and Environmental Control Docket No. 89-05-FF, August 16, 1993.

ES&H Justification: Improvements in the process will reduce benzene emissions, thereby decreasing pollution and health hazards for the immediate employee and the local population.

Cultural/Stakeholder Factors: Extensive interactions with the Defense Nuclear Facility Safety Board, with the Department of Energy, with numerous external consultants and with the local public occur. These interactions ensure the safe operation of the facility.

Cost Savings: The primary justification is to return the ITP facility to its design throughput. This will save the incremental costs incurred as a result of the throughput loss.

Other Justification: No known concerns.

Consequences of Not Filling Need: If the ITP throughput is not restored, tank closure and final waste disposal will be delayed, incurring all of the associated costs.

Privatization Potential: Department of Energy encourages efforts by commercial firms to treat waste of this nature. Advances in individual program elements offer high potential for commercialization.

Current Base Technology and Cost:

SUMMARY OF TFA RESPONSE:
The TFA did not rate the technical response to this need separately (TFA Response 98060). The TFA intends to satisfy this need through the technical responses prepared for SRS need SR-2908 (TFA Response 98057).

Tanks Focus Area Site Needs

Need Title: Demonstrate Alternative Filtration Technologies to Replace HEPA Filters

Site: SRS **TFA Functional Area:** Safety

TFA Response#: 98061 **Site Need#:** SR-2901 **Site Priority:** 1 of 20 **PBS#:** SR-HL01 and SR-HL02

SITE NEED:

Need Description: HEPA filters are used throughout the SRS complex to assure that air emissions to the environment are free of radioactive particulates. Filters are generally constructed of a 0.013 inch thick glass fiber material. Required minimum HEPA standards include 99.97% capture of 0.3 micro meter diameter aerosol particles.

Typical of the filters in use at SRS is the Flanders Super-Flow® II type GG-F filter. It is constructed of 'fan folded' borosilicate glass fiber paper. HEPA filters in service at SRS waste management have the following typical attributes:

- Two to four year average life (limited by filter media failure)
- Replaced when any of the following conditions are exceeded
- Pressure drop exceeds 6" wc
- Gamma radiation becomes excessive (due to collected particles)
- Fails 99.97% DOP test
- Pressure drop limit is determined by the strength of the 0.013" thick filter media
- Water is principle problem encountered with existing HEPA's.

A preheater is installed in the air ducts upstream of most waste management HEPA's in an effort to prevent condensation and subsequent damage to the HEPA.

Use of an alternative filtration technology such as a HEPA filter constructed of sintered stainless steel will provide a HEPA filter which is not subject to water damage, and can be installed with built in water jets which will be used to wash the filter to reduce radiation and to eliminate to dirt accumulation. Preliminary tests indicate that use of sintered metal filter material eliminates the release of particulates to the atmosphere with the same efficiency as filtration with a fiberglass filter medium, but can be cleaned with water, and is not subject to water damage.

Functional Performance Requirements: An alternative filtration technology should eliminate failure problems associated with wetting of the filter. A technology such as sintered metal filters should provide a filter whose design includes permanently installed spray wash nozzles which would be used to restore flow to a plugged or partially plugged filter. HEPA filters are used in the H&V system in tanks holding radioactive material.

Experiments using Mott Metallurgical Co. one micron sintered stainless steel filter media suggest that a waterproof HEPA filter could be manufactured to replace our existing HEPA filters. The medium is sintered stainless steel whose particle size is 1 micrometer diameter. SRS testing of the sintered metal filter resulted in data indicating that the material passes the 99.97% capture requirement using DOP 0.3 micro meter diameter aerosol. Water spray experiments have shown that the medium in unharmed by total immersion, and that water spray is effective at restoring flow through material which was plugged by accumulated atmospheric borne dirt. Water sprayed on the dirty side of a vertical filter appears to flush the accumulated "dirt" down the "dirty" side. Previous experiments by Lawrence Livermore Nat Lab. [LLL] researchers attempting to clean steel filters by back pulsing air (from the clean side of the filter) failed due to high moisture. The LLL filters were constructed of 2 micron diameter stainless steel fibers whereas the proposed sintered filter would be constructed of 1 micron particles which are formed into a 0.013 inches thick plate. The thinness of the plate creates a front surface filter which permits little if any penetration of particles into the mass of the filter.

SRS experimental evidence suggest that use of 36" x 36" flat Mott Corp. 1μ material will provide 555 cfm flow at 157 inches water column of vacuum. Waste tank installation will require replacement of the 1 hp exhaust fan with a 15 hp exhaust fan.

1)Very thin [0.013 inch] filter medium stops particle transmission at the exposed surface of the medium. The particles collected are more easily removed from the relatively smooth surface of the filter than particles collected within the bulk of a thicker filter medium such as stainless steel wire mesh. Use of thin sheet of sintered stainless steel makes the filter washable from dirty side

2)Relatively rigid [Not flexible] stainless steel construction makes the filter resistant to mechanical damage.
3)Material will tolerate higher pressure drop than glass paper type HEPA
4)Material could withstand high temperatures without damage or fire hazard

The 51 SRS waste tanks each use 500 cfm rated glass/paper HEPA filters to prevent radioactive contamination of the environment from the tank's purge off gas. Standard requirement is that a HEPA block 99.97% of 0.3 micro meter diameter particles.

Schedule Requirements: Detail Prototypical design of 500 cfm sintered HEPA by 10/1/98
Purchase materials for 500 cfm test apparatus - 1/2/99
Assembly of 500 cfm test -3/1/99
Complete testing and issue evaluation report 6/1/99
Design of field deployable 500 cfm system - 10/1/99

Problem Description: An alternative filtration technology such as a HEPA filter constructed of sintered stainless steel will provide a HEPA filter which is not subject to water damage, and can be installed with built in water jets which will be used to wash the filter to reduce radiation and to eliminate to dirt accumulation. Preliminary tests indicate that use of sintered metal filter material eliminates the release of particulates to the atmosphere with the same efficiency as filtration with a fiberglass filter medium, but can be cleaned with water, and is not subject to water damage. Test data indicates that a means of water removal from the clean side of the filter is required to maintain acceptable filter operation. In response to this need the 5 cfm test apparatus uses cylindrical filters mounted vertically. Dirty air will flow from outside in. Cleaning will be via spray to the.OD of the filter. Water on the clean side of the filter will flow by gravity and air movement out of the open bottom of the cylindrical filter. Clean air will be drawn by the vacuum pump out of the open bottom of the cylindrical filter.

Justifications:

Technical Justification: HEPA filter replacement is an issue with respect to personnel radiation exposure and contamination, HEPA filter disposal cost, the issue of radioactive material buildup, and release of unknown quantities as the result of a catastrophic failure. All waste tank purge HEPA systems include a preheater in an attempt to prevent condensation of water on the HEPA. The sintered steel HEPA will not be damaged when wetted.

Regulatory Justification: Monitoring and reporting of air emissions is required by the S. C. Department of Health and Environmental Control.

ES&H Justification: Use of sintered HEPA filters or an alternative filtration technology will reduce radioactive solid waste disposal and personnel exposure associated with changing current HEPA filters. HIGH in public safety due to significant reduction of personnel exposure. HIGH in Environmental due to significant reduction in contaminated waste disposal. Elimination of the catastophic release scenario through routine reduction in source term via in-situ cleaning.

Cultural/Stakeholder Factors: Self-cleaning HEPA filters will have a significant impact by reducing solid waste disposal land use.

Cost Savings: Self-cleaning HEPA filters will save manpower costs currently incurred with change out of the present paper filters, reduce HEPA material cost, and reduce solid waste disposal cost. This would apply to the overall DOE complex. Cost savings would be in Tens of Millions for complex.

Cost : Sintered metal self cleaning has been demonstrated FY 97 for $50,000
Developmental testing at 5 cfm will be completed in FY 98 for $50,000

Need Title: Demonstrate Alternative Filtration Technologies to Replace HEPA Filters

TFA Response#: 98061 **Site:** SRS **Site Need#:** SR-2901 **TFA Functional Area:** Safety **Site Priority:** 1 of 20 **PBS#:** SR-HL01 and SR-HL02

Detail Prototypical design of 500 cfm sintered HEPA will be completed in FY 98 for $50,000
Test data and evaluation will be completed in FY 98 for $50,000
Final design will be completed in FY 98 for $30,000Purchase materials for 500 cfm test apparatus will be completed in FY99 for 100,000
Assembly of 500 cfm test will be completed in FY99 for $100,000Complete testing and issue evaluation report will be completed in FY99 $50,000Design of field deployable 500 cfm system will be completed in FY99 for $50,000

How Long Will It Take :
Final design will be available in FY 98
Conversion to self-cleaning HEPA filters will take < 3 months per applications since the design will fit into the existing configuration of the current HEPA filter.

Other Justification:

Consequences of Not Filling Need: Continue overuse of land for disposal of solid waste. No resolution of current safety concern in relation to source term associated with catastrophic HEPA failure.

Privatization Potential: Pall Filter Company, Nuclear Filter Technology Co and Mott Corp. all have strong interest in sintered metal filter technology for use on a HEPA filter. Pall has constructed sintered wire type filters but has not as yet produced a unit operating in the nuclear industry. The Pall design is pleated and appears to provide capture sites which may prove impossible to clean in-situ. The Mott material has not been used for HEPA application because of the high pressure drop required to maintain flow. The Mott sintered particle filter has very smooth surface compared to the surface of the sintered wire type filters. SRS testing in FY98 will compare performance of the sintered wire verses sintered particle materials.

Current Base Technology and Cost:

SUMMARY OF TFA RESPONSE:
The TFA tentatively rated the priority of the technical response to this need as #10 (TFA Response 98061). The TFA is providing funding in FY98 and proposes to provide funding in FY99-00, given available funding. The TFA intends to satisfy the following additional needs in its technical response: Idaho need ID-2.1.13 (TFA Response 98042).

Tanks Focus Area Site Needs

Need Title: Develop Second Generation DWPF Melter

Site: SRS **TFA Functional Area:** Immobilization
TFA Response#: 98062 **Site Need#:** SR-2910 **Site Priority:** 10 of 20 **PBS#:** SR-HL05

SITE NEED:

Need Description: This need statement contains FY98 submissions SR-2012, SR-2021, SR-2022, and SR-2023.

A. The cost of a DWPF melter to vitrify 220 lbs/hr of an aqueous high level waste stream is approximately $20 million. Melter changeout requires long periods of outage time. A lower cost and longer life melter is desirable.

B. The DWPF Melter pour spout accumulates glass and crystalline deposits in three areas. These deposits must be removed periodically from the pour spout to maintain melter operability. Improved cleaning techniques would enhance the removal of these deposits from the pour spout.

C. These deposits can also result in further glass deposition and pluggage in the bellows assembly which couples the glass receiving canister to the melter. The causes of this accumulation and pluggage must be characterized as a part of the effort to eliminate the problem.

D. The DWPF Glass Melter has been unable to consistently sustain glass production rate (melt rate) equivalent to that achieved during pilot scale testing. Methods to increase melt rate will enhance DWPF ability to increase the rate of high level waste vitrification.

Functional Performance Requirements: A. The melter must vitrify a waste stream with an approximate composition of 45 wt.% solids in a water slurry with a density of 1.4. The major elements present in the solids are Al @ 2 wt.% elemental, B @ 2 wt.% elemental, Fe @ 8 wt.% elemental, and Si @ 24 wt.% elemental. The calcine factor for the waste solids is approximately 0.87. Melter temperature, other than those in the cold cap, must not be less than 1050 C to assure that glass quality requirements are met. Maximum temperature is 1200 C to assure that DWPF off-gas systems are not overloaded (i.e. Cs volatility) and materials of construction limitations (electrode surface temperature) are not exceeded.

B. Cleaning techniques are required to remove glass and crystalline deposits from the DWPF Melter pour spout. These techniques must satisfy the following criteria:

(1) Must remove as much of the accumulated material as possible, including that accumulated behind the disengagement points (45o back cut knife edge). This material consists of high level nuclear waste glass and waste glass devitrification (crystalline) products.

(2) Cannot damage or deform the pour spout or associated equipment

(3) Must be accomplished remotely. A telerobotic manipulator is available which reaches the melter pour spout. Other methods may be acceptable, however the only access to the melter is via overhead crane hook and impact wrench.

(4) Cannot get stuck in the pour spout. Must be easily removed.

(5) Cannot adversely impact wasteform acceptance criteria.

C. Characterization of the pour spout accumulation/pluggage must include:

(1) Evaluation of the importance of glass chemistry including composition, physical properties, redox state, devitrification.

(2) Evaluation of the physics of glass pouring.

(3) Evaluation of the pour spout design including physical configuration, thermal profile and materials aspects.

(4) Evaluation of relationship between melter, pour spout, bellows assembly, and canister.

(5) Evaluation of effect of melter/pour spout pressure control systems.

(6) Recommendations for optimization of items 1-5 above.

D. Method(s) to increase DWPF melt rate must satisfy the following criteria:

(1) Goal melt rate: 228 lb glass produced per hour (8 lb/hr ft2)

(2) Cannot adversely impact waste glass acceptance criteria.

(3) Minimal impact to existing feed preparation and delivery equipment.

(4) Minimal impact to melter design.

(5) Melter configuration needs to be accommodated by the present DWPF melt cell geometry.

Schedule Requirements:

A. Schedule is driven primarily by potential cost savings and available funding.

B. There is a current need for improved pour spout cleaning. Cleaning techniques should be developed to ensure that DWPF melter attainment is maintained sufficiently high to meet FY98 - FY99 production requirements.

C. To impact re-design and implementation for DWPF Melter-3 it must be complete by end of FY98. For DWPF Melter-4 and future melters it must be complete by end of FY99.

D. There is a current need for improving DWPF melt rate. Melt rate improvement methods should be developed during FY 98 - FY99 to ensure that DWPF melter attainment is maintained sufficiently high to meet increasing production requirements.

Problem Description:

A. The melter is one of the most expensive and most complicated components in the DWPF. In the future, it could also become the production rate limiting component in the plant. A simpler, lower cost melter could result in significant lower life cycle costs for the DWPF.

B. The DWPF Melter pour spout is approximately 25" long. It consists of three vertically oriented cylindrical sections of increasing diameter from top to bottom; 2", 3" and 3.96". The intersections between these sections are 45o back cut knife edges which are intended to serve as molten glass disengagement points. Under normal operation the first disengagement point (2" diam. cylinder) is where the pour stream begins a free-fall into the glass receiving canister. (The glass stream should not contact anything else after leaving that edge.) The pour spout is externally heated from within approximately 2" from the top to 3" from the bottom. The melter pour spout accumulates glass and crystalline deposits in three areas. The upper (heated) sidewalls, behind the glass disengagement points, and at the bottom. These deposits can adversely impact melter performance by deflecting the melt pour stream and ultimately causing partial or complete pluggage of the melter discharge area. Accumulated material on the upper sidewalls and disengagement points (knife edges) of the pour spout can contribute to a phenomenon referred to as "wicking" of the pour stream where glass flows down the side walls rather than free-falling from the disengagement point into the canister. When wicking occurs, significant glass buildup occurs in the lower (unheated) end of the spout. This causes further diversion of the pour stream which contacts the wall of the bellows assembly which mates the pour spout to the canister. Glass accumulation and resultant pluggage in this section is common. When pour spout and bellows pluggage occur, much time is required to remove accumulated glass and allow waste glass production to resume. This significantly impacts melter attainment and glass production. Severe pluggage can also jeopardize the glass melter. Methods are required to periodically clean the pour spout to help minimize glass "wicking", improve pouring behavior, lower the frequency of pluggage incidents, and shorten duration of recovery from pluggage and prepare the pour spout for insert installation.

C. The DWPF Melter pour spout is approximately 25" long. It consists of three vertically oriented cylindrical sections of increasing diameter from top to bottom; 2", 3" and 3.96". The intersections between these sections are 45o back cut knife edges which are intended to serve as molten glass disengagement points. Under normal operation the first disengagement point (2" diam. cylinder) is where the pour stream begins a free-fall into the glass receiving canister. (The glass stream should not contact anything else after leaving that edge.) The pour spout is externally heated from within approximately 2" from the top to 3" from the bottom. The melter pour spout accumulates glass and crystalline deposits in three areas. The upper (heated) sidewalls, behind the glass disengagement points, and at the bottom. These deposits can adversely impact melter performance by deflecting the melt pour stream and ultimately causing partial or complete pluggage of the melter discharge area. Accumulated material on the upper sidewalls and disengagement points (knife edges) of the pour spout can contribute to a phenomenon referred to as "wicking" of the pour stream where glass flows down the side walls rather than free-falling from the disengagement point into the canister. Another suspected contributor to wicking is the melter/pour spout pressure control system which affects the pour stream size and position. When wicking occurs, significant glass buildup occurs in the lower (unheated) end of the spout. This causes further diversion of the pour stream which contacts the wall of the bellows assembly which connects the pour spout to the canister. Glass accumulation and resultant pluggage in this section is common. When pour spout and bellows pluggage occur, much time is required to remove accumulated glass and allow waste glass production

to resume. This significantly impacts melter attainment and glass production. Severe pluggage can also jeopardize the glass melter. The pluggage phenomenon must be characterized in order to guide efforts to eliminate it. Suspected contributors to the problem include physical design, glass chemistry/redox, and melter/pour spout pressure control systems.

D. The DWPF Melter has been unable to sustain glass production at the reference rate of 228 lb/hr (8 lb/hr ft2). It is important to produce glass at that rate or above to meet production goals and work off HLW inventories within the projected time frame. Experience to date indicates that "foaming" at the glass/feedstock interface is contributing to the problem by limiting heat transfer from the glass to the feed material. The redox state of the feed/glass may be the cause. Viscosity of the glass and melting feed may also limit melting rate.

Justifications:

Technical Justification:
A. The cost of a DWPF melter to vitrify 220 lbs/hr of an aqueous high level waste stream is approximately $20 million. Melter changeout requires long periods of outage time. A lower cost long life melter is needed.
B. Improved pour spout cleaning techniques will help minimize the occurrence of glass "wicking", improve pouring behavior, lower the frequency of pluggage incidents, and shorten duration of recovery from pluggage and reduce outage time for pour spout insert installation.
C. Characterization of the pluggage problem will help guide design and/or process flow sheet changes. This will help minimize the occurrence of glass "wicking", improve pouring behavior, and lower the frequency of pluggage incidents.
D. The DWPF Glass Melter has been unable to sustain design glass melt rate equivalent to that achieved during pilot scale testing. Methods to increase melt rate are required to enhance DWPF HLW glass production goals.

Regulatory Justification:
A. Will aid in improving DWPF production capability and meeting HLW vitrification requirements.
D. This need is driven by the need to reduce costs by optimizing the process and is within the scope of the existing regulatory envelope.

ES&H Justification:
A. A longer life melter will reduce occupational exposure incurred during melter changeout.
B. If pluggage occurs which results in replacement of the DWPF Melter, significant personnel radiation exposure will occur during out.
D. This need is driven by the need to reduce costs by optimizing the process. There will be some incremental benefit in Environmental Safety and Health performance through optimization.

Cultural/Stakeholder Factors: Extensive interactions with the Defense Nuclear Facility Safety Board, with the Department of Energy, with numerous external consultants, and with the local public occur. Changes to the melter design will need to satisfy the safety perspective of these groups.

Cost Savings:
A. Depending upon potential capital and operating costs savings which could be attained from alternate melter designs, life cycle cost savings of several hundred million dollars may be possible.
B. Lost production as a result of glass pluggage will result in an equivalent extension of the time required for DWPF to operate to work off the SRS HLW inventory. DWPF operating costs are currently approximately $400,000.00 per day. If pluggage would require the replacement of the DWPF melter, the replacement cost is approximately $20 million. Additional costs are involved in installation of the new melter and disposal of the failed one.

Other Justification: None Identified.

Tanks Focus Area Site Needs

Need Title: Develop Second Generation DWPF Melter

Site: SRS **TFA Functional Area:** Immobilization
TFA Response#: 98062 **Site Need#:** SR-2910 **Site Priority:** 10 of 20 **PBS#:** SR-HL05

Consequences of Not Filling Need:
A. Higher capital and operating costs may be incurred if potential lower cost melters are not evaluated.
B. There will be continued negative impact on DWPF attainment and an increased risk of loss of the melter due to pluggage.
D. There will be continued negative impact on DWPF attainment.

Privatization Potential:
A. Improvements would probably also be applicable at other DOE sites where vitrification of high level waste is planned for the future e.g. Hanford and Idaho.
D. Technology associated with increased glass production rate may will have application in other waste glass production including hazardous as well as radioactive wastes. Waste glass melting technology exists throughout the country outside of the DOE complex. It may also have limited application in the commercial glass industry.

Current Base Technology and Cost:

SUMMARY OF TFA RESPONSE:
The TFA tentatively rated the priority of the technical response to this need as #19 (TFA Response 98062). The TFA is providing funding in FY98 and proposes to provide funding in FY99-01, given available funding. The TFA intends to satisfy the following additional needs in its technical response: Idaho need ID-2.1.08 (TFA Response 98037).

Tanks Focus Area Site Needs

Need Title: Develop Advanced Techniques to Improve Safety Infrastructure

Site: SRS **TFA Functional Area:** Safety

TFA Response#: 98063A, B, C, D **Site Need#:** SR-2916 **Site Priority:** 16 of 20 **PBS#:** SR-HL01, SR-HL02

SITE NEED:

Need Description: Develop advanced techniques to improve the safety infrastructure of the aging facilities. The improvements will maintain the safety of these aging facilities by replacing degraded equipment with new cost effective innovative concepts. The infrastructure improvements are listed below.

Develop a passive device that ventilates the waste tank interior. A tank top device is needed to purge the waste tank atmosphere of accumulated hydrogen gas and organic vapor. Such a device would save capital investment for the upgrades scheduled for the old style tanks. In addition, savings would be gained by the avoidance of operation and maintenance cost associated with tank ventilation upkeep.

Develop methods to stabilize waste that leaks onto or into the ground; thus, preventing a environmental release concern.

Develop NDA detection equipment to detect alpha and beta in low gamma fields for solid waste characterization. Also need detection equipment for monitoring storm water runoff and identify alpha and beta contamination exists.

Support efforts to resolve hydrogen retention and release concerns in salt and sludge.

Develop improvements in purge ventilation system for both annulus and purge systems of tanks.

Develop portable hydrogen monitors that will provide safety class detection level for varying ranges of H_2 in waste tanks.

Develop method to sample the evaporator pot.

Functional Performance Requirements: Passive Vent: Provide a HEPA barrier between the tank atmosphere and the environment. Provide an air exchange for a filled waste tank (362") air space to prevent reaching TFLF in 9 days. This volume is approximately 16,000 cubic feet. Device must be passive in nature (e.g., no electricity).

Stabilize leaked waste: Methods to contain and stabilize leaked waste in an emergency to provide control and minimize personnel hazards.

Develop NDA equipment to characterize solid waste and changeout of HEPA filters that have low gamma field but have alpha and beta contamination. Additionally provide detection equipment for monitoring rainwater runoff and characterize the alpha and beta quantities.

Support efforts to resolve hydrogen retention and release concerns in salt and sludge.

Support efforts to resolve hydrogen retention and release concerns in salt and sludge.

Schedule Requirements:

Develop a passive ventilation concept and design - FY99
Build and demonstrate a passive ventilation system operation on a clean tank - FY00
Demonstrate a passive ventilation system on a waste tank - FY00
Develop method to stabilize leaked waste in FY99
Develop NDA equipment in FY99
Deploy NDA equipment in FY99
Develop portable H_2 monitors in FY99
Support studies for hydrogen release in FY99

Need Title: Develop Advanced Techniques to Improve Safety Infrastructure

Site: SRS **TFA Functional Area:** Safety

TFA Response#: 98063A, B, C, D **Site Need#:** SR-2916 **Site Priority:** 16 of 20 **PBS#:** SR-HL01, SR-HL02

Demonstrate evaporator pot sample in FY99
Develop methods to improve ventilation system in FY99
Deploy ventilation improvement in FY00

Problem Description: Ventilation system installed on waste tanks installed in 1950's requires significant maintenance and upgrades to the ventilation equipment and to the services needed (power, cooling, and steam). Passive ventilation system has to prevent buildup of flammable gases and provide contamination control during safe storage.

Additional upgrades and controls are needed to address the aging system. The desire is to address these upgrades with minimum capital cost. These are discussed below.

Develop methods to stabilize waste that leaks onto or into the ground; thus, preventing a environmental release concern.

Develop NDA detection equipment to detect alpha and beta in low gamma fields for solid waste characterization. Also need detection equipment for monitoring storm water runoff and identify alpha and beta contamination exists.

Support efforts to resolve hydrogen retention and release concerns in salt and sludge.

Develop improvements in purge ventilation system for both annulus and purge systems of tanks.

Develop portable hydrogen monitors that will provide safety class detection level for varying ranges of H_2 in waste tanks.

Develop method to sample the evaporator pot.

Justifications:

Technical Justification: Ventilation systems required for flammable control and contamination control. Existing old systems require significant upgrades for contamination control to support removal operations and require high maintenance support.

Need improved methods to determine alpha and beta levels in solids and liquids.

Provide understanding of hydrogen retention in sludge and salt to support seismic resolution and necessary processing to remove waste from the tanks for vitrification.

Regulatory Justification: The facility operates under permit of the South Carolina Pollution Control Act. Refer to the Federal Facility Agreement between the U.S. Environmental Protection Agency Region IV, the Department of Energy, and the South Carolina Department of Health and Environmental Control Docket No. 89-05-FF, August 16, 1993. Potential exists for significant fines.

ES&H Justification: Posture of facility for ES&H is improved.

Cultural/Stakeholder Factors: Extensive interactions with the Defense Nuclear Facility Safety Board, with the Department of Energy, with numerous external consultants and with the local public occur. Posture of the facility will be improved by these infrastructure upgrades.

Need Title: Develop Advanced Techniques to Improve Safety Infrastructure

Site: SRS **TFA Functional Area:** Safety

TFA Response#: 98063A, B, C, D **Site Need#:** SR-2916 **Site Priority:** 16 of 20 **PBS#:** SR-HL01, SR-HL02

Cost Savings: Passive ventilation and other infrastructure upgrades and development would reduce cost of storing waste by tens of millions in complex.

Cost :
Develop a passive ventilation concept and design - FY 99 cost of $500,000
Build and demonstrate a passive ventilation system operation on a clean tank - FY 00 cost of $500,000
Demonstrate a passive ventilation system on a waste tank - FY 2000 cost of $700,000
Cost for other infrastructure activities will be: FY 99 - $250,000, FY 00 - $250,000

How Long Will It Take: Final design will be available in FY 2000

Other Justification:

Consequences of Not Filling Need: Maintain the existing active HVAC system until waste removal. Continue environmental impacts on solid waste disposal and continuing contamination problems. Safety improvements at a lower capital cost will not occur.

Privatization Potential: Excellent potential exists.

Current Base Technology and Cost: Simple exhaust fan purging the waste tank air space at a nominal 150-300 cfm. The inlet plenum is HEPA filtered and the exhaust plenum is dried and the air is condensed to keep the exhaust HEPA filter dry.

No evaporator sampling method exists.

No portable NDA equipment exists for solid waste or liquid characterization in low gamma to detect alpha and beta contaminates.

SUMMARY OF TFA RESPONSE:
The TFA separated this comprehensive need into four parts. The first part responds to requirements for Passive Ventilation. The TFA tentatively rated the priority of the technical response (TFA Response 98063A) to these requirements need as #30. The TFA proposes to provide funding in FY99-FY00, given available funding.

The second part consists of the TFA's Response 98063B to requirements for Leaked Waste Stabilization. The TFA tentatively rated the priority of the technical response to this need as #58.

The third part consists of the TFA's Response 98063C to requirements for an Evaporator Pot Sampler. The TFA tentatively rated the priority of the technical response to this need as #51, and proposes to provide funding in FY99-00, given available funding.

The fourth part consists of the TFA's Response 98063D to requirements for Non-destructive Analysis for Alpha and Beta in Solid Waste Containers. The TFA tentatively rated the priority of the technical response to this need as #59.

Tanks Focus Area Site Needs

Need Title: Develop Techniques to Increase DWPF Throughput and Productivity

Site: SRS **TFA Functional Area:** Characterization

TFA Response#: 98064 **Site Need#:** SR-2905 **Site Priority:** 5 of 20 **PBS#:** SR-HL05

SITE NEED:

Need Description: This need statement contains FY98 submissions SR-2014 and SR-1024 as well as other needs to improve DWPF productivity and throughput.

A. Currently, the DWPF requires the sampling of its feed streams for elemental analysis at several points during the preparation of a waste batch for melter pouring. These analyses require lengthy and laborious sample preparation in remote shielded cells prior to lab elemental analysis. Depending on sample type and analytical methodology employed, a single set of these analyses require from 24 to 72 hours to complete. Since the process is a batch process with no hold tanks, most of this analysis time is critical path time for the process. Thus, a reduction in this analytical time translates directly into process attainment improvement. Ideally, the need is for an elemental analysis system which can be operated in a remote cell with little to no pretreatment required for analysis. In addition to SRS, this technology improvement has direct applicability to West Valley Nuclear Services Vitrification Plant, Hanford, and INEL waste processing analytical processes.

B. The level and density of the contents (both liquid and slurry) of DWPF process tanks are currently determined by measuring the pressure at several levels in the tanks. The differential pressures are used to determine liquid level and density. Knowledge of these variables is necessary for successful operation of the process. Many of the tanks contain slurries containing glass frit and high level waste sludge solids. Nitrogen or air bubblers are commonly used to determine pressure in aqueous tanks. Bubblers have been unsuccessful at DWPF because of pluggage caused by the slurries. However, Holledge Gages have been used at DWPF with good success. The disadvantage of Holledge Gages are high cost (about 75-100K) for a remotable unit and relatively short useful life (estimated average 2 year life). The DWPF requires 8 remote Holledge gages. Estimated cost for replacement of Holledge Gages is about $500K/year.

Functional Performance Requirements:

A. DWPF operation requires measuring the components listed below in SRS waste slurries at 10-25 wt% total solids and waste/frit mixed slurries at 40-60 wt% total solids:

Waste Slurries Component Nominal Concentration (Wt % on dried solids basis)

Al	6	Ca	2	Cr	0.1	Cu	1	Fe	23
K	1	Li	0.1	Mg	1	Mn	3	Na	7
Ni	0.3	Si	0.7	Ti	1	U	3	Zr	0.1

Waste/Frit Mixtures Component Nominal Concentration (Wt % on glass)

Al	2	Ca	1	Cr	0.1	Cu	0.3	Fe	8
K	1	Li	2	Mg	1	Mn	1	Na	9
Ni	0.1	Si	23	Ti	0.5	U	1	Zr	0.1

Measurements must have a precision on four replicate measurements of <8% RSD. Accuracy as compared against consensus Corning or PNL glass standards should be within 8 % of theoretical values.

B. DWPF operation requires measuring the volume and density of a tankís contents. Some tanks contain liquids and others contain slurries. Specific gravities range from 1.0 to 1.5. The instrumentation must be remotable and must be capable of operation in radiation fields of up to 105 R/hr for a period of at least 5 years.

Schedule Requirements:

A. Needed within next 1 to 3 years to minimize attainment impacts on DWPF.

B. Need date depends on the schedule for improving DWPF attainment.

Problem Description:

Tanks Focus Area Site Needs

Need Title: Develop Techniques to Increase DWPF Throughput and Productivity

Site: SRS
TFA Functional Area: Characterization
TFA Response#: 98064
Site Need#: SR-2905
Site Priority: 5 of 20
PBS#: SR-HL05

Justifications:

Technical Justification:
A. DWPF must sample its process streams for elemental analysis at several points while preparing a waste batch for melter pouring. These analyses require lengthy and laborious sample preparation prior to the elemental analyses. Depending on sample type and analytical methodology employed, a single set of these analyses requires 24-72 hours to complete. The analyses are a batch process with no hold tanks and most of the analytical time is a critical path time for the process. Thus, a reduction in the analytical time translates directly into a process attainment improvement.
B. The level and density of the contents (aqueous or slurry) of DWPF process tanks are currently determined by measuring the pressure at several levels in the tanks. The differential pressures are then used to determine liquid level and density. These variables must be known for successful operation of the process. Many of the tanks contain slurries consisting of glass frit and high level waste sludge solids. Nitrogen or air bubblers are a common means to determine pressure in aqueous tanks. Such devices have generally been unsuccessful at DWPF because of pluggage caused by the solid slurries. Because of this, Holledge Gages have been tried at DWPF and the results were good. The disadvantage of Holledge Gages are the high cost (about 75-100K) for a remotable unit and a relatively short life (estimated average 2 year life). The DWPF needs 8 remote Holledge gages.

Regulatory Justification: N/A

ES&H Justification: N/A

Cultural/Stakeholder Factors: N/A

Cost Savings: Since this improvement could potentially reduce DWPF cycle times by as much as 20%, it could reduce the cost per waste canister by an equivalent percentage and reduce total DWPF processing years accordingly.

Other Justification: None

Consequences of Not Filling Need: If DWPF attainment is impacted by Lab throughput and canister production is lower than required, waste could potentially remain in storage tanks for a longer period than expected.

Privatization Potential: There is not a large commercial market, but there would a substantial market within DOE sites.

Current Base Technology and Cost:

SUMMARY OF TFA RESPONSE:
The TFA tentatively rated the priority of the technical response to this need as #55 (TFA Response 98064). The TFA proposes to provide funding in FY99-00, given available funding.

SITE NEED:

Need Description: The baseline sludge washing process at SRS has two known or suspected drawbacks. The first is the known slow settling rate of suspended sludge. Second is the suspected harmful reprecipitation of Aluminum following its removal from sludge by a NaOH leach. Another sludge issue related to the Aluminum leach is sludge blending. The original concept for HLW treatment included blending the sludge and not using an Aluminum leach. Resolution of the potentially harmful Aluminum reprecipitation issue must include the possible need to provide sludge blending. A final sludge issue comes from the recent work to understand TPB breakdown in the ITP process. This work indicates that sludge solids should be separated from salt solution prior to the TPB precipitation. This separation can be done as an additional unit process on the ITP feed, or it may be possible to combine it with a sludge blending step. If salt solution clarification is combined with sludge blending (using common sludge-blanket clarification technology), the possible benefits include:

- reduced TPB breakdown in ITP
- no Aluminum leach required
- enhanced DWPF operation
- much simplified Waste Removal operations
- reduction in water usage by up to 50%
- 2H and 2F evaporators not required
- no new salt cake produced
- reduction in Saltstone volume by up to 50%

Functional Performance Requirements:

1. Enhanced Sludge Settling: The wash water composition changes significantly from the first wash stage to the last stage. The first stage is high in dissolved salts and pH(e.g. 3 M Na & pH>>14) while the final stage is low (e.g. 0.2 M Na & pH<12). The observed settling rate also changes significantly because the surface properties of the sludge solids change concomitantly with the liquid composition. The technique for enhancing sludge settling must accommodate these natural changes between wash stages. Also the technique must not introduce any adverse effect anywhere else in the HLW processing system. This benign characteristic must be demonstrated for the technique to become part of the operation.
2. Reduce Aluminum in DWPF Sludge Feed: Sludge exists in two forms, high aluminum and low aluminum. The high aluminum form produces glass with too low a radionuclide loading. The loading can be raised to a satisfactory level if the aluminum content is reduced. The conditions (temperature, NaOH molarity and time) required for aluminum dissolution vary with the molecular form of the aluminum. The present distribution of aluminum between alpha, beta and gamma forms is unknown. Only the alpha form dissolves at the present baseline flowsheet conditions. The amount of aluminum that will dissolve must be determined for each sludge batch. After dissolution, the solution composition and temperature must be strictly controlled to maintain the aluminum in solution. It appears that the subsequent handling of the leach solution in the baseline process flowsheet was not designed cognizant of this propensity for reprecipitation. In the baseline flowsheet the reprecipitated aluminum will join the salt cake. Therefore when the salt cake is recovered, the aluminum precipitate will join the salt solution to ITP. The aluminum precipitate will likely be gelatinous and detrimental to filter operation. The aluminum precipitate will remain with the TPB precipitate and report to DWPF and thus to the glass. Thus, aluminum leaching, as presently planned, may not eliminate aluminum to DWPF at all; it may merely delay the date that it gets there! The disposition of aluminum with the baseline flowsheet must be determined. Flowsheet modifications to ensure the dissolved aluminum leaves the system without recycling or adverse impact must be designed and implemented.
3. Sludge Blending: Sludge blending can eliminate the need for aluminum leaching. The baseline flowsheet processes sludge in batches consisting of sludge from only one or two tanks - just the opposite of blending. A new waste removal flowsheet and operation must be designed to achieve blending adequate that the aluminum leach can be eliminated.
4. Eliminate Insoluble Solids from Salt Solution Feed to ITP: A clarification process must be designed to separate insoluble solids from the salt solution prior to the TPB addition in ITP. Clarification processes use either gravity settling, filtration or centrifugation. If gravity settling is selected, then it should be possible to obtain sludge blending as an integral part of the process. This follows if the settling is done in a waste tank and

the waste removal operation is altered to feed combined sludge and salt solution to the liquid-solid separation process continuously at low rates and switching frequently between source tanks. This approach should also the waste removal operations and not increase, overall, the complexity or work load of the HLW system. If filtration of the ITP feed is selected, then there will be an additional unit operation added to the ITP process. Centrifugation is not a practical option in this high radiation system because of the high maintenance requirement of centrifuges.

Schedule Requirements:

1. Enhanced Sludge Settling can be implemented for any wash step in the ESP operation. The HLW System Plan Revision 8 shows that the next scheduled ESP wash is for sludge batch 2A in July, 1999. Sludge batch 2B is scheduled for October, 2001. Sludge batch 3A is scheduled for January 2004. The earlier enhanced sludge settling is developed and implemented, the more the benefit will be.
2. The System Plan calls for removal of 75% of the aluminum in sludge batch 2A and 2B. Therefore, the aluminum leach-reprecipitation issue should be resolved before July, 1999. If there is no resolution by that date, then a project must be started to fit Tank 51 with equipment for performing the aluminum leach. The project cost will be about $1M per tank. The present plant configuration requires fitting two tanks for aluminum leaching, tank 51 and tank 40.
3. Sludge blending will be a modification of the baseline flowsheet. The benefits of blending, e.g. simplified waste removal operations and elimination of aluminum leaching, can be realized after implementation of sludge blending. The project cost to setup the ESP tanks for aluminum leaching can be avoided if sludge blending is implemented soon. Maximum cost avoidance will be obtained if sludge blending is implemented before July, 1999.
4. Removing insoluble solids from ITP salt solution feed will be a modification of the baseline flowsheet. The need for clarification is strongly indicated by the results from testing to determine the mechanism of TPB breakdown. However, there is yet no official decision to add clarification to the ITP flowsheet. Development of a clarification process should be started immediately to avoid a crises resulting from waiting to start until the need is officially decided. If the need should not arise, then the development would be stopped.

Problem Description:

1. Enhanced sludge settling requires using a coagulant or a flocculant. Using these chemicals to speed solids settling is well established technology and practice in the process industries. A program to select the settling aid, demonstrate its effect, design its implementation, and prove its safety will be a straight-forward development program. No new technology is required. All the equipment and chemicals are well proven in similar production applications.
2. Aluminum leaching is a standard industrial process (e.g. bauxite purification) and has been demonstrated on large scale here at SRS. The basic science of aluminum leaching and reprecipitation is mature. The application of that basic science to HLW sludge processing appears to be weak. In particular understanding the significance of the possible types of aluminum hydroxide appears to be little understood. Thus although the System Plan assumes that 75% of the aluminum can be leached, the actual amount will be determined by the relative abundance of the leachable type versus the unleachable types. There is no information available on the distribution of aluminum between these types of aluminum hydroxide in HLW sludge. Also, there appears to have been no attempt to track the dissolved aluminum to ensure the flowsheet and operating conditions force the aluminum to go where it is wanted and not where it is not wanted!
3. Sludge blending can be evaluated satisfactorily by mathematical modeling. The result will be a definitive position regarding whether aluminum leaching can be eliminated or not. If the modeling shows the leach operation can be eliminated, then a modified flowsheet and operation must be designed. The design work must be done carefully, because many options are available depending on the waste removal methods used, how existing tankage is used, and what new tankage is proposed.
4. Salt solution clarification: Clarifying salt solution could be a straight-forward development of standard commercial technology and adding another unit operation to the ITP flowsheet. However, it is also possible to use standard sludge-blanket technology for clarification in an existing waste tank. This approach would give sludge blending as an accompanying feature. This approach would need a scaled demonstration because the

commercial examples use purpose designed tanks which are unlike our waste tanks. The purpose designed tanks have sloped bottoms, central inlet and outlet, and bottom rakes.

Justifications:

Technical Justification: Each of the four sludge issues illustrates that the baseline HLW flowsheet can be modified to advantage. It is common for first-of-a-kind processes to require rework to achieve necessary performance. These modifications may be necessary to achieve the desired safety levels, to achieve the desired productivity levels or to achieve the desired cost-of-production. Enhanced sludge settling can shorten the ESP wash cycle time, thereby improving productivity and lowering costs. Sludge blending can help DWPF operation, simplify waste removal, and potentially, eliminate aluminum leaching. If aluminum leaching must be done, then it will be necessary to modify the flowsheet to prevent harmful aluminum reprecipitation. Salt solution clarification could lead to lower benzene emissions from ITP and improved filter performance by 10-30%.

Regulatory Justification: Future regulations may require dramatic reduction or elimination of benzene emissions from ITP. In this case a flowsheet modification that results in lowering the emissions would be good. This gives some support for the clarification of salt solution feed to ITP. There are no known regulatory drivers for the other modifications discussed above.

ES&H Justification: The four issues discussed above will improve the environmental safety and health level of the HLW operations. The amount of improvement will depend on the design details of the modifications. The improvement can vary from moderate to significant improvement. The more extensive the modifications, the more significant the improvement. Some of the improvements might include: reduction in number of sludge samples and analyses, reduction in benzene emissions at ITP, reduction in amount of wash water to recycle, and reduction in chemicals added to the process.

Cultural/Stakeholder Factors: The most significant concern comes from considering that more modifications are required to make the HLW treatment plants work. The need or desire to rework the HLW processes and plants is not generally included in strategic plans.

Cost Savings: The four issues discussed above will result in cost savings and mortgage reduction. The extent of the savings and mortgage reduction will depend on the design details of the modifications. The improvement and reduction can vary from minor to fairly significant. The most significant savings and reductions will come from the most extensive modifications of the baseline operation. The synergistic effect of several modifications acting together is the source of the greatest benefit.

Other Justification: None.

Consequences of Not Filling Need: The major consequence is that the plant production rate will remain at a small fraction of the design rate.

Privatization Potential: Some of the process changes will be patentable.

Current Base Technology and Cost:

SUMMARY OF TFA RESPONSE:
The TFA did not rate the technical response to this need separately (TFA Response 98065). The TFA intends to satisfy this need through the technical responses prepared for Hanford need RL-WT024 (TFA Response 98024B).

Tanks Focus Area Site Needs

Need Title: Alternative DWPF Canister Decontamination Techniques

Site: SRS **TFA Functional Area:** Immobilization
TFA Response#: 98066 **Site Need#:** SR-2903 **Site Priority:** 3 of 20 **PBS#:** SR-HL05

SITE NEED:

Need Description: DWPF canister decontamination is a water-frit slurry blast technique that removes contamination and oxides from the entire canister exterior surface. The waste from this process is in two forms. An off-gas is routed to the facility vessel ventilation system and on to facility controlled ventilation exhaust. A water-frit slurry waste stream is pumped into the facility chemical process and fed into the vitrification process stream, to minimize liquid waste production.

This coupling of canister decontamination with chemical processing is less than optimum and could limit production rates in the future.

Technology development is desired in this area, with the following objectives.
- Minimize actual decontamination time, as well as full cycle time between canister decontaminations
- Simplify decontamination system controls, regarding operations and maintenance functions
- Minimize gas and liquid waste
- Minimize cost
- Minimize or eliminate the couple between canister decontamination and chemical processing.

Functional Performance Requirements: A decontamination method is required which will remove the oxide layer from the exterior surface of the DWPF stainless steel canister. The contamination level of the exterior surface must be less than 2200 dpm/100cm2 beta gamma and 220 dpm/100cm2 alpha.

Schedule Requirements: There is no direct schedule tie for this item.

Problem Description: There is a potential problem that at near design production rates the DWPF canister decontamination operation could limit plant operating attainment to less than the design 75%. An improved decontamination method as described under Need Description would eliminate this concern.

Justifications:

Technical Justification: DWPF canister decontamination is a water-frit slurry blast technique that removes contamination and oxides from the entire canister exterior surface. The waste from this process is in two forms. An off-gas is routed to the facility vessel ventilation system and on to facility controlled ventilation exhaust. A water-frit slurry waste stream is pumped into the facility chemical process and fed into the vitrification process stream, to minimize liquid waste production.

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Technology development is desired in this area, with the following objectives.

- Minimize actual decontamination time, as well as full cycle time between canister decontaminations
- Simplify decontamination system controls, regarding operations and maintenance functions
- Minimize gas and liquid waste
- Minimize cost
- Minimize or eliminate the couple between canister decontamination and chemical processing

Regulatory Justification: No known concerns

ES&H Justification: No known concerns

Cultural/Stakeholder Factors: No known concerns

Site: SRS **TFA Functional Area:** Immobilization
TFA Response#: 98066 **Site Need#:** SR-2903 **Site Priority:** 3 of 20 **PBS#:** SR-HL05

Cost Savings: The primary justification is potential improved attainment for DWPF. Additional DWPF operating experience is required to quantitize potential cost savings.

Other Justification: No known concerns

Consequences of Not Filling Need: Potential lower attainment for DWPF and higher operating costs for DWPF. Additional operating DWPF experience is required to quantitize the actual cost saving.

Privatization Potential: Potential application at West Valley, Hanford, Idaho and other areas where radioactive decontamination of surface is required.

Current Base Technology and Cost:

SUMMARY OF TFA RESPONSE:
The TFA tentatively rated the priority of the technical response to this need as #42 (TFA Response 98066). The TFA proposes to provide funding in FY99-01, given available funding.

Tanks Focus Area Site Needs

Need Title: Develop Advanced Techniques for Life Extension of Tanks/Piping

Site: SRS **TFA Functional Area:** Safety

TFA Response#: 98067A, B, C **Site Need#:** SR-2909 **Site Priority:** 9 of 20 **PBS#:** SR-HL01, SR-HL02, SR-HL04

SITE NEED:

Need Description: Savannah River Site (SRS) has tanks that have exeeded their original design life but will be used for waste for other 50 years. These transfer lines and tanks are required to maintain safe operation of the facility. Equipment is need to ensure the integrity of the piping system by inspection. Additionally equipment is needed to inspect the tanks both visually and to perform NDE. Data archiving of video informaiton is alos needed. Several of the SRS tanks have leak sites. It is desired to develop tank repair technology and repair technology for future use if required.

Cost :
Identify commercial equipment that can be modified for deployment in 4 inch risers for visual inspections and NDE integrity verification fi FY 99 for a cost of $10,000
Work with industry to modify their equipment and deploy equipment in FY 99 for a cost of $400,000
Identify possible repair technologies for tanks and transfer systems in FY 99 for a cost of $ 100,00
Demonstrate techniques in a test facility in FY 00 for a cost of $200,000
Develop deployment mechanism for repair technology in FY 00 for a cost of $ 150,000

How Long Will It Take: 1 year for integrity equipment. 2 to 3 years for repair technologies.

Functional Performance Requirements: Develop pipe integrity equipment that will fit in 2 inch pipe and in the space between the primary and secondary pipe. Develop NDE and visual inspection equipment that will fit in 4 in diameter openings and can be deployed in various locations up to a depth of 40 ft down. Develop data management system to allow automatic comparisons of video visual images from year to year and will be able to merge with 30 years of photographic slides.
Develop repair technology that will ensure integrity of tanks for continued operation and allow repair of transfer lines. Repair technology has to be implemented remotely with high radiation and contamination addressed.

Schedule Requirements: Identify commercial equipment that can be modified for deployment in 4 inch risers for visual inspections and NDE integrity verification in FY99
Deploy equipment in FY99
Identify possible repair technologies for tanks and transfer systems in FY99
Demonstrate techniques in a test facility in FY00
Develop deployment mechanism for repair technology in FY00

Problem Description: Provide tools to continue to ensure integrity of tank and transfer systems required for another 50 years. Also provide repair technologies for tanks and transfer systems. No future facilities will be built and it is essential to continue to validate the current tanks and transfer systems and repair them until all the HLW waste is removed.

Justifications:

Technical Justification: Savannah River Site (SRS) has tanks that have exceeded their original design life but will be used for waste for other 50 years. These transfer lines and tanks are required to maintain safe operation of the facility. Equipment is need to ensure the integrity of the piping system by inspection. Additionally equipment is needed to inspect the tanks both visually and to perform NDE. Data archiving of video information is alos needed. Several of the SRS tanks have leak sites. It is desired to develop tank repair technology and repair technology for future use if required.

Regulatory Justification: Safe storage of radioactive waste regulated by Federal, State or local laws with potential for significant fines. DOE commitment with FFA requires tanks maintain structural integrity and also has potential for significant fines.

Tanks Focus Area Site Needs

Need Title: Develop Advanced Techniques for Life Extension of Tanks/Piping

Site: SRS **TFA Functional Area:** Safety

TFA Response#: 98067A, B, C **Site Need#:** SR-2909 **Site Priority:** 9 of 20 **PBS#:** SR-HL01, SR-HL02, SR-HL04

ES&H Justification: The integrity of the systems are needed and repair technologies to ensure no waste is released and personnel are impacted.

Cultural/Stakeholder Factors: No issues on integrity on HLW systems.

Cost Savings: Potential to save $1,000,000/year by being able to repair systems and identify integrity problems prior to complete failure.

Other Justification:

Consequences of Not Filling Need: Reduced ability to verify integrity . No ability to repair systems.

Privatization Potential: Excellent potential for integrity equipment with minor changes. Repair technologies would have good change for privatization.

Current Base Technology and Cost:

SUMMARY OF TFA RESPONSE:
The TFA developed three separate replies to this need. The first, TFA Response 98067A, replied to the need for Tank Inspection Techniques for Hanford, SRS, ORR. The TFA tentatively rated the priority of the technical response to this need as #4. The TFA proposes to provide funding in FY99-00, given available funding. The TFA intends to satisfy the following additional needs in its technical response: Hanford needs RL-WT05 (TFA Response 98005) and RL-WT022 (TFA Response 98022), and potentially ORR need TK-01 (TFA Response 98044B).

The second response was TFA Response 98067B, a reply to the requirement for Tank Repair Technology. The TFA did not rate the technical response to this need separately (TFA Response 98067B). The TFA intends to satisfy this need through the technical responses prepared for Hanford need RL-WT026 (TFA Response 98026).

The third response was TFA Response 98067C, a reply to the requirement for Transfer Line Inspection and Repair for Hanford and SRS. The TFA tentatively rated the priority of the technical response to this need as #34. The TFA proposes to provide funding in FY99-00, given available funding, and partly address this need in its response to SRS need SR-2913 (TFA Response 98056). The TFA intends to satisfy the following additional need in its technical response: Hanford need RL-WT020 (TFA Response 98020).

Tanks Focus Area Site Needs

Need Title: Demonstrate Remote Disassembly of High Level Waste Melters and Other Processing Equipment

Site: SRS **TFA Functional Area:** Immobilization

TFA Response#: 98068 **Site Need#:** SR-2914 **Site Priority:** 14 of 20 **PBS#:** SR-HL05

SITE NEED:

Need Description: Savannah River Site currently does not have the capability to dispose of failed, highly contaminated processing equipment, including failed HLW glass melters. The current approach to dealing with this equipment at DWPF is storage in an underground "Failed Equipment Storage Vault." While storage is acceptable for the short term, technology must be developed to properly dispose of this equipment. This should include dismantling/size reduction of the equipment, decontamination and recyling of as much material as possible, disposal of much material as low-level waste and disposal of remaining high level waste materials in a controlled repository or as a recycle stream to the DWPF.

A single failed glass melter, for example, could contain as much high level waste glass as five canisters and additional contamination in the form of volatile cesium and ruthenium and unmelted waste solids. It is undesireable to leave this ìwaste formî in minimally controlled long term storage and to continue to add more of the same and other equipment.

While failed HLW Glass melters are prime examples to demonstrate this need, it also applies to other equipment such as failed jumpers, off-gas system components, process tanks, pumps and many others. Many of these examples are difficult or impossible to decontaminate by existing methods and can now only be disposed of by vault storage.

This need does not apply just to SRS. It spans the entire DOE complex. We must address it now to ensure that the technology is developed and demonstrated to support funding, design and construction of D&D facilities for SRS as well as other sites in the near future.

Functional Performance Requirements: Equipment must ultimately be capable of remote handling, dismantling and size reduction of equipment occupying an envelope as large as 20 ft. wide by 40 ft. deep by 20 ft. tall. (For the purpose of demonstrating the technology the size envelope may be significantly reduced.)

Equipment must be capable of dismantling/cutting/size reduction of materials including:
- Various metal alloys up to 6 in. thick
- Refractory materials up to 14 in. thick
- Glass blocks up to 2 ft. thick

Equipment must be remotely replaceable and must be capable of operation in radiation fields of up to 104 R/hr.

Schedule Requirements: No firm schedule exists. Timing is driven by availability of failed equipment storage capacity, the need to D&D failed equipment and the budget cycle for future capital projects.

Problem Description: Savannah River Site currently does not have the capability to dispose of failed, highly contaminated processing equipment, including failed HLW glass melters. While baseline storage is acceptable for the short term, technology must be developed to size reduce, decantaminate and properly dispose of or recycle this equipment.

While failed HLW Glass melters are prime examples to demonstrate this need, it also applies to other equipment such as failed jumpers, off-gas system components, process tanks, pumps and many others. Many of these examples are difficult or impossible to decontaminate by existing methods and can now only be disposed of by vault storage.

Justifications:

Technical Justification: There is a need to apply existing technology to this task to address similar needs across the DOE complex.

Tanks Focus Area Site Needs

Need Title: Demonstrate Remote Disassembly of High Level Waste Melters and Other Processing Equipment

Site: SRS **TFA Functional Area:** Immobilization

TFA Response#: 98068 **Site Need#:** SR-2914 **Site Priority:** 14 of 20 **PBS#:** SR-HL05

Regulatory Justification: Failed equipment storage vaults and the high level waste containing equipment to be stored in them are not controlled with the same rigor applied to the DWPF glass waste storage building or the proposed federal repository. There are no criteria akin to the "Waste Acceptance Product Specifications" to control these waste materials or their storage.

ES&H Justification: Failed equipment storage vaults and the high level waste containing equipment to be stored in them are not controlled with the same rigor applied to the glass waste storage building or the proposed federal repository. The storage boxes are designed to be fabricated from carbon steel which will not provide long term containment for the contamination. The vaults are not designed to provide long-term isolation of the materials from the environment which is equivalent to a repository.

Cultural/Stakeholder Factors: DOE and the site contractor(s) have a responsibility to permanently dispose of high level waste materials in the most effective way. Accumulation and long term storage of the waste materials is a stop-gap measure and does not solve the problem, it merely extends it.

Cost Savings: The long term cost of building storage vaults/boxes, the cost of controlling and monitoring the vaults, and the cost of cleaning up contaminated vaults will outweigh the cost of developing this technology for proper dispensation of these wastes.

Other Justification: No other concerns.

Consequences of Not Filling Need: Accumulation of high level waste materials in minimally controlled storage with the potential for release of contamination. Potential application of regulatory controls and oversight of the storage areas. Public criticism of waste handling practices.

Privatization Potential: Application of this D&D technology is perfectly suited to privatization across the DOE complex.

Current Base Technology and Cost:

SUMMARY OF TFA RESPONSE:
The TFA tentatively rated the priority of the technical response to this need as #53 (TFA Response 98068). The TFA proposes to provide funding in FY99-01, given available funding.

Tanks Focus Area Site Needs

Need Title: Alternate Mixer Pumps

Site: SRS **TFA Functional Area:** Retrieval
TFA Response#: 98069 **Site Need#:** SR-2915 **Site Priority:** 15 of 20 **PBS#:** SR-HL03

SITE NEED:

Need Description: Vertical shaft 150 HP slurry pumps are used to agitate waste solutions. The waste solutions are stored in one (1) million gallon storage tanks in the F- and H-Area Tank Farms. The pumps mix the waste into a solution/slurry so that it can be pumped to either the Extended Sludge Processing (ESP) facility or the In-Tank Precipitation (ITP) facility for further processing.

Removing waste from a waste tank using the slurry pump method cost between $6-10 million, therefore, cost effective alternatives to agitating the waste are desired.

Functional Performance Requirements: Develop methods to suspend and mobilize the waste for eventual removal.

Schedule Requirements: Prototypical methods must be presented and tested during FY99. The first viable technique must be tested successfully during FY99.

Problem Description: A typical sludge tank may have 800,000 gallons of 30-50 wt% sludge. The sludge is made of iron, aluminum, and manganese oxides. Smaller percentages of silica and zeolite may also exist. Particle sizes range from 100 microns down to near- colloidal. Size distribution is on a tank-by-tank basis. Most of the radioactivity emanates from Strontium-90. The hard packed sludge does not readily suspend and has typically required vigorous agitation over long periods of time to overcome the yield stress and suspend and mobilize the material. Equipment must fit through 22 - 23 inch openings. Available mixing equipment (such as submersible ducted turbine pumps) must be studied and tested for viability.

Justifications:

Technical Justification: The waste forms are stored in one (1) million gallon storage tanks in the F- and HArea Tank Farms. The pumps mix the waste into a solution/slurry that can be pumped to either the Extended Sludge Processing (ESP) facility or the In-Tank Precipitation (ITP) facility for further processing. A typical sludge tank may have 800,000 gallons of 30-50 wt% sludge. The sludge is made of iron, aluminum, and manganese oxides. Smaller percentages of silica and zeolite may also exist. Particle sizes range from 100 microns down to near-colloidal. Size distribution is on a tank-by-tank basis. Most of the radioactivity emanates from Strontium-90. The hard packed sludge does not readily suspend and has typically required vigorous agitation over long periods of time to overcome the yield stress and suspend and mobilize the material. Settled sludge is classified as a Bingham plastic with varying yield stresses ranging up to 500 dynes/cm2. The equipment to performed this agitation involves vertical shafted 150 HP slurry pumps. As many as four slurry pumps are needed for sludge tanks to create the required effective cleaning radius (ECR) for complete tank cleaning. When suspended sludge gets outside of the ECR, it settles and forms mounds. Removing waste from a waste tank using the slurry pump method cost between $6-10 million, therefore, cost effective alternatives to agitating the waste is desired.

Regulatory Justification: The Tank Farms are permitted under the South Carolina Pollution Control Act. Waste removal schedules were discussed and agreed to the FFA. Refer to the Federal Facility Agreement between the U.S. Environmental Protection Agency Region IV, the U.S. Department of Energy, and the South Carolina Department of Health and Environmental Control Docket No. 89-05-FF, August 16, 1993.

ES&H Justification: An alternative mixing method could potentially reduce personnel radiation exposure and reduce the potential for contamination.

Cultural/Stakeholder Factors: Waste Removal, tank closure, and tank cleaning has been discussed at the local level including public meetings and hearings with the Citizens Advisory Board (CAB).

Tanks Focus Area Site Needs

Need Title: Alternate Mixer Pumps

Site: SRS **TFA Functional Area:** Retrieval
TFA Response#: 98069 **Site Need#:** SR-2915 **Site Priority:** 15 of 20 **PBS#:** SR-HL03

Cost Savings: Slurry Pump Method: $6,000,000/tank
Alternative Method: $2,000,000/tank
Savings: $4,000,000/tank

Other Justification:

Consequences of Not Filling Need: The DOE, EPA, and SCDHEC have agreed under the FFA, to eventually close both F- and H-Area Tank Farms with most of the older tanks to be emptied and cleaned first and closed under an accelerated schedule. Most of these tanks have been in existence for 35 to 40 years. These tanks are physically degrading and are in need of expeditious stabilization. Failure to approve funding for this effort could further delay specific waste removal and closure activities.

Privatization Potential: Privatization of technology development and deployment is highly viable and encouraged. There are numerous vendors and firms capable of performing this work to meet the functional requirements and schedule demands.

Current Base Technology and Cost:

SUMMARY OF TFA RESPONSE:
The TFA did not rate the technical response to this need separately (TFA Response 98069). The TFA intends to satisfy this need through the technical response prepared for Hanford need RL-WT028 (TFA Response 98028).

Tanks Focus Area Site Needs

Need Title: Develop Remote Technology to Improve DWPF Operations

Site: SRS **TFA Functional Area:** Immobilization

TFA Response#: 98070 **Site Need#:** SR-2917 **Site Priority:** 17 of 20 **PBS#:** SR-HL05

SITE NEED:

Need Description: The Defense Waste Processing Facility (DWPF) is limited in the ability to perform remote maintenance, inspection, and cleanup activities. The only access to the majority of the facility for maintenance, etc. is via overhead crane using hooks and an impact wrench. Viewing capability within the facility is limited to video cameras mounted on the Main Process Cell (MPC) Crane. It is desirable to develop improved capabilities to inspect, perform maintenance, and perform doncontamination/cleanup activities within the facility.

The following are cited to show the need for these capabilities:

1. Since the start of radioactive operation, the Melt Cell has accumulated a large amount of litter on the cell floor which could jeopardize equipment operation. This litter consists of high level waste glass shards and dropped tools/equipment. There is currently no equipment capable of retrieving those items and cleaning up in-cell equipment and the cell floor.

2. The Remote Equipment Decontamination Cell (REDC) currently uses two Electromechanical Manipulators (EMMís) to handle decontamination nozzles for cleaning equipment for repair or disposal. These EMMís are limited in their reach/capabilities, are very difficult to manipulate and are frequently broken-down.

3. There are many areas within the DWPF process cells that are inaccessible via the overhead crane hooks. A method to view and access these areas for inspection, repair, D&D, equipment recovery, etc., is needed.

Functional Performance Requirements: 1. Equipment to be used for cell recovery and cleanup must be remotely controlled, self propelled, and capable of remote video observation of its surroundings. It may obtain power and commands and return signal svia an umbilical to an existing spare Hanford connector or the melt cell telerobotic manipulator. It should have the capability to grasp objects up to 4î across and weighing up to 100 lb. The equipment must be remotely replaceable and must be capable of operation in radiation fields of up to 104 R/hr.

2. Improved telerobotic replacements for the REDC electromechanical manipulators must be installed in a manner similar to their predecessors and be powered/controlled through existing penetrations and/or feed through assemblies similar to those used for the melt cell telerobotic manipulator. They must have video capability and lifting capacity equivalent to their predecessors. They must withstand decontamination media including water, steam, nitric acid, and caustic. The equipment must be remotely replaceable and must be capable of operation in radiation fields of up to 10 to the power of 4 R/hr.

3. The need for an improved method to perform inspection, repair, D&D and equipment recovery using the MPC can be adddressed via the use of a dual arm telerobotic manipulator. This device would be capable of hanging from a crane hook to perform work with both arms or alternatively use one arm for support/movement and the other to perform work. The device must be remotely controlled and capable of remote video observation of its surroundings. It may obtain power and commands and return signals via an umbilical to an existing spare Hanford connector, the MPC, or telerobotic manipulator support. The equipment must be remotely replaceable and capable of operation in radiation fields of up to 10 to the power of 4 R/hr.

Schedule Requirements: These capabilities are needed by the end of FY99.

Problem Description: The Defense Waste Processing Facility (DWPF) is limited in the ability to perform remote maintenance, inspection, and cleanup activities. The only access to the majority of the facility for maintenance, etc. is via overhead crane using hooks and an impact wrench. Viewing capability within the facility is limited to video cameras mounted on the Main Process Cell (MPC) Crane. It is desirable to develop improved capabilities to inspect, perform maintenance, and perform doncontamination/cleanup activities within the facility.

Tanks Focus Area Site Needs

Need Title: Develop Remote Technology to Improve DWPF Operations

Site: SRS **TFA Functional Area:** Immobilization

TFA Response#: 98070 **Site Need#:** SR-2917 **Site Priority:** 17 of 20 **PBS#:** SR-HL05

Justifications:

Technical Justification: DWPF processing could be impacted if these tools are not incorporated. DWPF remote repair/inspection/recovery capability is currently minimal. The technology exists to apply to these goals.

Regulatory Justification: None.

ES&H Justification: None.

Cultural/Stakeholder Factors: None.

Cost Savings: The cost of installing this technology is small when compared to the impact of halted DWPF production due to equipment malfunction that cannot be remedied remotely. This technology can eliminate the need to remove many pieces of process equipment in order access one piece that is not easily reached by current methods.

Other Justification: No other concerns.

Consequences of Not Filling Need: The consequences of not filling this need now are:

1. Accumulation of large quantities of high level waste materials in DWPF process cells which can adversely impact equipment operation..
2. Inability to effectively decontaminate DWPF equipment for repair or disposal..
3. Inability to repair/inspect/recover equipment within the DWPF facility.

Privatization Potential: Application of this technology is well suited to privatization across the DOE complex. The basic technology to perform this remote work is available in industry and only needs to be tailored to suit this need.

Current Base Technology and Cost:

SUMMARY OF TFA RESPONSE:
The TFA tentatively rated the priority of the technical response to this need as #54 (TFA Response 98070). The TFA proposes to provide funding in FY99-00, given available funding.

Tanks Focus Area Site Needs

Need Title: Evaporator Residual Waste Removal and Closure

Site: SRS **TFA Functional Area:** Retrieval

TFA Response#: 98071A, B **Site Need#:** SR-2912 **Site Priority:** 12 of 20 **PBS#:**

SITE NEED:

Need Description: The 242-H and 242-F evaporator systems (typically called 1H and 1F respectively) were constructed in the late 1950's to reduce the liquid volume of low level and high level radioactive waste by boiling supernate liquid using steam supplied bent-tubes inside of the evaporator vessels. The concentrated waste was gravity fed to Concentrate Transfer Systems (CTS) for agitation and pumping to receipt waste tanks. There is one CTS system associated with the 1F evaporator and two CTS systems associated with the 1H evaporator. The evaporator vessel and associated equipment is enclosed in a concrete structure 30 ft. by 19 ft. by 26 ft. high, with 24-in. thick walls and 12-in. thick cover blocks. The CTS systems contain a concentrate pump tank enclosed below grade in concrete CTS pits.

Residual heels of waste remain in the evaporator vessels, containment cell, CTS, and auxiliary systems equipment. Methods must be explored and developed to successfully remove these heels. Evaporator system closure is not possible unless this residue is removed. There are no proven methods of removing radioactive waste from this type of system.

Functional Performance Requirements: The residual heel must be removed completely from each Evaporator and CTS system, i.e., no visible evidence of waste. Conduct performance evaluation modeling for software. Determine special grout design mixes for encapsulation and fill material for closure.

Schedule Requirements: Prototypical methods to remove the water in-leakage in the 1F Evaporator cell will be developed by September 1998. Develop methods to remove residual heels from the entire evaporator systems (vessels, cells, CTS tanks), and conduct performance evaluation modeling for closure by September 1999.

Problem Description: Residual waste heels have accumulated within the evaporator and CTS systems over more than 25 years of operation including leakage into the containment cells. Rainwater in-leakage into the cells has resulted in accumulations of contaminated liquid. Recent leakage of contaminated liquid from the 1F evaporator cell has increased the urgency of de-watering the cell, removing the residual waste and closing the system. An 8-in. access port in the cell cover is obstructed by numerous pipes and supports inside the cell. Cut and capped piping systems into the cell have experienced major corrosion.

Justifications:

Technical Justification: The 242-H and 242-F evaporator systems (typically called 1H and 1F respectively) were constructed in the late 1950's to reduce the liquid volume of low level and high level radioactive waste by boiling supernate liquid using steam supplied bent-tubes inside of the evaporator vessels. The concentrated waste was gravity fed to Concentrate Transfer Systems (CTS) for agitation and pumping to receipt waste tanks. There is one CTS system associated with the 1F evaporator and two CTS systems associated with the 1H evaporator. The evaporator vessel and associated equipment is enclosed in a concrete structure 30 ft. by 19 ft. by 26 ft. high, with 24-in. thick walls and 12-in. thick cover blocks. The CTS systems contain a concentrate pump tank enclosed below grade in concrete CTS pits.

Mechanical or remote cleaning techniques are hampered by numerous interferences created by a network of support system piping and ventilation ducts within the cells. Removal of cell covers to obtain access to the evaporator vessels and CTS pump tanks requires a vast array of radiological control measures.

Residual heels of waste remain in the evaporator vessels, containment cell, CTS, and auxiliary systems equipment. Methods must be explored and developed to successfully remove these heels. Evaporator system closure is not possible unless this residue is removed. There are no proven methods of removing radioactive waste from this type of system. Closing of the evaporator systems will reduce surveillances, repairs, etc.

Regulatory Justification: Removal of the heels is desired to meet performance requirements set forth by the Site Tank Closure Program. The Tank Farms are permitted under the South Carolina Pollution Control Act,

therefore, closure activities are governed by South Carolina Regulation R.61-82, "Proper Closeout of Wastewater Treatment Facilities." Refer to the Federal Facility Agreement between the U.S. Environmental Protection Agency Region IV, the U.S. Department of Energy, and the South Carolina Department of Health and Environmental Control Docket No. 89-05-FF, August 16, 1993.

ES&H Justification: Removal of the heels will significantly reduce the potential for environmental injury and aid in meeting the performance objectives for fate and transport modeling (as dictated by the closure process). Without heel removal, evaporation systems cannot be closed. Closing of the evaporator systems will reduce surveillances, repairs, etc. High in worker safety and health due to significant reduction in personnel exposure and high in environmental due to significant reduction in waste disposal.

Cultural/Stakeholder Factors: High cultural impact due to significance of first of a kind operation to remove evaporator heel waste and complete evaporator system closure. Greatly reduces the catastrophic damage to social, cultural, political, and economic conditions that could be caused by tank failure.

Cost Savings: Technology developed can be used to remove known heels throughout the DOE complex. Evaporator systems in their current state cost (TBD) per year to maintain. This cost will be eliminated upon closure of the systems.

Other Justification:

Consequences of Not Filling Need: The DOE, EPA, and SCDHEC have agreed under the FFA, to eventually close both F- and H-Area Tank Farms with most of the older tanks to be emptied and cleaned first and closed under an accelerated schedule. The evaporator systems associated with the older style tanks are physically degrading and are in need of expeditious stabilization. Failure to approve funding for this effort could further delay specific closure activities.

Privatization Potential: Privatization of technology development and deployment is highly viable and encouraged. There are numerous vendors and firms capable of performing this work to meet the functional requirements and schedule demands.

Current Base Technology and Cost:

SUMMARY OF TFA RESPONSE:
The TFA developed two separate replies to this need. The first, TFA Response 98071A, replied to the need for Evaporator Residual Waste Removal. The TFA did not rate the technical response to this need separately, and intends to satisfy this need through the technical responses prepared for ORR need TK-09 (TFA Response 98059B).

The second response was TFA Response 98071B, a reply to the requirement for Evaporator Closure. The TFA tentatively rated the priority of the technical response to this need as #43. The TFA proposes to provide funding in FY99-01, given available funding.

Tanks Focus Area Site Needs

Need Title: In-tank Corrosion Probe Development

Site: SRS **TFA Functional Area:** Safety
TFA Response#: 98072A, B **Site Need#:** SR-2919 **Site Priority:** 19 of 20 **PBS#:** SR-HL01, SR-HL02, SR-HL04

SITE NEED:

Need Description: Savannah River Site (SRS) has had, for twenty some years, a successful corrosion program for its waste tanks and their cooling coils, using tank chemistry control. Through continuous research, judicious application of research results, and disciplined and vigilant adherence to its corrosion program, SRS has successfully contained nitrate stress corrosion cracking (SCC) in older tanks, from the late '50's through the early '70's. Now, the mechanism of SCC is fairly well understood for our waste system. The newer Type III fully contained tanks designed and built based on site research, have not had any SCC or leaks or any indication of one in some 474 tank-years of service, excluding Tank 15. Recent visual inspection shows new crack above the waste line. SRS will continue to rely on its tank chemistry program as its primary means of corrosion control.

However, the in-situ corrosion probes being tested at Hanford may add to our capability to fine tune the amount of tank inhibitor needed, and the response time necessary. It will also enhance our understanding of the mechanism of pitting and general corrosion for our system in the vapor-liquid interface. This new probe with faster response may also help in controlling corrosion for site processing tanks, e.g., ITP/ESP, and evaporator feed tanks, where tank chemistry can undergo rapid changes.

Additionally a corrosion species probe is needed. The probe will measure the concentration of the inhibitors in the waste and more cost effectively maintain implementation of the tank chemistry program by measuring corrosion inhibitors in-situ.

In-site equipment for determination of the % solids in the waste at varying heights is also needed. This tool will allow confirmation of the solids in the waste streams and allow on-line validation the AB source term is being maintained. Mapping of the settled sludge height is also needed to verify operation stays within the SAR controls for source term and flammability.

Cost:
Demonstrate correlation with corrosion mechanisms - FY98 for $50,000
Test probe with actual tank waste - FY98 for $50,000
Develop deployment mechanism - FY99 for $50,000
Demonstrate deployment - FY99 for $150,000
Demonstrate % solids instrument with waste simulants in FY99 for $100,000
Demonstrate mapping equipment in tank mock-up - FY99 for $150,000
Deploy % solids instrument and mapping equipment in FY00 for $200,000

How Long Will It Take: Probe development will be complete in FY98 and deployment will be in FY99. Other in-situ instruments will be developed in FY99 and deployed in FY00.

Functional Performance Requirements: 1. Test probe in simulants to demonstrate correlation with corrosion mechanisms.
2. Demonstrate confidence and reliability of probe signal
3. Test probe in actual waste tanks. One that is well inhibited and in storage mode, and one undergoing rapid changes and in processing mode.
4. Test the probe's materials of construction for durability and service life estimates.
5. Develop in-tank deployment technique for the probe at the interfacial region.
6. Develop % solids instrument that will measure % solid levels in the range of 0 to 20 wt %.
7. Develop mapping equipment that can map the sludge height below the supernate level across the diameter of the tank with cooling coil interferences. Results should reflect sludge height within 1 inch.

Schedule Requirements:
Demonstrate corrosion probe correlation with corrosion mechanisms - FY98

Tanks Focus Area Site Needs

Need Title: In-tank Corrosion Probe Development

Site: SRS **TFA Functional Area:** Safety
TFA Response#: 98072A, B **Site Need#:** SR-2919 **Site Priority:** 19 of 20 **PBS#:** SR-HL01, SR-HL02, SR-HL04

Test corrosion probes with actual tank waste - FY98
Develop deployment mechanism - FY99
Demonstrate deployment of corrosion probes- FY99
Demonstrate % solids instrument with waste simulants in FY99
Demonstrate mapping equipment in tank mock-up - FY99
Deploy % solids instrument and mapping equipment in FY00

Problem Description: Characterization of waste tank constituents for corrosion chemistry is important due to the waste being stored in carbon steel tanks. Failure to control the corrosion chemistry can result in tank failure and potential for an environmental release. Failure of a tank would also severely impact operation of the HLW facilities resulting in large production/utility costs.

Characterization of waste tank weight % solids and height of solids layer is required to ensure the SAR source term and flammability controls are being maintained throughout all tank farm operations.

Justifications:

Technical Justification: Develop a corrosion species probe that provides characterization information without physically sampling material in the Waste Tanks. Current sampling and analytical methods for liquid phase characterization are very time consuming and do not provide real-time results. A corrosion probe could be of great help in fine tuning SRS tank corrosion chemistry program both in amounts of inhibitors needed and the response time necessary, especially in waste processing tanks. It will also help SRS having a better control on the pitting corrosion in the vapor-liquid interface.

Develop in-situ % solids instrumentation and mapping equipment to measure sludge height to maintain SAR controls without sampling or taking manual soundings.

Regulatory Justification: Safe storage of radioactive waste regulated by Federal, State or local laws with potential for significant fines. DOE commitment with FFA requires tanks maintain structural integrity and also has potential for significant fines.

ES&H Justification: Pulling current samples or taking soundings results in personnel exposure, creation of low level radioactive waste, and cost associated with handling and analysis. High in Worker safety and Health due to significant reduction in personnel exposure and High in Environmental due to significant reduction in contaminated waste disposal.

Cultural/Stakeholder Factors: Corrosion probe and other in-situ equipment will have a significant impact by reducing solid waste disposal land use.

Cost Savings: Potential to save $1,000,000/year by eliminating corrosion chemistry samples at SRS. Cost savings for the complex would be in tens of millions per year.

Other Justification:

Consequences of Not Filling Need: Continued analytical cost and personnel exposure and waste generation.

Privatization Potential: Excellent potential for a corrosion probe, % solids, and mapping equipment with deployment systems.

Current Base Technology and Cost:

Tanks Focus Area Site Needs

Need Title: In-tank Corrosion Probe Development

Site: SRS **TFA Functional Area:** Safety

TFA Response#: 98072A, B **Site Need#:** SR-2919 **Site Priority:** 19 of 20 **PBS#:** SR-HL01, SR-HL02, SR-HL04

SUMMARY OF TFA RESPONSE:

The TFA developed two separate replies to this need. The first, TFA Response 98072A, replied to the need for In-Tank Corrosion Probe Development. The TFA did not rate the technical response to this need separately, and intends to satisfy this need through the technical response prepared for Hanford need RL-WT04 (TFA Response 98004).

The second response was TFA Response 98072B, a reply to the requirement for In-tank Corrosion Probe Development (Sludge Mapping and Percent Solids). The TFA did not rate the technical response to this need separately, and intends to satisfy this need through the technical response prepared for SRS need SR-2918 (TFA Response 98055).

Need Title: Volume Reduction and Stabilization of CIF Secondary Salt (NaCl) Liquid Waste

Site: SRS **TFA Functional Area:** Pretreatment

TFA Response#: 98073 **Site Need#:** SR-2921 **Site Priority:** Unranked **PBS#:** SR-SW01

SITE NEED:

Need Description: The Need exists at SRS for a modular evaporator system to reduce the volume of secondary liquid waste resulting from the CIF operation and to provide for stabilization of the resulting reduced concentration salt waste into a regulatory conforming waste form for disposal. The evaporation and stabilization technology for high salt wastes is needed immediately. It will be used for the design life of the CIF.

Functional Performance Requirements: Modular evaporator system with minimum footprint capable of being installed in the existing facility with minimal new ancillary equipment:
- Maximum steam pressure not to exceed 300 psi
- An automated system and interface with existing CIF Control system
- Must not require additional operating personnel
- Stabilization technology should utilize existing mixing equipment, if possible
- Technology must be suitable for stabilization of high concentration salt waste
- Combination stabilization of blowdown and ash preferred
- Must minimize evaporative water in final waste form to reduce drum corrosion

Must have set times compatible with next day shipment.

Schedule Requirements: Technology requirement is immediate for cost effective volume reduced disposal of CIF secondary wastes.

Problem Description: The CIF incinerates mixed, low level, and hazardous waste at SRS. The CIF is equipped with a wet offgas system (quench) which uses NaOH to scrub particles and chemicals from the offgas system. This treatment of the incinerator offgasses results in the generation of blowdown, a high salt (NaCl) and high suspended solids liquid waste. The quench solution is reused until the concentration of the total dissolved solids (TDS) and the total suspended solids (TSS) reaches the design and permit limits. The estimated generation rate is 50,000 gallons of blowdown per year at the design limits of 10% TDS and 3% TSS. The existing stabilization process and equipment can not handle this volume and therefore, slows down the CIF production process.

Additionally, it is preferable to blowdown quench water at concentrations well below the design limits to reduce corrosion, erosion of the offgas system components, and reduce the fouling of the HEPA filters. The fouling of the filters at the blowdown design limits requires a weekly filter changeout. Reducing the blowdown concentration to 1-5% TDS and 1-2% TSS increases the HEPA life to 4-8 weeks, reduces nozzle replacement frequency, and reduces quench transfer line pluggage, thereby reducing CIF maintenance costs and reducing plant downtime.

The above approach, however, increases the volume of blowdown, thus outstripping the stabilization system capacity. Therefore, a fully automated evaporator is needed which will concentrate the blowdown waste stream to increase the waste loading in the stabilized waste form. The evaporation process results in high concentration of salts, and therefore is less suitable for cement stabilization. A stabilization technology with suitability to stabilize high salt content wastes is needed. The same stabilization process should be able to handle ash stabilization.

Justifications:

Technical Justification: As stated in the problem description above, generation of the offgas blowdown to the design limits TDS and TSS results in excessive CIF maintenance costs for weekly HEPA filter replacement and frequent nozzles replacement, and in excessive downtime due to quench line pluggage. Reduction of the blowdown concentrations well below the design limits results in excessive volumes of blowdown that outstrips stabilization system capacity. Addition of an evaporation system alone reduces the volume but leaves the cement stabilization technology less suitable for high salt wastes.

Tanks Focus Area Site Needs

Need Title: Volume Reduction and Stabilization of CIF Secondary Salt (NaCl) Liquid Waste

Site: SRS **TFA Functional Area:** Pretreatment
TFA Response#: 98073 **Site Need#:** SR-2921 **Site Priority:** Unranked **PBS#:** SR-SW01

Regulatory Justification: SRS has regulatory commitments to treat waste per the Site Treatment Plan (STP) and is committed to contribute to the Complexwide Environmental Management (EM) Integration Treatment Plan. With the current system, even if the blowdown waste loading is allowed to reach the design limits, the resulting blowdown volume marginally exceeds the existing cement stabilization capacity. Frequent plugging of the quench system lines increases CIF downtime. This significantly impacts the volume of waste that can be treated by the CIF, which puts the SRS regulatory commitments and contributions to the complexwide EM Integration treatment plan in jeopardy.

If the blowdown concentrations are reduced well below the design limits to reduce maintenance costs and CIF downtime, the excessive volume of blowdown generated severely limits the CIF production due to the limited capacity of the existing stabilization system. Regulatory commitments are still jeopardized.

Reduction of blowdown volume by evaporation alone does not solve the problem because evaporation results in high salt wastes that are difficult to stabilize with the existing cement stabilization process.

Therefore, the need for the evaporation technology and for stabilization technology capable of handling high salt loading is essential to the SRS regulatory commitments and complexwide EM Integration efforts.

ES&H Justification: None.

Cultural/Stakeholder Factors: The introduction of an evaporator and a high salt waste stabilization technology to the CIF is not expected to impact stakeholder concerns.

Cost Savings: The existing CIF process requires excessive maintenance to replace HEPA filters and nozzles, and excessive downtime due to plugging of quench lines. Reduction in blowdown concentrations below design limits reduces CIF maintenance and downtime, but creates excessive amounts of blowdown wastes. This additional waste volume will require additional capacity to be added to the cement stabilization process, and also increases the stabilized waste volume due to lower waste loading. Cost avoidance by reducing CIF maintenance and downtime is offset by the increased cost of stabilization system expansion and larger volumes of disposal.

The need for the evaporator and a suitable stabilization technology for high salt wastes, if fulfilled, will provide estimated annual cost savings of $1.2M by reducing CIF maintenance costs, downtime costs, and treated secondary waste disposal costs.

Other Justification: None.

Consequences of Not Filling Need: Failure to fulfill this need will delay regulatory committed treatment of incinerable waste volumes due to the high CIF downtime, putting SRS and complexwide regulatory commitments in jeopardy. Also there are significant costs associated with high system downtime.

Privatization Potential: Since the need is to provide evaporation and stabilization support to CIF, there is privatization potential.

Current Base Technology and Cost:

SUMMARY OF TFA RESPONSE:
The TFA tentatively rated the priority of the technical response to this need as #16 (TFA Response 98073). The TFA is providing funding in FY98 and proposes to provide funding in FY99-01, given available funding. The TFA intends to partially satisfy the following additional needs in its technical response: ORR need TK-11 (TFA Response 98052).

Site: SRS **TFA Functional Area:** Pretreatment
TFA Response#: 98074 **Site Need#:** SR-2923 **Site Priority:** Unranked **PBS#:** SR-HL08

SITE NEED:

Need Description: Large quantities of sodium hydroxide (caustic) are present in the low-level liquid waste produced in the In-Tank Precipitation process. This concentrated salt solution is disposed in a cement wasteform referred to as Saltstone. Significant savings in disposal costs could be realized if the caustic was recovered and recycled.

Functional Performance Requirements: The caustic recovery process must be cost effective and deliver a product that meets customer requirements for purity and concentration. The facility must be capable of processing low-level radioactive waste at a rate of between 0.94 and 4.7 million gallons per year. Transport, storage and handling of the recovered caustic must be accomplished with minimal changes to the existing customer facilities and equipment.

Schedule Requirements: This is an optimization alternative that is not being driven by current schedules.

Problem Description: Large quantities of chemicals (chiefly sodium salts of nitrate, nitrite, hydroxide, and aluminate) are present in the liquid phase of high-level waste (HLW). Greater than 99.9% of the soluble salts will be disposed in Saltstone after removal of radioactive species in the In-Tank Precipitation (ITP) process. Recovery of sodium hydroxide (caustic) from the salt solution could significantly reduce the volume of waste disposed in Saltstone. Electrochemical technology exists to separate salts from aqueous waste streams. An electrochemical salt splitting process has the potential to recover the sodium from salt solution as caustic solution. Recycling caustic reduces the quantity of new chemicals added to the high-level waste system at the Savannah River Site. The recovered caustic could be used to neutralize fresh waste from the Separations canyons, Defense Waste Processing Facility, and the Effluent Treatment Facility, used as a corrosion inhibitor in the Tank Farm, and used to dissolve alumina in Extended Sludge Processing (ESP).

Justifications:

Technical Justification: Large quantities of sodium hydroxide (caustic) are present in the low-level liquid waste produced in the In-Tank Precipitation process. This concentrated salt solution is disposed in a cement wasteform referred to as Saltstone. Significant savings in disposal costs could be realized if the caustic was recovered and recycled.

Regulatory Justification: This need is driven by the need to reduce costs by optimizing the process and is within the scope of the existing regulatory envelope.

ES&H Justification: This need is driven by the need to reduce costs by optimizing the process and is within the scope of the existing safety envelope. There will be some incremental benefit in Environmental Safety and Health performance through optimization.

Cultural/Stakeholder Factors: No known concerns.

Cost Savings: Possible cost benefits for the recovery and recycle of caustic to SRS operations are based on the following:
(1) annual usage of 50% sodium hydroxide in Separations, Tank Farm and ETF operations is 420,000 gallons,
(2) annual usage of 50% sodium hydroxide in the DWPF is 175,000 gallons,
(3) design rate for feed of decontaminated salt solution to Saltstone is 4.7 million gallons/year,
(4) proposed budgets for HLW could limit feed rate of decontaminated salt solution to Saltstone to as low as 0.94 million gallons/year,
(5) Saltstone variable cost is $3.00/gallon,
(6) value of sodium hydroxide is $300/ton,
(7) maximum possible recovery of Na from salt solution is 42% of total Na assuming average flowsheet composition (5.16 M Na+) and 80% if nitrate and nitrite are converted to hydroxide before Na recovery step

(these limits apply if the depleted product stream is to remain alkaline; higher recovery is possible if the stream is allowed to become acidic - this will, however, result in the precipitation of alumina and silica and the need for a acid corrosion resistant storage tank).

Costs for processing the evaporator overheads in the ETF are not included as are the cost savings from reducing the amount of salt solution that is processed through ITP. Potential cost savings included in this evaluation are the value of the fresh caustic and the cost of disposal of the fresh caustic in Saltstone. This results in a reduction in the volume of salt solution sent to Saltstone. The possible cost saving is determined to be $11.60 per gallon of 50% caustic solution recovered. At the design rate for salt processing, the possible cost savings range from $6.5 to $12 million per year depending on the fraction of sodium recovered (see basis #7). At the lower processing, the possible cost savings range from $1.3 to $2.5 million per year.

Other Justification: No known concerns.

Consequences of Not Filling Need: All decontaminated salt solution from SRS waste processing will be disposed in Saltstone.

Privatization Potential: A caustic recovery operation could be implemented into the SRS high-level waste flowsheet in such a manner that a stand alone facility could be built and operated by a private vendor. Decontaminated salt solution would be provided to the facility for treatment. The facility would produce a caustic product for SRS and offsite customers and a caustic depleted salt solution for disposal in Saltstone. Electrochemical salt splitting is a well-known technology that has been successfully commercialized for the desalination of water, treatment of pulp and paper wastes and the recovery of chemicals from spent plating baths.

Current Base Technology and Cost:

SUMMARY OF TFA RESPONSE:
The TFA did not rate the technical response to this need separately (TFA Response 98074). The TFA intends to satisfy this need through the technical response prepared for Hanford need RL-WT08 (TFA Response 98008).

Tanks Focus Area Site Needs

Need Title: In-situ Grouting of Underground Tanks (Formerly Used for the Storage of Radioactive Solvents)

Site: SRS
TFA Functional Area: Closure
TFA Response#: 98075
Site Need#: SR-3022
Site Priority: Not Ranked
PBS#: SR-ER02

SITE NEED:

Need Description: Twenty-two inactive underground radioactive waste solvent storage tanks (Sl-S22) located in the Old Burial Ground (OBG) 643-E, are scheduled for closure under the FFA agreement.

Functional Performance Requirements: The grout must provide structural support for the backfill over the tanks and a RCRA style cover up to 20 feet in thickness to be installed over the OBG. The grout must be capable of hardening in the presence of tributyl phosphate.

The grouting program should be planned to reduce loading on tanks walls and heat generation by utilizing a number of lifts.

The grout must be capable of entraining the remaining sludge and absorbing all remaining liquid. Entrainment and absorption must be accomplished in the first lift. The grout must be resistant to leaching by infiltrating low pH precipitation, to prevent the migration of radionuclides and metals to the water table.

The grout must be emplaced uniformly in the tank. The grouting system must be capable of spreading the grout to all portions of all tanks without leaving appreciable void space.

A HEPA filter must be installed to filter the air displaced by the grout and prevent any airborne release. Eight of the tanks have only a single riser/vent pipe at mid tank, the remaining tanks have separate riser and vent pipes located at the opposite ends of the tank.

The tanks will not be exhumed, cutting of additional openings into the tanks shall be minimized, and personnel will not enter the tanks under any circumstances.

The new technology must minimize the generation of secondary wastes and will not dilute existing wastes.

Schedule Requirements: 1-3 years.

Problem Description: Twenty-two underground solvent storage tanks were installed between 1955 and 1968. It is believed that saddles support none of the tanks. Individual tank volumes range from 6,800 gallons to 27,000 gallons. The tanks are currently accessible only via riser pipes with internal diameters as small as 3.0 inches. Radioactive sludge heels remaining in the tanks may total as much as 7,600 gallons and may contain as much as 175 Curies of alpha emitting radionuclides. The largest heel in any of the tanks is 2500 gallons. The sludges are believed to be dark and highly viscous in character, containing organic solvent residues such as kerosene and tributyl phosphate. The pH of the residual heels in the tanks is known to be very alkaline. A new technology must be developed considering the weakened structural integrity of the tanks (see functional requirements).

Justifications:

Technical Justification: Tanks Sl-S22 have been in place for 28 to 41 years, these tanks will ultimately fail by collapse unless structural stabilization is enhanced. Disintegration of the tanks will probably result in release to the groundwater, atmosphere and exposure of personnel. The placement of the soil cover on the OBG could accelerate the collapse of these tanks. There is a need for a technology which can isolate the tanks, support their structure, and prevent tank collapse and provide stabilization for materials within the tank.

Regulatory Justification: DHEC is aware of the presence of these tanks, the closure of the tanks is driven indirectly by the closure of the OBG.

Tanks Focus Area Site Needs

Need Title: In-situ Grouting of Underground Tanks (Formerly Used for the Storage of Radioactive Solvents)

Site: SRS **TFA Functional Area:** Closure

TFA Response#: 98075 **Site Need#:** SR-3022 **Site Priority:** Not Ranked **PBS#:** SR-ER02

ES&H Justification: The tanks will ultimately disintegrate unless action is taken to provide internal support, this could result in exposure of personnel on-site and release of radionuclides to the atmosphere and groundwater with off-site exposure potential.

Cultural/Stakeholder Factors: Due to the condition of the tanks and the high risk category of the contents, stakeholder concern over this issue is significant.

Cost Savings: Eventual leakage and collapse of the tanks could compromise the integrity of the cover on the OBG and necessitate extensive repair or replacement.

Other Justification: None.

Consequences of Not Filling Need: Failure to stabilize the tanks and sludge could result in the release of radionuclides, metals, and solvents to the groundwater and atmosphere. There is a high potential for the exposure of personnel both on-site and off-site.

Privatization Potential: Tanks Focus Area is responsible for remediating 273 large, underground storage tanks and 7 calcine vaults at Handford, Idaho National Engineering and Environmental Laboratory, Oak Ridge, and SRS. DOE sites have additional waste storage tanks that are not included in the Tank Focus Area. As a result, DOE has significant need across the complex for new technologies.

In addition, the potential for privatization may be excellent due to the specific design and use of equipment needed to remotely place grout uniformly in an almost inaccessible vessel. This technology could be expanded to filling highly contaminated buildings and pipelines at other DOE and private sites.

Current Base Technology and Cost: Existing RCRA type cover technologies cost $40-$100/sq. yd depending on area extent. Current grouting technologies are estimated to cost $200 to $540/cu. yd, without the additional capabilities outlined in the functional performance requirements.

SUMMARY OF TFA RESPONSE:
The TFA tentatively rated the priority of the technical response to this need as #50 (TFA Response 98075). The TFA proposes to provide funding in FY99-00, given available funding. The TFA intends to partially satisfy the following additional need in its technical response: ORR need TK-09 (TFA Response 98050A).

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