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7. Abstract The Low-Level Waste Technical Strategy document describes the mechanisms which the Low-Level Waste Program Office plans to implement to achieve its mission. The mission is to manage the receipt, immobilization, packaging, storage/disposal and RCRA closure (of the site) of the low-level Hanford waste (pretreated tank wastes) in an environmentally sound, safe and cost-effective manner.		
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**LOW-LEVEL WASTE PROGRAM
TECHNICAL STRATEGY**

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LOW-LEVEL WASTE PROGRAM
TECHNICAL STRATEGY

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FIGURE 1 Logic for the LLW Program

TABLE 1 LLW Program Interfaces

TABLE 2 Risk Assessment

THE LOW-LEVEL WASTE PROGRAM TECHNICAL STRATEGY

1.0 INTRODUCTION

There are 28 double-shell tanks (DST) and 149 single-shell tanks (SST) containing the radioactive byproducts from nearly 50 years of spent fuel and waste processing at the Hanford site. A variety of processes have been used over the years, resulting in several distinct categories of waste. The waste is in the form of sludge, hard salt cake, and supernatant. Initially, sludges from the various processes were segregated. Over the years, sludges have been intermixed to a large extent; the salts and supernatants have been intermixed to an even greater extent in an effort to conserve tank space and stabilize tanks. Of the 177 tanks, about 50 are currently classified as "watchlist" tanks because they pose potential safety issues associated with the storage of the waste.

In 1987, the Hanford Defense Waste Environmental Impact Statement was issued (DOE 1987) with the associated Record of Decision (ROD) in 1988 (DOE 1988). That ROD called for the waste from the 28 DST's to be retrieved and pretreated to separate the waste into high-activity and low-activity fractions. The high-activity radioactive fraction would be vitrified and disposed in the nation's deep geologic repository. The low-activity portion would be made into a cement-like grout and disposed in near-surface vaults at the Hanford Site.

Pretreated DST supernate would be made into grout. Sludge washing would produce a soluble waste liquid that also would have been made into grout. The insoluble sludge would be treated later to minimize the volume of material going to the HLW vitrification facility. The advanced separations would be done in B Plant, a renovated chemical separations plant built in 1943.

Subsequently, several changes affected the planned approach for disposal of Hanford Site tank waste.

- The U.S. Department of Energy (DOE) made the decision to plan to retrieve the waste from all SST's.
- Safety issues were identified for about 50 DST's and SST's, which became classified as watchlist tanks. Early retrieval and pretreatment were identified as likely processes to ensure that the safety issues could be resolved before the planned disposal activities for several of these watchlist tanks.
- Upgrading B Plant to bring it into compliance with current environmental and safety requirements was not found to be cost effective.

- Near-surface disposal of low-level waste (LLW) in grout vaults as planned was determined to be unacceptable, and a vitrified form with further radionuclide removal was determined to be the preferred approach.

As part of the Tank Waste Remediation System (TWRS) rebaselining effort in fiscal year (FY) 1993, a new technical strategy was defined based on the application of systems engineering to identify the best technical options for disposal of tank wastes.

Two bounding separation strategies were identified as part of the new technical strategy.

- Minimum pretreatment
 - Wash sludges to remove water-soluble species from high-level waste (HLW)
 - Separate radioactive cesium from other water-soluble species to produce LLW
 - Use proven processes and minimize equipment and facility costs for pretreatment
 - Larger HLW volume relative to other approaches.

This was considered minimum pretreatment because it required minimal facilities to implement (tank farms for decantation and sludge washing, and a facility for the ion exchange process), and the degree of separation (radionuclides from inert constituents) was the least.

- Extensive separations
 - Maximum removal of radionuclides from LLW
 - Minimum HLW volume
 - Early focus on pretreatment of supernatant and salt cake to produce LLW
 - Later focus on pretreatment of sludges to produce a concentrated HLW
 - Could require a large number of processes and substantially more equipment and facilities to implement.

The objective of this "clean option" was to 1) minimize the inventory of radionuclides left at Hanford in near surface disposal, and 2) minimize the volume of the HLW (approximately 1,000 canisters of glass was targeted).

The LLW was to be vitrified into a glass and disposed of on-site, near-surface in a form which would permit retrieval for an unspecified period of time after placement.

The DOE provided the new technical strategy to other two parties to the *Hanford Federal Facility Agreement and Consent Order* (U.S. Department of Ecology, et al. 1994), known as the Tri-Party Agreement, in the form of a request to modify the existing agreement in March 1993. The negotiations involved input of stakeholders (e.g., regulators, the general public, Indian tribes). The result of the negotiations was the agreement (signed by all three parties on January 25, 1994) to proceed with limited pretreatment to support a LLW vitrification process startup of radioactive operations in the year 2005.

The strategy, and details for the vitrification and disposal of the LLW, in accordance with the terms of the Tri-Party Agreement, are presented in the following sections.

2.0 MISSION

The Low-Level Waste Program Office mission is to manage the receipt, immobilization, packaging, storage/disposal and RCRA closure (of the site) of the low-level Hanford waste (pretreated tank wastes) in an environmentally sound, safe and cost-effective manner.

3.0 OBJECTIVES

The primary objective of the TWRS Low-Level Waste Program Office is to vitrify the LLW fraction of the tank waste and dispose of it onsite, in a near-surface retrievable form, allowing for retrieval up to an unspecified period of time from the time of initial placement of the immobilized waste. In order to achieve that goal, processes and equipment are being identified, designed, tested, and evaluated and technologies are being developed that would lead to the design, construction and operation of a government-owned vitrification facility. As an alternative to this traditional approach, the DOE is also evaluating the technical and economic advantages and disadvantages of a proposal to privatize the vitrification facility.

The Low-Level Waste Program Office objectives (which are technically based) are listed below. The Low-Level Waste Program Office must achieve these objectives to successfully accomplish the mission.

1. Verify LLW can be vitrified at high (200 tons of glass/day) capacity

2. Preparation of the waste feed composition criteria
3. Integrate the LLW Vitrification Facility with the rest of TWRS
4. Define, plan, and prepare trade studies required for scoping of facilities and processes for LLW treatment and disposal
5. Melter selection for the vitrification of the LLW
6. Initiate the LLW Vitrification Plant startup by June 2005
7. Glass formulation(s)
8. Manage Program costs to DOE's FY constraints and total Program cost
9. Maintain the Grout Facility for emergency tank space only
10. Establishment of the vitrified waste performance criteria
11. Performance Assessment document preparation
12. Preliminary and Final Safety Analysis Reports
13. Parts A and B of the Dangerous Waste Permit Application
14. Function and Requirements Document
15. Provide for the design, construction, operation, and monitoring of the LLW vitrification and disposal facilities through hot start up by the year 2005.
16. Complete vitrification processing in 2022
17. Closure of the Disposal Site as a Resource Conservation and Recovery Act (RCRA) landfill.
18. This process will demonstrate a technically defensible program allowing a technically based decision process. Litigation of this decision process may occur.

4.0 STRATEGY AND ASSUMPTIONS

This section describes the technical strategy and supporting assumptions that have been developed to achieve the objectives listed in the previous section. Overall strategy for the Low-Level Waste Vitrification Program is to utilize mature commercially available technologies or systems whenever possible, modify or enhance existing technologies, develop technologies when

none exit and provide a technically defensible basis for the immobilization and disposal of low-level tank wastes.

Alternative technologies will be investigated on a case-by-case basis for their viability to the Program. This strategy supports the tight schedule and intent of the Tri-Party Agreement. Outside consultants will be used to aid in glass formulation, melter selection, Performance Assessment (PA), and disposal systems. The consultants will lend credibility to the process and hopefully help us with public involvement.

Creative and innovative methods will be evaluated during the design and construction of the LLW Vitrification Plant. This may include 'commercialization' (design, build, and operate with government funds), and/or the traditional method of DOE contracting techniques.

The principals which guide the development of the PA will be used to guide the development of the design work also. As the design of the melter, formulation of the glass, waste glass package design, and the design of the disposal site proceeds the information will be transmitted to the PA developers. The design information may then be processed to detect any deficiencies, with respect to environmental protection, which will require design modification.

4.1 LOW-LEVEL WASTE IMMOBILIZATION STRATEGY

Throughout the Program trade off studies (as identified by Systems Engineering) will be conducted. This will determine items as facility layout, off-gas systems, disposal systems, type of melter, etc. Additional trade studies can also be identified through testing, design or construction options.

The Low-Level Waste Vitrification Plant will vitrify the low-level tank wastes and dispose (and close) onsite, near-surface in a retrievable form. The final containment (e.g., vault) will be designed to be closed as a RCRA landfill.

4.1.1 Melter Selection

Currently a melter assessment is in progress to identify and evaluate existing melter technologies that have potential application for vitrifying LLW. Glass formulation and other process development activities that support the melter evaluation (near-term) and conceptual design of the LLW Vitrification Facility (long-term) are also in progress.

Use commercially available high capacity technology for melter selection, operation, and the melter feed system, wherever possible. Commercial melter vendors will be selected and their melters tested to determine if their melter types can be adapted to the LLW Program. The testing will be a phased testing with the first phase as proof of principle.

The second phase will allow for enhancements to melter systems to handle progressively difficult simulants. A primary melter and an alternate will be chosen at the end of testing.

4.1.2 Vitrification Facility Production Matching

The LLW Vitrification Facility capacity will, as a minimum match waste retrieval and pretreatment rates so as to minimize the amount of DST storage needed.

4.1.3 Simulant Development

Simulants will be developed for melter testing and supplied to the potential vendors. The first simulant to be developed will be a double-shell simulant as this is most likely to be the first feed to a melter. This simulant is based on double-shell tank waste characterization information. Later simulants for Phase II testing will be based on the best information available from tank inventories.

4.1.4 Vitrification Facility Shielding

The LLW Vitrification Facility will be lightly shielded if practical.

4.1.5 Vitrified Waste Disposal

The vitrified LLW will be placed in an onsite near-surface disposal system in a manner that will allow retrieval should that become necessary.

4.1.6 Glass Formulation Development

Formulations will be developed to support melter testing and selection in the early phases of the program. Formulations to support the Program will continue to be developed as characterization information becomes available. There will be a range of formulations developed for variations in waste as tanks are retrieved. The characteristics of the various glasses to be produced can then be used in modeling on the entire disposal package (and site) to determine the effects on the environment. This work will proceed concurrently as the design work on the waste package and disposal site is developed. Durability testing will be carried on for glass formulations. If deemed necessary, new ways of testing durability will be developed for the glasses selected. Work in predicting offgas and non-vitrifiable products will support design of the vitrification facility. All work will follow closely with melter selection.

4.1.7 Grout Facility Disposal

Disposal of LLW as grout is not planned, but the Grout Facilities will be maintained in standby in case of a tank space emergency. The intervening period would allow for final activities such as records storage/destruction and disposition of all equipment and facilities.

4.1.8 LLW Vitrification Process

The LLW vitrification process will be designed based upon melter testing with simulants, lab and bench-scale testing of radioactive waste samples, and cold testing of facility components.

4.1.9 Feed Specification Development

Development of a feed specification will be an interactive process with pretreatment. Feed specification will most likely be a combination of pretreatment technologies for removals, retrieval sequence and melter/formulation ability to capture wastes.

4.1.10 Glass Quality Verification

The need for a means of certifying the quality of glass waste form integrity and integrity of the refractory will be approached from a non-destructive testing avenue. An important lesson learned from the Grout Facilities was that this is a long lead item that should be worked upfront.

4.1.11 Low-Level Waste Vitrification Plant

The Low-Level Waste Vitrification Plant will be comprised of several operations: blender, melter, offgas, and a packaging facility. The design of these operations is dependent on a number of variables which are yet to be determined. The melter is in process (yet to be designed/accepted). The formulation (to be designed) and the melter along with the waste feed will determine the composition of the off-gas. Chemicals vaporized during vitrification will be captured and/or treated to meet effluent release limits. Since the vitrified waste package has not been designed, the design of the packaging operation will be a follow-on procedure.

4.1.12 Low-Level Waste Vitrification Disposal Facilities

The vitrified low level waste will be placed in an onsite near-surface disposal system in a manner that will allow retrieval for placement elsewhere (for an unspecified period of time after emplacement), should that become necessary. Design of the disposal facility will be a somewhat iterative process as the package design is accepted and information from the package

characteristics and conceptual design of the disposal facility are supplied to the PA development organization. Modeling will assist in finalizing design work on the disposal facility.

4.2 LOW-LEVEL WASTE IMMOBILIZATION ASSUMPTIONS

Current technology has provided the Program with most of the technical information needed to meet our concerns. However, there will be certain areas in the Program where additional developmental work will be identified. In the meantime work will proceed in other areas until the required information is available or alternatives must be pursued.

The LLW vitrification project will be authorized as a FY 1997 design only Major Systems Acquisition. The following tasks must be completed to support start of design:

- Completion of the conceptual design report by November 1996
- Completion of phase 1 melter technology tests by June 1996.

4.2.1 Hot Pilot Plant

A cold pilot plant and bench scale radioactive pilot system will be used for scale up testing of equipment, process chemistry and training.

4.2.2 Commercial Melter Technology

The LLW Vitrification Facility will use high throughput melter(s) developed for application in the glass industry. The facility's capacity of 200 metric tons per day production will minimize the need for additional DST storage. High throughput melter technology developed for the commercial industry will prove to be adequate for the LLW immobilization mission.

4.2.3 Low Activity Melter Feed Stream

Separations/pretreatment will provide a waste feed stream that is sufficiently low in radioactivity to allow contact maintenance of the LLW Vitrification Facility. Separations/pretreatment (Cs/Sr removal) start-up by December 2004 will provide adequate feed available for LLW Vitrification start-up. Pretreatment will provide a continuous feed product which meets LLW feed criteria to assure long term waste form performance. Pretreatment product output will be batched, with similar product types, to maximize operating efficiencies.

4.2.4 Dangerous Waste Permit

The Part B Dangerous Waste Permit will be in place in time to permit hot operations of the LLW Vitrification Facility.

4.2.5 Design of the LLW Vitrification Facility

The LLW Vitrification Facility is to be constructed by December 2003 with operations beginning in June 2005 using continuously fed pretreated waste. Pretreated double-shell slurry feed will be the initial feed.

Various design strategies will be examined prior to a decision being achieved for the final design strategy. The LLW Vitrification Facility will be designed based upon results of vendor testing of simulants, lab and bench-scale testing of radioactive waste samples, and cold testing of facility components. Once the final decision has been determined then design will be initiated. The design may be performed through one of several contract options (privatized, commercialized, or traditional). Once the contract team organization has been selected the design will be controlled by WHC through contractual agreements and statements of work. Design of the LLW Vitrification Facility will be accomplished in a timely and cost effective manner that will satisfy the Tri-Party Agreement and the regulatory requirements.

The vitrified LLW will be placed in an onsite near-surface disposal system in a manner that will allow for retrieval for placement elsewhere (for an unspecified period of time from the time of emplacement) should that become necessary.

4.2.6 Cost for LLW Vitrification Facility

The LLW Vitrification Facility (Project W-378) assumed rough order of magnitude estimate of capital costs is \$500 million to \$1.2 billion, excluding initial disposal facilities and equipment.

4.2.7 Construction of the LLW Vitrification Facility

Construction of the LLW Vitrification Facility will follow the approved plans and specifications on budget and on schedule. Any requested changes/deviations from the approved plans and specifications will be subjected to an approved method for approving/rejecting requested changes/deviations. It is further assumed that the selected contractor will, as a part of his Program, provide a waste Management Program and a Quality Assurance Program, both documents subject to approval by WHC.

4.2.8 Environmental Impact Statement

The TWRS Environmental Impact Statement (TWRS EIS) will be approved and the ROD will be issued to support start of definitive design November 1996.

4.2.9 Waivers

During the development and implementation of the Low-Level Waste Vitrification Plant, no waivers for regulatory requirements (DOE Orders, Code of Federal Regulations [CFR], Washington Administrative Codes [WAC], etc.) are anticipated or requested at this time, however this is not to preclude a request for delisting should it prove to be warranted.

4.2.10 Budget Authority

Budget authority will support this aggressive schedule and capital cost increases/decreases as required as additional engineering documentation/estimates are completed.

4.2.11 Production Rate Reduction

Each melter will be replaced every four years during a planned outage. Production rates will be reduced accordingly.

4.2.12 Cost Estimates

Costs estimates were based on the following:

- Previously estimated costs for the Hanford Waste Vitrification Plant (deemed related to LLW work)
- Technology Development Program Office (TDPO) work planning/expertise
- Engineering judgements
- WHC-EP-0616, Rev. 0, "Technical Options Report."

4.2.13 Public Acceptance

The public will accept near term waste form and barrier performance data from extrapolation to long term performance.

5.0 METHODOLOGY

This section will describe the interface responsibilities and provide additional details on the individual objective items.

5.1 INTERFACING

Successful accomplishment of the mission for the LLWDP will require interfacing with numerous organizations. Some of the contacts will be on a one time basis, while other contacts will be off and on for the life of a particular aspect of the program.

5.1.1 Systems Engineering

Systems Engineering is being applied to the TWRS; this is a structured process to identify and implement a complete, traceable solution to a mission need for complex programs or projects. Work is currently underway using this approach to develop a consistent set of functions and requirements that satisfy the mission needs.

The Low-Level Waste Disposal Program Technical Strategy will implement, as may be appropriate, the methods as described in the "Systems Engineering Working Plan." The Systems Engineering (SE) process that will be implemented in this Strategy Plan is briefly outlined (stepwise) as follows:

- Mission Analysis - describes what needs to be done to get the desired end use.
- Function and Requirements Analysis and Allocation - describes what the system does, how well the system needs to perform and relates the how well to the description.
- Alternative Generation and Architecture Selection - produces design concepts that can accomplish the Function and Requirements (F&R) and produces a preferred design concept.
- Evaluation and Optimization - assesses requirements, function, and design concepts to support choosing a preferred optimal design concept.
- Value System - provides input from the public and other stakeholders, which will be incorporated and tracked in the SE process.
- Verification - shows how well the system is progressing and conforming with the functions, requirements, and specifications.

The SE process is iterative and is used to produce solutions for the technical baselines.

The technical baseline evolves through seven phases over the life cycle of the system. The baseline phases are:

- Functional Requirements - a program level description of what the system does and how well the system needs to perform.
- Technical Requirements - a program level description of design concept selected to accomplish the TWRS Program Mission. The description includes system level requirements traceability.
- Design Requirements - a project level description that includes project specification to be given to the A/E and requirements traceability.
- Design Configuration - the A/E package that starts as a preliminary design and finishes as a build-to design.
- As-built Configuration - the A/E as-built package to be used by operations.
- Operational - the operations package that reflects the current system configuration. The package reflects all changes and updates on the system since A/E turnover.
- Decontamination and Decommissioning - the operations and D&D package that gives the systems configuration at the end of operations, the location of hazardous areas, and the characteristics, form, and quantity of the remaining residual waste and hazards in the system.

SE management techniques are used to plan and control the process. The techniques consist of configuration management, SE schedules, work breakdown structures, risk management, technical performance measurements, test and evaluation, and quality assurance.

Throughout the systems life cycle, teams using the SE process work together to develop the technical baseline. The teams include specialists from specialty and engineering disciplines. Examples of specialty disciplines are regulatory compliance, safety, value engineering, operations, decontamination and decommissioning, and training.

The Function and Requirements Document (F&RD) has a milestone (RL) for completion in September 1994, by the end of the present FY. There are basically three documents which will provide input to the F&RD: the Facility Options Trade Studies, the TWRS Function and Requirements Document, and the Systems Engineering, "Process." The F&RD will define the mission parameters.

LLW Immobilization and Disposal System (4.2.3.1) is the system that is the LLW Program's contribution to completing the TWRS mission. It involves the vitrification and near-surface disposal (in a retrievable mode, for an unspecified period of time after emplacement) as a RCRA landfill.

The vitrify LLW function is divided into three subfunctions (Note: These subfunctions are subject to change):

1. **Immobilize Low-Level Waste (4.2.3.1.1).** Vitrify prepared melter feed consisting of pretreated LLW, glass frit and/or glass forming additives and chemicals.
2. **Dispose/Store Waste (4.2.3.1.2).** The vitrified LLW will be disposed on-site in a near-surface RCRA landfill in a manner which will allow retrieval for an unspecified period of time after emplacement.
3. **Close Site (4.2.3.1.3).** The disposal landfill will be closed in accordance with EPA Title 40, CFR Part 264 and WAC 173-303.

The requirements to address each of these functions are also being developed. A critical requirement for low-level waste program and technical activities to proceed effectively is to establish product specifications for the pretreated feed streams that require LLW immobilization. Preliminary feed specifications are being prepared for use in the TWRS technical baseline. A clear understanding of the tank waste characteristics is also critical to defining the requirements for the process flowsheet. Technology evaluating in the laboratory with simulated and actual waste is a key part of developing the process requirements.

5.1.2 Interfaces with Other Organizations

Numerous organizations will be involved in the activities and goals assigned as responsibilities to the Low-Level Waste Program Office. Interfacing will be required to accomplish the exchange of ideas, assignment/identification of tasks, budget and schedule agreements and finalizing of work scope. Primary interface mechanisms will be as determined by the Low-Level Waste Program Office such as the following: baseline schedules, presentations, meetings (scheduled or as-needed), telephone discussions, fax, cc:Mail, internal memos, or external letters.

The Low-Level Waste Program Office must establish and maintain lines of communication for the following:

- Interfacing with other TWRS Program offices (Characterization, Pretreatment, High-Level Waste, Tank Farm Operations, Tank Safety)
- Interfacing with TWRS Engineering and Projects

- Interfacing with other WHC Organizations, i.e., decontamination and decommissioning
- Interfacing with the TWRS TDPO
- Interface with Ecology, the Environmental Protection Agency (EPA), stakeholders, Advisory Panels, and DOE.

The TWRS Projects organization is responsible for design, construction, and start up of the vitrification facility. They will use the results of trade studies; technology demonstrations activities; and engineering evaluations, testing, and demonstrations as inputs to the conceptual and definitive designs of the facility. The Design Requirements Document (DRD) will be the primary document used by projects to define overall facility functions. The project will produce the Functions and Operational Requirements document for design preparation. Additional testing and evaluation may be performed during the design phases to confirm design features and systems in support of TWRS Projects.

5.1.3 Interfaces With External Organizations

WHC's Process Engineering Center of Excellence and its Systems Engineering group are two engineering organizations that are performing key roles in defining what work will be done by the Low-Level Waste Program Office and what are the preferred alternatives to support decisions that need to be made within TWRS.

Pacific Northwest Laboratories' (PNL) TWRS TDPO coordinates and integrates the technology development activities required by the Low-Level Waste Program Office to support the Program.

Fluor Daniels, as the former architect/engineer for the Hanford Waste Vitrification Plant, and Ebasco/British Nuclear Fuels Ltd. are performing facility option trade studies in support of the disposal program. These studies are evaluating various combinations of pretreatment, LLW vitrification and HLW vitrification facilities that will be required to complete the tank waste disposal mission. The trade studies will serve as the basis for early design activities, i.e. conceptual design, and eventually for definitive design.

The secondary wastes generated by the Low-Level Waste Program Office in the course of performing technology development, process and equipment development and verification, and waste form qualification will be transferred to the Liquid Waste and Solid Waste Programs for processing.

Once the LLW vitrification facilities are no longer needed for the tank waste disposal mission, they will be transferred to the Environmental Restoration Program for decontamination and decommissioning.

5.2 REQUIREMENTS (DRIVERS)

This urgency is captured in the aggressive schedule of Tri-Party Agreement milestones agreed to by the DOE, EPA, and Ecology in January 1994 (Ecology, et al. 1994).

One of the key drivers for separating the tank waste into an optimally reduced volume of HLW with the remaining volume as LLW is the anticipated cost of disposing of defense HLW in the national geological repository which is projected to cost significantly more per unit volume than near-surface disposal of LLW at Hanford.

Another driver for the disposal program is the urgency to make progress in cleanup of the Hanford site, particularly to initiate retrieval, pretreatment, and disposal of the tank waste. Specifically retrieving these wastes from tanks that are leaking or have the potential to leak waste to the groundwater, and transforming those wastes into a more chemically stable form is highly desirable, even if it is necessary to store the canistered HLW at the Hanford Site for several years while a repository is sited and built.

5.3 PROGRAM LOGIC

The program logic for the LLW Program is shown in Figure 1. The interfaces with the other TWRS program elements and external entities are defined in Table 1 (Pages 1 and 2 of 2).

5.4 PROGRAM RISK

The Program Risk for the LLW Program is shown on Table 2, page 1 of 1.

5.5 WASTE FEED COMPOSITION CRITERIA

Preparation of the waste feed composition criteria is expected to be an iterative process based on the pretreatment product, the conceptual design of the melter, the results of the melter testing (performed by external contractors), and additional constraints from the Low-Level Waste Vitrification Facility.

5.6 CONSTRUCTION AND OPERATION

The Low-Level Waste Program Office shall provide for the construction and operation of the melter facility, the off-gas facility, and the waste package storage/disposal facility.

An engineering evaluation of the processing facility configuration alternatives for housing the Pretreatment, LLW Vitrification Facility, and HLW Vitrification activities is underway. This trade study is evaluating the following alternatives: a stand-alone pretreatment capability (either modular or centralized facility) together with a stand-alone LLW Vitrification Facility. Other alternatives under study include all combinations of combining the Pretreatment, LLW Vitrification Facility, and the HLW Vitrification Facility. This study is evaluating facility layout and equipment and providing a basis of comparison of the configuration of alternatives (cost, operability, maintainability, and process flexibility).

5.7 PERFORMANCE ASSESSMENT DOCUMENT PREPARATION

The PA document preparation has been initiated, and since it is an iterative process will continue for quite some time. It must be completed and approved prior to Design/Construction of the Disposal Facilities. The interim PA will be used in the initial stage to determine glass quality and the type of disposal/matrix. This is a requirement of DOE Order 5820.2A.

5.8 WORK CONTROL, TASK ASSIGNMENT, AND OUTYEAR PLANNING

For the Low-Level Waste Program Office to efficiently discharge its responsibilities it must maintain close control over all organizations performing activities which fall under §1.0 mission items. This will include, but not be limited to the following: the establishment of Program priorities, the approved periodic examination of budget and schedule variances, progress reports, stop work orders, funding, and the establishment of agreed upon (prior to start up of work) deliverables. The TWRS Systems Engineering Work Plan defines roles and responsibilities.

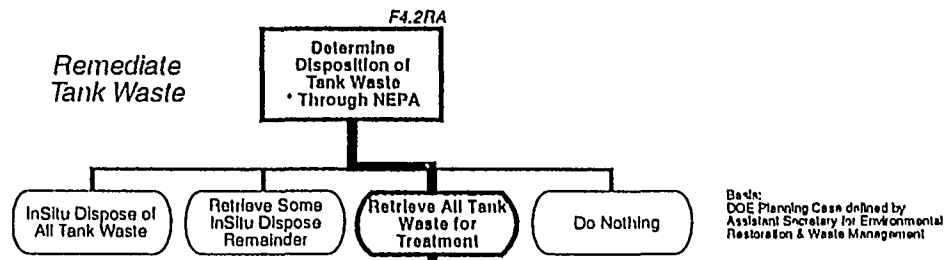
The Low-Level Waste Program Office is an administrative office and a part of its responsibilities are the assignment of tasks (by contract or other), identification of key program interfaces, control of budgets and schedules. Organizations performing for the Low-Level Waste Program Office may be internal (WHC), external (PNL) the academic community, or the private sector. The Low-Level Waste Program Office will seek to match a specific task with an organization qualified to provide the required deliverables in a timely and cost effective manner. This work must be performed within the budgets and schedules as agreed to by the Customer, performing organization, and the Low-Level Waste Program Office.

The Low-Level Waste Program Office must provide the planning for the life cycle of the Program. The planning must consider any changes in the over all TWRS program which could influence the long range and near term implementation of the LLW mission.

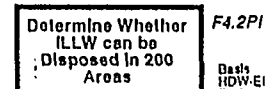
5.9 KEY PLANNING ASSUMPTIONS

Several key assumptions have been used as the basis for the current multi-year Program planning of high-level waste vitrification at the Hanford Site.

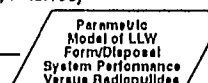
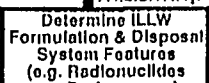
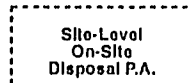
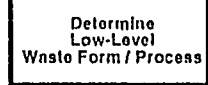
- The LLW Vitrification Plant will start up in 2005, and will be a government-designed, constructed and operated facility
- The LLW fraction from all waste storage tanks (both DST's and SST's) will be vitrified
- The LLW Vitrification Facility will have adequate throughput capacity to complete its vitrification mission by 2022 using a LLW feed stream resulting from cesium ion exchange. Based on this operating scenario, it is estimated that as much as 1,241,000 metric tons of vitrified LLW will be produced
- Waste streams sent to the LLW Vitrification Facility will meet feed specification(s) jointly developed by the Pretreatment, LLW and HLW program elements
- Alternate melter technologies will be selected for further testing, evaluation.
- Adequate funding will be provided to insure adequate resources for the required research, testing, design, construction, operation, product quality verification, and Program management.



Manage System Generated Waste & Excess Facilities



Immobilize & Dispose LLW



8

Facility Configuration Study

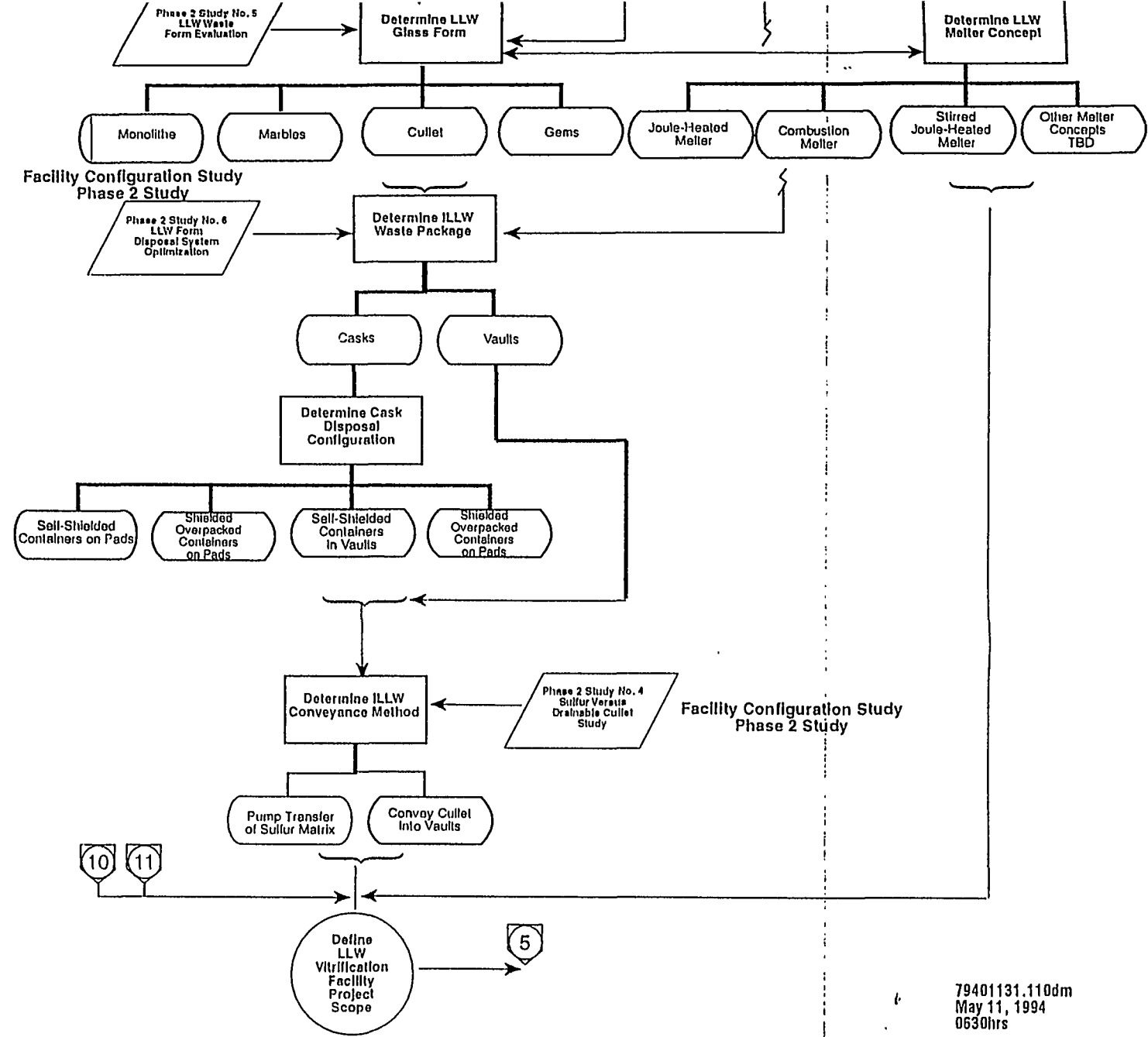


Facility Configuration Study Phase 2 Study

Vendor Testing of LLW Melters

Phase 2 Study No. 7 LLW Melter Selection Impacts on Facility Layout

Facility Configuration Study Phase 2 Study



Facility Configuration Study Phase 2 Study

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Figure 1. Logic for the LLW Program.

**Table 1. 1994 Multi-year Program Plan/Baseline
Low-Level Waste Program Inputs/Output Key**

#	FROM ACT ID	TO ACT ID	ITEM PROVIDED
1	LLW (LOT101, LOT106, LOT112)	PRETR	Preliminary Feed Specification
2	LLW (LOT101, LOT106, LOT112)	PRETR	Final Feed Specification
3	PRETREATMENT	LLW (LOT101, LOT112, LOS0106)	Preliminary Product Specification
4	PRETREATMENT	LLW (LOT101, LOT112, LOS0404)	Final Product Specification
5	DOE-HQ	LLW	Program funding supporting Program
6	DOE-HQ (LOMS03)	LLW (LOEC506)	Approval of new start: Key Decision 0 authorization to proceed with Conceptual Design of Low-Level Waste Vitrification Plant
7	DOE-HQ (ABF 12)	LLW (LOEC503)	Approve TWRS EIS and issue ROD
8	PRETR (PLW 0120)	LLW (LOS0406)	Treated waste feed
9	LLW (LOS0406)	LW	Liquid effluent to Liquid Effluent and Retention Facility basins
10	LLW (LOS0406)	SW	Solid waste streams (failed equipment, HEPA filters, etc.)
11	LLW (LOT101)	decontamination & decommissioning (D&D)	Transfer Grout Treatment Facility to D&D
12	CHAR (COOD204A)	LLW (LOS0406)	Process samples and data
13	LLW (LOS0408)	D&D	Transfer Low-Level Waste Vitrification Facility to D&D

#	FROM ACT ID	TO ACT ID	ITEM PROVIDED
14	DOE-HQ	LLW (LOEC503, LOEC504, LOECT05)	Key Decisions 1, 2, 3, 4, 5
15	State of Washington	LLW (LOS0404)	Permit approvals
16	DOE-HQ	LLW (LOS0404)	Approval of Final Safety Analysis Report
17	DOE-HQ	LLW (LOS0407)	Approval of PA
18	Site integration	LLW (LOEG211)	Site dose commitment allocated to LLW Program
19	TWRS Environmental Compliance	LLW (LOEG214)	Site allocation of effluent releases for LLW
20	LLW (LOEG203 and LOEG205)	TWRS Environmental Compliance	NEPA documentation
21	LLW (LOS0406)	CHAR	Campaign sampling
22	ER Program	LOEG211	Design for Hanford permanent isolation barrier

Table 2. Low-Level Waste Program
FY 1994 MYPP/Baseline

RISK ASSESSMENT

Summary: This Program is one of high risk, but of great reward for not only the Hanford Site, but for the nation. The major risks are identified below.

TYPE OF RISK (P, M, T)	ITEM OF RISK	LEVEL OF RISK (H, M, L)	IMPACT	MITIGATING STEPS
T	The ability to successfully apply high capacity commercial melter technology to the vitrification of radioactive high sodium waste feed is a major Program uncertainty	M	The melter is a key process area for successful, reliable high capacity waste form production. Lack of available melter technology could significantly delay the 2005 hot startup date of the mission completion well beyond 2028.	Steps are being taken to arrange for testing of several melter technologies. Testing will continue through 1995. Additional testing and a pilot plant may be necessary to confirm the selected technology. Additional budget could be required.
T	The PA will be heavily dependent of advisable high quality glass and/or a chemical matrix material to inhibit the release log long-lived soluble species such as Tc, U, Np, I.	H	Lack of DOE-approved PA would delay the planned 2005 startup or cause the Program to significantly change its direction and mission.	Several steps are being taken: <ul style="list-style-type: none"> • Develop durable waste form • Collect field data to support a focused PA • Investigate removal of offending species • Develop a chemical binder or matrix for the waste • Provide engineering barriers
M	The TPA funding profile may be inadequate to support the construction and operation of the Low-Level Waste Vitrification Facility (i.e. a \$500 million lightly-shielded facility)	M	The facility startup could be delayed several years.	Provide required funding to support TPA schedule
M	The 2005 hot startup date is a "demand schedule," which forces the development of key activities on a parallel path	M	Failure of a step could have more serious consequences to the overall Program cost and schedule. It will also cause the development of some activities without complete data (i.e. Conceptual Design without knowing the melter selected)	Significant management attention will be needed to ensure that work scope is focused, information is rapidly shared and critical tasks are completed on time

Type of Risk key:
P = Programmatic
M = Management
T = Technical

6.0 REFERENCES

- 53 CFR 12449, "Final Environmental Impact Statement for the Disposal of Hanford Defense, High-Level, Transuranic, and Tank Wastes, Hanford Site, Richland, Washington; Record of Decision," *Federal Register*, Vol. 53, No. 72, pages 12449-12453, U.S. Department of Energy, Washington D.C.
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- WAC, 1986, "Dangerous Waste Regulations," WAC 173-303, Olympia, Washington.