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Hanford Waste Vitrification Systems Risk Assessment Action Plan

W. C. Miller

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Westinghouse Hanford Company
P.O. Box 1970
Richland, Washington 99352

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HANFORD WASTE VITRIFICATION SYSTEMS RISK ASSESSMENT

ACTION PLAN

REVISION 0

NOVEMBER 16, 1990

W C Miller

W. C. Miller, Manager
Hanford Waste Vitrification Systems Risk
Assessment Team
Westinghouse Hanford Company

11/16/90
Date

C M Cox

C. M. Cox, Manager
Waste Vitrification Division
Westinghouse Hanford Company

11/16/90
Date

J. L. McElroy, Manager
Waste Technology Center
Pacific Northwest Laboratories

11/16/90
Date

J. H. Anttonen, Project Manager
Vitrification Project Office
Richland Operations Office
Department of Energy

11/16/90
Date

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HANFORD WASTE VITRIFICATION SYSTEMS RISK ASSESSMENT ACTION PLAN

ABSTRACT

Recent events in the Hanford waste storage tanks and delays in the startup of U.S. Department of Energy vitrification plants suggest that the schedule for waste vitrification activities at the Hanford Site should be reexamined. As a result, a Hanford Waste Vitrification Systems Risk Assessment will be performed to identify significant risks associated with the vitrification of Hanford high-level and transuranic wastes. This document defines the purpose, scope, plan of execution, responsibilities, reporting requirements, and preliminary schedule and cost estimate to complete this assessment.

The study will identify and evaluate uncertainties, quantify potential consequences from these uncertainties, and identify the risks to successful completion of the Hanford vitrification mission. Waste characterization, retrieval, pretreatment, and vitrification will be addressed. Uncertainties associated with the vitrification of double-shell and single-shell tank wastes and cesium and strontium capsules, as well as a limited assessment of the grouting of low-level wastes, will be defined. Technical, regulatory (safety and environmental), and programmatic (cost and schedule) uncertainties will be defined. Recommendations for mitigating strategies and assessments of technical alternatives will be made to reduce substantial risks.

The study began in October 1990. Preliminary results will be provided in December 1990 to January 1991, and a final report, approved by the U.S. Department of Energy-Richland Operations Office, is expected to be issued in June 1991.

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1.0 PURPOSE

Recent events in the Hanford Site waste storage tanks, delays in the startup of other U.S. Department of Energy (DOE) vitrification plants, and the yet-to-be-determined scope of future Hanford vitrification missions suggest that the schedule for Hanford waste vitrification activities, including the construction of the Hanford Waste Vitrification Plant (HWVP), be reexamined. Waste in some of the Hanford double-shell storage tanks is known to generate hydrogen. The start of hot operations of the Defense Waste Processing Facility (DWPF), the predecessor waste vitrification plant to the HWVP located at the DOE Savannah River Site, has been delayed. These events raise uncertainties as to the present knowledge of waste composition and the suitability of vitrification processes. Questions have been raised whether the acquisition of additional Hanford waste characterization data or startup information from the DWPF could dictate changes to the pretreatment or HWVP processes, or if possible future missions could significantly change the current HWVP design basis.

As a result, a Hanford Waste Vitrification Systems Risk Assessment will be performed to identify and evaluate all significant uncertainties associated with the vitrification of Hanford high-level and transuranic wastes. This study will quantify potential consequences from these uncertainties and assess their impacts. Technical, regulatory (safety and environmental), and programmatic (cost and schedule) uncertainties which could affect successful completion of the vitrification mission at Hanford, within prescribed performance, cost, and schedule limitations, will be considered. The results of the study will be used to reevaluate current planning and to refine the schedule for the Hanford vitrification activities, including the construction of the HWVP [currently scheduled to begin in July 1991 in the Tri-Party Agreement (Ecology 1989)], in an effort to eliminate any excessive risks identified.

2.0 SCOPE

2.1 SCOPE INCLUDED

The study will specifically assess the uncertainties to successful completion of the following Hanford vitrification mission objectives.

- Comply with environmental and safety regulations.
- Complete construction and startup of the waste retrieval and pretreatment projects and the HWVP Project on schedule and within budget. Further, achieve the required operational performance without major process or design changes due to new or emerging data from other U.S. vitrification sites or the Defense High-Level Waste Technology Program(s).

- Pretreat the wastes to meet the composition limits defined in the HWVP feed specification.
- Provide pretreated feed for hot startup of HWVP, and maintain continuous or nearly continuous pretreated feed of double-shell tank (DST) wastes to HWVP.
- Produce a glass waste form that meets waste acceptance criteria.
- Ensure the HWVP design does not preclude the vitrification of other waste types not currently within the HWVP Project scope, such as single-shell tank (SST) wastes and cesium and strontium capsules.

Other objectives may be identified during the performance of the study.

All major vitrification activities associated with Hanford wastes will be considered in this assessment, including the following:

- Waste characterization
- Retrieval from the storage tanks
- Pretreatment to separate the waste into high- and low-level fractions
- Vitrification of the high-level waste fraction
- Related activities, such as grouting of the low-level waste, to the degree they could adversely affect the vitrification mission objectives previously stated.

The study will identify uncertainties in the development, design, construction, and operations of Hanford vitrification facilities that could adversely impact mission objectives. A systems analysis of the major vitrification activities will be performed to assess the potential impacts of the uncertainties on meeting mission objectives, and to quantify these potential impacts. The timing to resolve these uncertainties will be evaluated with respect to the current schedules to identify potential changes that would reduce risks to acceptable levels. Alternatives to the currently defined technical approaches for the vitrification activities will not be explicitly identified in the study, but significant risks will be identified for further evaluation and optimization.

Specific assessments will be performed to ensure all major uncertainties are identified. Examples are noted as follows. The study will examine the planning and status for waste characterization activities to assess the ability of pretreatment processes to meet HWVP feed requirements. Emphasis will be placed on how uncertainties (or unknowns) related to the waste content could potentially affect the suitability of pretreatment processes and the waste form qualification process for the glass. In addition, the complexity of the chemical processes, the maturity of the technology, the compliance of the current design criteria to existing DOE, federal, and state requirements, the level of design definition, the capability to support safe and reliable facility operations, and the state of development of safety and environmental

documentation [e.g., safety analyses reports, environmental permit applications, and National Environmental Policy Act (NEPA) documents] will be addressed.

Other specific assessments will include a comparison of the waste vitrification activities and facilities at the Savannah River, West Valley, and Hanford Sites. The goal will be to identify potential impacts on the Hanford vitrification activities from problems identified at the other vitrification facilities. Risks associated with the use of existing Hanford facilities for major vitrification activities will be identified. In addition, the possible impacts of potential future missions, including vitrification of Hanford SST wastes and cesium and strontium capsules, on the HWVP design will be identified.

The study will determine if there is a significant decrease in risk associated with the construction of the HWVP as a result of increased experience from the startup and operation of other vitrification facilities, primarily the DWPF, as well as from the progression of other Hanford vitrification activities. The study will also address risks associated with DST utilization to determine if there is an impact to vitrification activities resulting from full utilization of all available DST storage space due to delays in the vitrification and/or grouting activities.

To the maximum extent possible, the study will make use of existing documentation and previous or current assessments. For example, DOE's independent review team assessment of the pretreatment activities performed in October and November 1990, will be used as a key element in the evaluation of the pretreatment program.

2.2 SCOPE LIMITATIONS

Recommendations to refine the vitrification program schedules will be developed. Recommendations for assessments of technical alternatives to the baseline technology approach will also be developed, as appropriate. However, specific recommendations on the implementation of process or design alternatives are beyond the scope of this study.

Because vitrification is a prime candidate for ultimate disposal of Hanford wastes other than those currently contained in the double-shell storage tanks, such as SST wastes and the cesium and strontium capsules, this study will assess the possible impacts of these potential future missions on the HWVP design and glass technology. However, because no decision has been made to include these additional wastes in the vitrification mission, the assessment of these waste types will only address the capability and related uncertainties associated with the vitrification of these waste types in the HWVP, and will not include an assessment of all aspects or alternatives for disposal of the SST wastes and cesium and strontium capsules. Potential major modifications to the HWVP design to accommodate these future missions will be identified.

The schedule for grouting of the low-level fraction of the liquid wastes affects the availability of double-shell storage tank space and could impact the vitrification activities. Therefore, the grout program will be included

in the study. Coverage will be limited to an assessment of tank space and pretreatment impacts resulting from uncertainties in the waste composition in the storage tanks, uncertainties in the feed specification for grout due to environmental regulation considerations, and uncertainties in the schedule for the grout program.

The interim storage of vitrified waste in sealed canisters at the Hanford Site will not be addressed by the study because the risks related to storage of the canisters are estimated to be insignificant compared with the other vitrification activities.

2.3 DELIVERABLE

A final report will be prepared documenting the approach and findings from this assessment. This report will be subject to approval by U.S. Department of Energy-Richland Operations Office (DOE-RL) and concurrence by U.S. Department of Energy-Headquarters (DOE-HQ).

3.0 PLAN OF EXECUTION

The major activities for this study include the following.

- Prepare an action plan.
- Establish the assessment team.
- Prepare a detailed work plan.
- Prepare the systems analysis statement of work (SOW).
- Select a systems analysis contractor.
- Assemble background information and documentation.
- Perform an analysis of current programs, technologies, designs, etc.
- Identify uncertainties and perform the impact analysis.
- Prepare the final report.
- Obtain DOE-HQ review and concurrence.

Each of these activities is discussed in the following subsections.

3.1 PREPARE ACTION PLAN

This Action Plan defines the scope, plan of execution, responsibilities, summary schedule, and rough-order-of-magnitude cost estimate for the study. A draft work breakdown structure (WBS) is included (Appendix A).

The plan will be reviewed and approved by Westinghouse Hanford Company (Westinghouse Hanford), Pacific Northwest Laboratory (PNL), and the DOE-RL Vitrification Project Office (VPO). The Action Plan will be provided by DOE-RL to DOE-HQ for their information.

The deliverable for this activity is this document.

3.2 ESTABLISH ASSESSMENT TEAM

The systems risk assessment will be conducted as a project with a task-force type of organizational structure. Hanford contractor and DOE-RL personnel will be assembled into teams to direct the study, collect data related to each vitrification activity, interface and participate with the analysis contractor in the performance of the study, review the results of the contractor's analyses, develop conclusions and recommendations, and present the findings to DOE and Hanford contractor management. The teams will consist of Westinghouse Hanford, PNL, and support contractor personnel as performers, and DOE-RL program management personnel.

The team members will represent each vitrification activity, including waste characterization, retrieval, pretreatment, and vitrification. Collectively, the task force will include expertise in technology, process engineering, project engineering, operations, safety, environmental engineering, systems analysis, and program planning. Expertise from the SST waste program will also be included in the team.

The task force will be lead by a project manager, and will be subdivided into three teams, each with a team leader. The SST waste team will be responsible for identifying and characterizing the uncertainties related to SST waste, and providing input to the systems analysis and the final report. The DST waste team similarly will be responsible for identifying and characterizing the uncertainties related to DST waste, and providing input to the systems analysis and the final report. The analysis and documentation team will be responsible for providing the day-to-day interface with the systems analysis contractor, preparing the final report, and cost and schedule planning and reporting.

Completion of this task will be demonstrated by having the appropriate staff identified and functioning as team members.

3.3 PREPARE WORK PLAN

A work plan will be developed which defines the specific work activities and responsibilities, and provides detailed schedule and cost information. Reviews will be performed by all participating contractors and DOE-RL.

Deliverables for this activity include a DOE-RL approved Summary Schedule (Level 1), a Westinghouse Hanford-approved Level 3 Schedule, a Westinghouse Hanford-approved Cost Account Authorization, a Westinghouse Hanford-approved Cost Account Plan, and an approved Change Request to fund the work.

3.4 PREPARE SYSTEMS ANALYSIS STATEMENT OF WORK

An SOW will be prepared to define the specific work scope for the systems analysis contractor. The SOW will define the scope, activities, deliverables, and schedule for the completion of the tasks to be performed by the contractor. Reviews of the SOW will be performed by all participating contractors and DOE-RL.

The deliverable for this activity is a Westinghouse Hanford-approved SOW.

3.5 SELECT SYSTEMS RISK ANALYSIS CONTRACTOR

A support contractor will be selected to perform the systems risk analysis. A list of available contractors will be assembled and their capabilities evaluated to identify qualified contractors. Only contractors who currently have contracts with Westinghouse Hanford, PNL, or DOE-RL will be considered to expedite the selection of a contractor and the initiation of the study. The final selection of the contractor will be made based on experience and capabilities, availability of qualified personnel to meet the schedule, and cost. The draft SOW will be reviewed with the selected contractor and a cost estimate will be prepared by the selected contractor for the work.

Early input will be obtained from the selected contractor on the methodology to be used in the assessment to ensure proper integration of the tasks with the analysis.

The deliverable for this activity is the selection of the contractor and the completion of all contract-related documentation needed to initiate the work.

3.6 ASSEMBLE BACKGROUND INFORMATION AND DOCUMENTS

This activity includes the identification and accumulation of available documents that provide objectives and descriptions of the vitrification activities, scope and status of the activities, criteria documents, related safety assessments, safety analysis reports, environmental impact statements and other environmental documents, relevant studies of key issues, key design documents, and other documents to provide the basis for the identification of uncertainties and the assessment of impacts. Documentation for each of the four major DST waste types, all the SST wastes, and each of the major vitrification activities will be identified and cataloged.

The deliverable for this activity is a collection of related documents for use by the Hanford team and the analysis contractor. All documents referenced in the final report will be cleared for public release during the preparation of the report.

3.7 PERFORM ASSESSMENT

This activity includes all the tasks to assess the status of the vitrification activities and to identify uncertainties. Each task will be

performed for each DST and SST waste type, where applicable. The major tasks include the following.

- Review documents and plans.
- Review candidate SST waste vitrification scenarios.
- Review cesium and strontium capsule vitrification scenarios.
- Define processing system bases.
- Identify uncertainties and unknowns by vitrification activity and waste type.
- Assess process complexity and technology maturity.
- Assess criteria compliance to DOE Orders and state and federal regulations.
- Assess level of design definition.
- Assess capability to support safe and reliable operations.
- Assess state of development of safety and environmental documentation.
- Compare Savannah River, West Valley, and Hanford programs and facilities.
- Assess uncertainties with use of existing facilities.
- Assess programmatic uncertainties.
- Assess waste storage tank utilization uncertainties.

These tasks and deliverables are described below.

3.7.1 Review Documents and Plans

The documents identified in Subsection 3.6 will be reviewed to gain familiarity with the vitrification activities, identify missing information that needs to be obtained or developed, and establish the basis for the follow-on tasks to complete the risk assessment. This task will include a review of scope, objectives, functions, and requirements to ensure the activities are adequately defined. Interviews will be performed with knowledgeable personnel to become more familiar with the details of the vitrification activities and to discuss specific issues identified by the contractor and/or the Hanford team members.

The deliverable from this task is the identification of missing information and actions planned to obtain that information.

3.7.2 Review Candidate Single-Shell Tank Waste Vitrification Scenarios

Candidate scenarios for the vitrification of SST waste will be reviewed to understand the disposal strategies and alternatives for the various types of SST waste. Additional program details will be postulated or developed as necessary to define the candidates sufficiently to identify significant uncertainties that could impact the HWVP design if the decision is made to use the HWVP for the ultimate disposal of the SST high-level waste.

The deliverable from this task will be an assessment of the candidate approaches for vitrification of SST waste and the development of additional details as necessary to perform the risk assessment.

3.7.3 Review Candidate Cesium and Strontium Capsule Vitrification Scenarios

Candidate scenarios for the vitrification of cesium and strontium capsules will be reviewed to understand the disposal strategies and alternatives for these materials. Additional program details will be postulated or developed as necessary to define the candidates sufficiently to identify significant uncertainties that could impact the HWVP design if the decision is made to use the HWVP for the ultimate disposal of these capsules.

The deliverable from this task will be an assessment of candidate approaches for vitrification of cesium and strontium capsule materials and the development of additional details as necessary to perform the risk assessment.

3.7.4 Define Processing System Bases

Reference processing systems bases will be defined for SST and DST wastes, as well as cesium and strontium capsules, based on existing documentation and planning. These bases will define reference data on waste characterization, waste volumes, and treatment processes. Processing facilities will be defined for all significant operations. Baseline schedules will be defined.

The deliverable from this task will be reference systems bases for SST and DST wastes and for cesium and strontium capsules to be used in the systems risk analysis.

3.7.5 Identify Uncertainties and Unknowns by Vitrification Activity and Waste Type

Lists of potential uncertainties will be developed using the results of the review of the documentation, interviews with personnel, and the review of vitrification scenarios for SST waste and cesium and strontium capsules. The uncertainties will address each vitrification activity (i.e., characterization, retrieval, pretreatment, and vitrification), including uncertainties to achieve compliance with the waste acceptance process and related quality assurance requirements, for each of the major waste types. In addition, potential events that are non-mechanistic or are not presently considered

credible (unknowns), but could have significant impacts on the performance, cost, or schedule of the vitrification activities, will be identified for each activity and waste type. Uncertainties will be classified as technical, regulatory (safety or environmental), or programmatic (cost or schedule).

The assessment of uncertainties related to grout will be limited to an assessment of tank space and pretreatment uncertainties resulting from uncertainties in the waste composition in the storage tanks, uncertainties in the feed specification for grout due to environmental regulation considerations, and uncertainties in the schedule for the grout program.

In addition, uncertainties associated with removal of the DST waste heels will be identified. Decontamination and decommissioning options for the DSTs will not be addressed in the study, however.

The deliverable for this task is a list of uncertainties and unknowns associated with waste characterization, retrieval, pretreatment, vitrification, and grouting for each waste type.

3.7.6 Assess Process Complexity and Technology Maturity

Assessments of the complexity of the each of the major processes used in each vitrification activity will be developed based on a comparison with existing processes and technologies. Factors such as the extent of prior use in nuclear or commercial facilities and the number and uniqueness of major elements will be evaluated to establish a measure of the complexity of the processes. In addition, the depth and breadth of the technology that supports the major processes for each of the vitrification activities will be evaluated to establish an objective measure of the overall maturity of technology supporting each of the processes.

The deliverable for this task is a draft section of the final report which documents the approach and the findings from this assessment.

3.7.7 Assess Criteria Compliance to Orders and Regulations

Design criteria for each major Hanford vitrification facility will be reviewed to determine if appropriate safety and environmental regulations are being utilized in the design process. The design criteria documents for each of the major vitrification facilities will be examined to determine if applicable DOE Orders and federal and state regulations are properly referenced. Furthermore, the specific criteria will be compared to key DOE Orders and regulations, such as DOE Order 6430.1A, *General Design Criteria* (DOE 1989), to assess their compliance with the applicable Orders and regulations.

The deliverable for this task is a draft section of the final report which documents the approach and the findings from this assessment.

3.7.8 Assess Level of Design Definition

The level of completion of the designs for construction or modifications of each major Hanford vitrification facility will be reviewed to assess the degree of confidence in the maturity and completeness of the design approaches. In addition, planning documents will be reviewed to ensure appropriate planning is in place for design to ensure the overall schedule can be achieved. This task will include a review of the design status for each of the major facilities. Design criteria, documentation, and schedules will be reviewed to define the overall status of the design process.

The deliverable for this task is a draft section of the final report which documents the approach and the findings from this assessment.

3.7.9 Assess Capability to Support Safe and Reliable Operations

The capability for the facility designs to meet safety requirements and to support efficient and reliable operations will be reviewed to determine compliance with safety and operability requirements. This task will provide a review of each of the facility designs as currently defined in existing design documents to assess the inherent safety, reliability, and overall operability of each of the major facility designs. This will consider such factors as hazardous and radioactive material confinement barriers, ventilation systems, redundancy and separation of safety equipment, worker radiation exposure, and facility layout for efficient operations. Maintenance considerations in the design will also be assessed.

The deliverable for this task is a draft section of the final report which documents the approach and the findings from this assessment.

3.7.10 Assess State of Development of Safety and Environmental Documentation

The status of safety analysis and related documentation (e.g., safety analysis reports), NEPA documentation (e.g., environmental impact statements, environmental analyses, etc.), State Environmental Policy Act documentation, and Washington State environmental permit applications will be assessed for each vitrification activity. The assessment will determine if the proper documents are either completed or appropriately planned to support scheduled construction and operation, and assess their approval status.

The deliverable for this task is a draft section of the final report which documents the approach and the findings from this assessment.

3.7.11 Compare Savannah River, West Valley, and Hanford Programs and Facilities

Because of the similarity of both the vitrification programs and facilities at the Savannah River and Hanford Sites, the vitrification programs at the two sites will be compared to determine if there are major elements from the Savannah River program that are appropriate, but missing, from the

Hanford program. Furthermore, a comparison of the major facilities and key processes utilized for the vitrification programs at the two sites will be compared to document both similarities and differences. Current and evolving problems and uncertainties in the Savannah River program will be identified to assess their potential impacts to the Hanford program.

A limited comparison of the basic processes and process uncertainties will be made with the West Valley vitrification program for specific Hanford wastes that are comparable to those at West Valley.

The deliverable for this task is a draft section of the final report which documents the approach and the findings from this comparison.

3.7.12 Assess Uncertainties With Use of Existing Facilities

The Hanford pretreatment activities are based on the use of existing facilities, primarily B Plant and AR Vault, which were constructed approximately 45 years ago. This task will review existing documentation used to support the use of these facilities and update those assessments to current requirements and schedules. Key considerations include the ability to meet current safety and environmental regulations and requirements.

The deliverable for this task is a draft section of the final report which documents the approach and the findings from this assessment.

3.7.13 Assess Programmatic Uncertainties

Schedules and cost estimates for all major DST waste vitrification activities will be reviewed to determine significant programmatic (cost and schedule) uncertainties based on the identified technical and regulatory uncertainties. Uncertainties associated with providing pretreated DST waste feed to the HWVP to support startup and subsequent continuous, or nearly continuous, operation of HWVP will be identified. Existing independent program or project cost estimates and reviews, such as independent cost estimate reviews performed by DOE-HQ, will be used to the maximum extent practical. Activities not currently within the defined vitrification scope, such as SST wastes and cesium and strontium capsules, will be excluded from this assessment.

The deliverable for this task is a draft section of the final report which documents the approach and the findings from this assessment.

3.7.14 Assess Waste Storage Tank Utilization Uncertainties

The availability of double-shell storage tanks to support Hanford operations and waste cleanup activities will be assessed based on the Site waste management schedules. Uncertainties associated with Site operations and processing of DST and SST wastes which will impact storage tank availability will be identified to assess their impacts to the vitrification mission. In addition, the impact of delays in the vitrification or grouting missions on tank availability will also be assessed.

The deliverable for this task is a draft section of the final report which documents the approach and the findings from this assessment.

3.8 PERFORM ANALYSIS

This activity includes all the tasks required to provide quantitative definition of the risks. The major tasks include the following.

- Postulate consequences of uncertainties.
- Perform a systems risk analysis.
- Identify a schedule to resolve uncertainties.
- Define risks as a function of the schedule.
- Develop recommendations.
- Recommend additional assessments of technical alternatives.

Each of these tasks is described below.

3.8.1 Postulate Consequences of Uncertainties

The possible consequences of each uncertainty and unknown identified in the assessment will be postulated in order to identify the potential impacts that could occur. Potential changes to safety and environmental regulations will be assessed as possible uncertainties. The propagation of uncertainties through the various vitrification activities will be evaluated. These consequences will be quantified to identify potential technical, cost, or schedule impacts. Potential impacts to the design or construction of the HWVP will be specifically identified for possible future missions to vitrify the SST waste and the cesium and strontium capsules. In addition, impacts to pretreatment and vitrification activities due to the uncertainties in the grout program and the removal of the DST waste heels will be identified. Ranges will be used where the potential consequences have substantial breadth in impact.

This task will produce a description of potential consequences for each identified uncertainty and unknown and a description of the resultant range of potential impacts for each uncertainty. The deliverable for this task is a draft section of the final report which documents the approach and the findings from this assessment.

3.8.2 Perform Systems Risk Analysis

A systems model of the major vitrification processes and facilities will be developed to quantify the risks associated with vitrification of the Hanford wastes. Risks will be classified as technical, regulatory (safety or environmental), or programmatic (cost or schedule). Probabilities of each postulated consequence for the identified uncertainties will be estimated

using the best available information, including the judgment of knowledgeable individuals. Because the probabilities will be based on subjective information, probability ranges will be defined when a consensus cannot be established.

Risks will be ranked as major, moderate, or low. System analysis techniques will be applied to the consequences and probabilities to establish a quantitative level or range of potential impacts to successfully complete the mission objectives outlined in Section 1.0 for all major and moderate risks.

The deliverable for this task is a draft section of the final report which documents the approach and findings from the systems analysis, including a description of all risks.

3.8.3 Identify Schedule to Resolve Significant Uncertainties

Schedules will be reviewed to determine when each of the significant uncertainties will be resolved. If sufficiently detailed schedules do not exist for selected vitrification activities, estimates will be established based on the best available judgment of knowledgeable personnel.

The deliverable for this task is a tabulation of the projected schedule to resolve each of the major uncertainties and a definition of the bases for those schedules.

3.8.4 Define Risks as a Function of Schedule

The schedule to resolve each of the significant uncertainties will be compared with the vitrification activity schedules to determine if there are definitive points in the schedule when the major and moderate risks will be substantially reduced. The schedules will also be reviewed to determine potential cost or schedule improvements that could be achieved through changes to individual activities.

The deliverable for this task is a draft section of the final report which documents the change in the risks as a function of schedule.

3.8.5 Develop Recommendations

Potential mitigating strategies will be developed for high and moderate risks to adjust the priorities and modify the overall schedule for the vitrification activities based on the information generated in the systems risk assessment. Specific strategies will be recommended, including a recommendation for scheduled construction of the HWVP.

The deliverable for this task is a draft section of the final report which documents the recommended mitigating strategies.

3.8.6 Recommend Additional Assessments of Technical Alternatives

This assessment will not analyze technical alternatives to reduce or eliminate the technical risks, except those specifically related to schedule changes. It is anticipated, however, that potential areas for optimization will be identified. Recommendations for additional assessments of technical alternatives will be developed and included in the final report. Preliminary recommendations will be provided to responsible management as early as practical to allow additional assessments to begin expeditiously.

3.9 PREPARE REPORT

The results of the systems risk assessment will be documented in a final report. The document and all references will be cleared for public release. Supporting documents will be prepared by the Hanford and/or support contractor participants as necessary to document the details of individual assessments. The report will be reviewed by all involved organizations and approved by Westinghouse Hanford, PNL, and DOE-RL. An outline of the final report will be developed early in the performance of this study. The report will include the following:

- Description of the activities for the study
- Description of waste vitrification system elements and their interrelationships
- Brief description of waste vitrification activities and schedules
- Description of uncertainties and potential consequences
- Description of risk modelling technique(s)
- Description of risks
- Ranking of risks as high, moderate, or low, with high and moderate risks quantified
- Description of potential mitigating strategies for high and moderate risks
- Recommendations for mitigating strategies and additional assessment of technical risks, as needed.

Preliminary findings will be reported to support out-year budget planning. These findings will include the following:

- Brief description of waste vitrification system elements and interrelationships
- Brief description of significant uncertainties identified to date
- Qualitative description of risks

- Qualitative ranking of risks as high, moderate, or low
- Brief description of potential mitigating strategies for high and moderate risks.

3.10 U.S. DEPARTMENT OF ENERGY-HEADQUARTERS REVIEW AND CONCURRENCE

The final report will be transmitted to DOE-HQ for review and concurrence following approval by DOE-RL.

4.0 RESPONSIBILITIES

Overall responsibilities for the Hanford assessment team, the analysis contractor, an advisory board, and a peer review team are outlined below. The task force and the analysis contractor will perform the tasks as an integrated team, with individual tasks assigned where specific expertise is available, and others performed as a combined effort. A preliminary definition of responsibilities for specific tasks outlined in this Action Plan is given in Appendix B. These responsibilities will be suitably revised during the development of the work plan.

4.1 ASSESSMENT TEAM

The assessment team will consist of management, engineering, and scientific personnel from Westinghouse Hanford and PNL. In addition, individuals from other organizations may be utilized as necessary to provide an appropriate level of expertise in selected activities. Individuals from each of the major vitrification activities, including characterization, retrieval, pretreatment, and vitrification for both DST and SST wastes, will be included.

A project manager will be assigned to provide overall management of the system risk assessment. Team leaders will be assigned for SST waste, DST waste, and analysis and documentation. A DOE-RL program manager will be assigned to the project.

The assessment teams will have the responsibility to prepare the work plan; write the SOW for the risk analysis; select the risk analysis contractor; collect all available documents; perform several of the specific assessments; direct, and participate with, the analysis contractor in the details of the risk analysis; provide the interface between the risk analysis contractor and the site personnel; develop the recommendations from the assessment; and coordinate the preparation of the final report.

4.2 ANALYSIS CONTRACTOR

The systems risk analysis contractor will be selected from consultants or engineering support firms with existing contracts with Westinghouse Hanford, PNL, or DOE-RL to minimize the time to initiate the assessment.

The contractor will have the primary responsibility to perform the details of the systems risk analysis using the information provided by the assessment team. Several activities will be assigned to the contractor. The contractor will prepare much of the information to be published in the final report.

4.3 ADVISORY BOARD

An advisory board of knowledgeable senior management from Westinghouse Hanford, PNL, and DOE-RL will be established to review the approach and progress on the risk assessment. A representative from the Washington State Department of Ecology will participate as a member of the advisory board. Monthly briefings will be provided to the advisory board. The advisory board will also participate in the review of the preliminary findings and the final report.

4.4 PEER REVIEW TEAM

A team of experts will be assembled to provide periodic technical review of the preliminary findings of this assessment. Members will be independent of the assessment team, and will include experts from Westinghouse Hanford, PNL, and DOE-RL. This review team will also include experts or consultants independent of the Hanford Site. Potential sources include other DOE waste processing facilities, DOE national laboratories, and individual consultants. The team will specifically include a representative from the Savannah River Site. Review meetings will be scheduled approximately every 3 months. The peer review team will also review the draft final report.

5.0 ROUTINE REPORTING

A management report will be prepared monthly to document the status of the risk assessment and to provide early identification of any preliminary recommendations related to additional assessments of technical alternatives. Weekly management reports will also be prepared summarizing the status of key activities.

6.0 SCHEDULE

A summary schedule for the study is shown in Figure 1. Key milestones for the completion of the study are presented in Table 1.

A more detailed schedule will be developed in the work plan.

Figure 1. Hanford Waste Vitrification Systems Risk Assessment Summary Schedule.

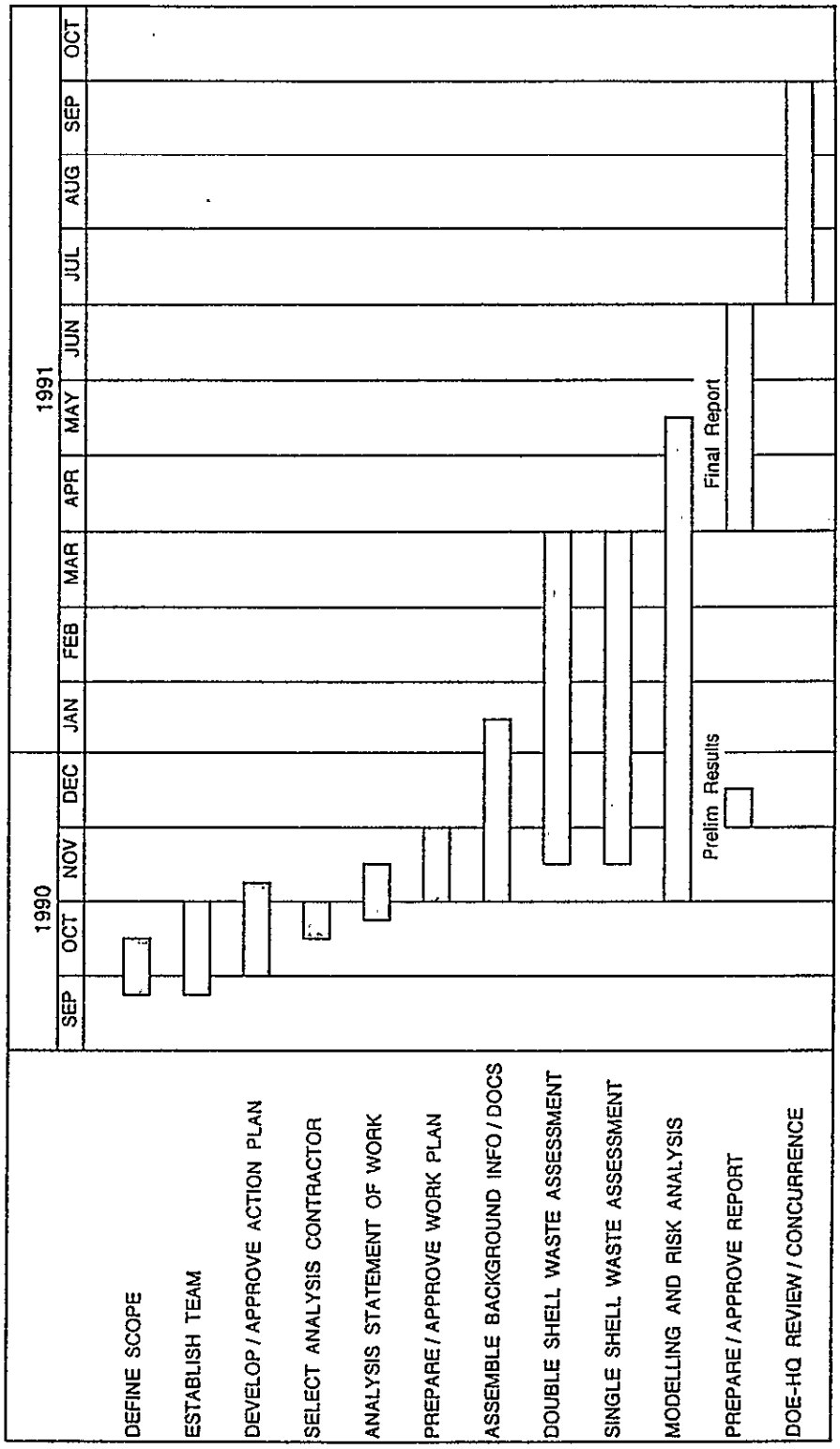

Table 1. Key Milestones.

Milestone	Date
Establish assessment team	10/31/90
Select systems risk analysis contractor	11/02/90
Complete detailed work plan	11/30/90
Issue preliminary findings	12/17/90
Complete systems risk analysis	05/17/91
Issue draft final report for review	05/22/91
Issue approved final report by DOE-RL (Revision 0)	06/28/91

7.0 COST ESTIMATE AND FUNDING SOURCE

This risk assessment is estimated to cost $1,750,000. The study will be funded from two funding sources: Waste Vitrification Program--$1,250,000; and Waste Management Program--$500,000.

Details of the cost estimate are given in Appendix C.

8.0 REFERENCES

Ecology, 1989, *Hanford Federal Facility Agreement and Consent Order*, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington.

DOE, 1989, *General Design Criteria*, DOE Order 6430.1A, U.S. Department of Energy-Headquarters, Washington, D.C.

9.0 GLOSSARY

ABBREVIATIONS, ACRONYMS, AND INITIALISMS

DOE	U.S. Department of Energy
DOE-HQ	U.S. Department of Energy-Headquarters
DOE-RL	U.S. Department of Energy-Richland Operations Office
DST	double-shell tank
DWPF	Defense Waste Processing Facility
HWVP	Hanford Waste Vitrification Plant
NEPA	National Environmental Policy Act
PNL	Pacific Northwest Laboratory
SOW	Statement of Work
SST	single-shell tank
VPO	Vitrification Project Office
Westinghouse Hanford	Westinghouse Hanford Company

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APPENDIX A

PRELIMINARY WORK BREAKDOWN STRUCTURE

NOTE: This work breakdown structure (WBS) is preliminary. A final WBS will be developed in the Work Plan.

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APPENDIX A

PRELIMINARY WORK BREAKDOWN STRUCTURE

1.0 Project Management

1.1 Management

1.1.1 Select Team

- Select Project Manager
- Define Team Structure
- Identify Program Contacts
- Select Contractor Leads
- Select Team Leaders
- Identify Safety/Environmental Members
- Select Remaining Team Members

1.1.2 Project Direction and Oversight

- Project Manager
- Clerical Support
- Program Contacts
- Safety/Environmental Members

1.2 Planning and Reporting

1.2.1 Action Plan

- Develop Preliminary Work Breakdown Structure
- Prepare Summary Schedule
- Prepare Preliminary Cost Estimate
- Identify Funding Source and Impacts
- Westinghouse Hanford/Pacific Northwest Laboratory/U.S. Department of Energy-Richland Operations Office Review of Action Plan
- Comment Resolution and Westinghouse Hanford/Pacific Northwest Laboratory Approval
- U.S. Department of Energy-Richland Operations Office Approval
- Submit to U.S. Department of Energy-Headquarters for Information

1.2.2 Work Plan

- Prepare Level 3 Schedule
- Prepare cost account authorization and cost account plan
- Prepare Change Request
- Westinghouse Hanford/Pacific Northwest Laboratory/ U.S. Department of Energy-Richland Operations Office Review of Work Plan
- Comment Resolution and Westinghouse Hanford/Pacific Northwest Laboratory Approval
- U.S. Department of Energy-Richland Operations Office Approval

1.2.3 Progress Reports

- Weekly Reports
- Monthly Reports
- Status Meetings
- Advisory Board Meetings
- Peer Review Meetings

1.3 Contractor Selection
- 1.3.1 Statement of Work
  - Prepare Draft Statement of Work
  - Westinghouse Hanford/Pacific Northwest Laboratory/ U.S. Department of Energy-Richland Operations Office Review of Statement of Work
  - Comment Resolution and Westinghouse Hanford Approval of Statement of Work
- 1.3.2 Select Contractor
  - Identify Candidates
  - Assess Capabilities/Identify Qualified Candidates
  - Review Qualified List with U.S. Department of Energy-Richland Operations Office
  - Review Draft Statement of Work with Contractor
  - Obtain Contractor Estimate
  - Select Contractor
  - Prepare Contract Documents

1.4 Assemble Background Information and Documents
- 1.4.1 Characterization
  - Double-Shell Tank Waste
  - Single-Shell Tank Waste
- 1.4.2 Retrieval
  - Double-Shell Tank Waste
  - Single-Shell Tank Waste
- 1.4.3 Pretreatment
  - Double-Shell Tank Waste
  - Single-Shell Tank Waste
- 1.4.4 Vitrification
  - Double-Shell Tank Waste
  - Single-Shell Tank Waste
- 1.4.5 Grout
- 1.4.6 Cesium and Strontium Capsule Disposal

2.0 Risk Assessment

2.1 Double-Shell Tank Waste Assessment
- 2.1.1 Characterization
  - Review Documentation
  - Define Processing Systems Bases
  - Identify Uncertainties and Unknowns
  - Assess Process Complexity and Technology Maturity
  - Assess Criteria Compliance to Orders and Regulations
  - Assess Level of Design Definition
  - Assess Capability to Support Safe and Reliable Operations
  - Assess Development of Safety and Environmental Documentation
  - Compare Savannah River Site and Hanford Programs and Facilities
  - Assess Programmatic Uncertainties
- 2.1.2 Retrieval
  - Review Documentation
  - Define Processing Systems Bases
  - Identify Uncertainties and Unknowns
  - Assess Process Complexity and Technology Maturity
  - Assess Criteria Compliance to Orders and Regulations

- Assess Level of Design Definition
- Assess Capability to Support Safe and Reliable Operations
- Assess Development of Safety and Environmental Documentation
- Compare Savannah River Site, West Valley, and Hanford Programs and Facilities
- Assess Programmatic Uncertainties

2.1.3 Pretreatment

- Review Documentation
- Define Processing Systems Bases
- Identify Uncertainties and Unknowns
- Assess Process Complexity and Technology Maturity
- Assess Criteria Compliance to Orders and Regulations
- Assess Level of Design Definition
- Assess Capability to Support Safe and Reliable Operations
- Assess Development of Safety and Environmental Documentation
- Compare Savannah River Site, West Valley, and Hanford Programs and Facilities
- Assess Uncertainties with Use of Existing Facilities
- Assess Programmatic Uncertainties

2.1.4 Vitrification

- Review Documentation
- Define Processing Systems Bases
- Identify Uncertainties and Unknowns
- Assess Process Complexity and Technology Maturity
- Assess Criteria Compliance to Orders and Regulations
- Assess Level of Design Definition
- Assess Capability to Support Safe and Reliable Operations
- Assess Development of Safety and Environmental Documentation
- Compare Savannah River Site, West Valley, and Hanford Programs and Facilities
- Assess Programmatic Uncertainties

2.2 Single-Shell Tank Waste Assessment

2.2.1 Characterization

- Review Documentation
- Define Processing Systems Bases
- Identify Uncertainties and Unknowns
- Assess Process Complexity and Technology Maturity
- Assess Level of Design Definition
- Assess Development of Safety and Environmental Documentation
- Assess Programmatic Uncertainties

2.2.2 Retrieval

- Review Documentation
- Define Processing Systems Bases
- Identify Uncertainties and Unknowns
- Assess Process Complexity and Technology Maturity
- Assess Criteria Compliance to Orders and Regulations
- Assess Level of Design Definition
- Assess Development of Safety and Environmental Documentation
- Assess Programmatic Uncertainties

2.2.3 Pretreatment

- Review Documentation
- Define Processing Systems Bases
- Identify Uncertainties and Unknowns

- Assess Process Complexity and Technology Maturity
- Assess Criteria Compliance to Orders and Regulations
- Assess Level of Design Definition
- Assess Development of Safety and Environmental Documentation
- Assess Uncertainties with Use of Existing Facilities
- Assess Programmatic Uncertainties

2.2.4 Vitrification

- Review Documentation
- Define Processing Systems Bases
- Identify Uncertainties and Unknowns
- Assess Process Complexity and Technology Maturity
- Assess Criteria Compliance to Orders and Regulations
- Assess Level of Design Definition
- Assess Development of Safety and Environmental Documentation
- Assess Programmatic Uncertainties

2.3 Grout Assessment

- Review Documentation
- Define Processing Systems Bases
- Identify Uncertainties and Unknowns
- Assess Criteria Compliance to Orders and Regulations
- Assess Development of Safety and Environmental Documentation
- Assess Programmatic Uncertainties

2.4 Cesium and Strontium Capsule Vitrification Assessment

2.4.1 Pretreatment

- Review Documentation
- Define Processing Systems Bases
- Identify Uncertainties and Unknowns
- Assess Process Complexity and Technology Maturity
- Assess Level of Design Definition
- Assess Development of Safety and Environmental Documentation

2.4.2 Vitrification

- Review Documentation
- Define Processing Systems Bases
- Identify Uncertainties and Unknowns
- Assess Process Complexity and Technology Maturity
- Assess Level of Design Definition
- Assess Development of Safety and Environmental Documentation

2.5 Waste Storage Tank Utilization Assessment

2.6 Risk Analysis

2.6.1 Postulate Consequences of Uncertainties
2.6.2 Perform Systems Risks Analysis
2.6.3 Identify Schedule to Resolve Uncertainties
2.6.4 Define Risks as a Function of Schedule

3.0 Final Report

3.1 Develop Recommendations

3.2 Recommend Additional Assessments of Technical Alternatives

3.3 Write Report

3.4 Graphics and Technical Editing

3.5 Review and Approval
- 3.5.1 Westinghouse Hanford/Pacific Northwest Laboratory/ U.S Department of Energy-Richland Operations Office Review
- 3.5.2 Peer Review
  - Review Meeting
- 3.5.3 Comment Resolution and Report Update
  - Final Editing
  - Westinghouse Hanford/Pacific Northwest Laboratory Approval
- 3.5.4 U.S. Department of Energy-Richland Operations Office Approval
- 3.5.5 Publish Initial Document (Revision 0)

4.0 U.S. Department of Energy-Headquarters Review and Concurrence

4.1 Initial Review
- 4.1.1 Review Meeting

4.2 Comment Resolution and Report Update
- 4.2.1 Final Editing

4.3 U.S. Department of Energy-Headquarters Approval

4.4 Publish Final Document (Revision 1)

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APPENDIX B

PRELIMINARY RESPONSIBILITIES

NOTE: The attached responsibilities matrix is preliminary. A final matrix will be developed in the Work Plan.

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APPENDIX B

PRELIMINARY RESPONSIBILITIES (sheet 1 of 5)

WBS	Task	Responsibility* WHC	PNL	Contr.
1.0	Project Management			
1.1	Management			
1.1.1	Select Team	L	S	
1.1.2	Project Direction and Oversight	L	S	
1.2	Planning and Reporting			
1.2.1	Action Plan	L	S	
1.2.2	Work Plan	L	S	S
1.2.3	Progress Reports	L	S	S
1.3	Contractor Selection			
1.3.1	Statement of Work	L	S	
1.3.2	Select Contractor	L		
1.4	Assemble Background Information and Documents			
1.4.1	Characterization			
	• Double-Shell Tank Waste	S	L	
	• Single-Shell Tank Waste	L	S	
1.4.2	Retrieval			
	• Double-Shell Tank Waste	L	S	
	• Single-Shell Tank Waste	L	S	
1.4.3	Pretreatment			
	• Double-Shell Tank Waste	L	S	
	• Single-Shell Tank Waste	L	S	
1.4.4	Vitrification			
	• Double-Shell Tank Waste	L	S	
	• Single-Shell Tank Waste	L	S	
1.4.5	Grout	L	S	
1.4.6	Cesium and Strontium Capsule Disposal	L	S	
2.0	Risk Assessment			
2.1	Double-Shell Tank Waste Assessment			
2.1.1	Characterization			
	• Review Documentation	S	L	S
	• Define Processing Systems Bases	S	L	
	• Identify Uncertainties and Unknowns	S	L	S
	• Assess Process Complexity and Technology Maturity	S	L	S
	• Assess Criteria Compliance to Orders and Regulations	S	S	L
	• Assess Level of Design Definition	L		
	• Assess Capability to Support Safe and Reliable Operations	L	S	
	• Assess Development of Safety and Environmental Documentation	L	S	
	• Compare Savannah River Site and Hanford Programs and Facilities	L	S	
	• Assess Programmatic Uncertainties	L	S	S

APPENDIX B

PRELIMINARY RESPONSIBILITIES (sheet 2 of 5)

WBS	Task	Responsibility* WHC	PNL	Contr.
2.1.2	Retrieval			
	• Review Documentation	L	S	S
	• Define Processing Systems Bases	L	S	
	• Identify Uncertainties and Unknowns	L	S	S
	• Assess Process Complexity and Technology Maturity	S	L	S
	• Assess Criteria Compliance to Orders and Regulations	S	S	L
	• Assess Level of Design Definition	L	S	
	• Assess Capability to Support Safe and Reliable Operations	L		S
	• Assess Development of Safety and Environmental Documentation	L		
	• Compare Savannah River Site, West Valley, and Hanford Programs and Facilities	L		
	• Assess Programmatic Uncertainties	L	S	S
2.1.3	Pretreatment			
	• Review Documentation	L	S	S
	• Define Processing Systems Bases	L	S	
	• Identify Uncertainties and Unknowns	L	S	S
	• Assess Process Complexity and Technology Maturity	S	L	S
	• Assess Criteria Compliance to Orders and Regulations	S	S	L
	• Assess Level of Design Definition	L	S	
	• Assess Capability to Support Safe and Reliable Operations	L		
	• Assess Development of Safety and Environmental Documentation	L		
	• Compare Savannah River Site, West Valley, and Hanford Programs and Facilities	L	S	
	• Assess Uncertainties with Use of Existing Facilities	L	S	S
	• Assess Programmatic Uncertainties	L		S
2.1.4	Vitrification			
	• Review Documentation	L	S	S
	• Define Processing Systems Bases	S	L	
	• Identify Uncertainties and Unknowns	L	S	S
	• Assess Process Complexity and Technology Maturity	S	L	S
	• Assess Criteria Compliance to Orders and Regulations	S	S	L
	• Assess Level of Design Definition	L		
	• Assess Capability to Support Safe and Reliable Operations	L		
	• Assess Development of Safety and Environmental Documentation	L		

APPENDIX B

PRELIMINARY RESPONSIBILITIES (sheet 3 of 5)

WBS	Task	Responsibility* WHC	PNL	Contr.
	• Compare Savannah River Site, West Valley, and Hanford Programs and Facilities	L	S	
	• Assess Programmatic Uncertainties	L		S
2.2	Single-Shell Tank Waste Assessment			
2.2.1	Characterization			
	• Review Documentation	L	S	S
	• Define Processing Systems Bases	L	S	
	• Identify Uncertainties and Unknowns	L	S	S
	• Assess Process Complexity and Technology Maturity	L	S	
	• Assess Level of Design Definition	L	S	
	• Assess Development of Safety and Environmental Documentation	L		
	• Assess Programmatic Uncertainties	L		S
2.2.2	Retrieval			
	• Review Documentation	L	S	S
	• Define Processing Systems Bases	L	S	
	• Identify Uncertainties and Unknowns	L	S	S
	• Assess Process Complexity and Technology Maturity	S	L	S
	• Assess Criteria Compliance to Orders and Regulations	S	S	L
	• Assess Level of Design Definition	L		
	• Assess Development of Safety and Environmental Documentation	L		
	• Assess Programmatic Uncertainties	L		S
2.2.3	Pretreatment			
	• Review Documentation	L	S	S
	• Define Processing Systems Bases	L	S	
	• Identify Uncertainties and Unknowns	L	S	S
	• Assess Process Complexity and Technology Maturity	S	L	S
	• Assess Criteria Compliance to Orders and Regulations	S	S	L
	• Assess Level of Design Definition	L		
	• Assess Development of Safety and Environmental Documentation	L		
	• Assess Uncertainties with Use of Existing Facilities	L	S	S
	• Assess Programmatic Uncertainties	L		S
2.2.4	Vitrification			
	• Review Documentation	L	S	S
	• Define Processing Systems Bases	S	L	
	• Identify Uncertainties and Unknowns	L	S	S
	• Assess Process Complexity and Technology Maturity	S	L	S

APPENDIX B

PRELIMINARY RESPONSIBILITIES (sheet 4 of 5)

WBS	Task	Responsibility* WHC	PNL	Contr.
	• Assess Criteria Compliance to Orders and Regulations	S	S	L
	• Assess Level of Design Definition	L		
	• Assess Development of Safety and Environmental Documentation	L		
	• Assess Programmatic Uncertainties	L		S
2.3	Grout Assessment			
	• Review Documentation	L	S	S
	• Define Processing Systems Bases	L	S	
	• Identify Uncertainties and Unknowns	L	S	S
	• Assess Criteria Compliance to Orders and Regulations	S	S	L
	• Assess Development of Safety and Environmental Documentation	L	S	
	• Assess Programmatic Uncertainties	L		S
2.4	Cesium and Strontium Capsule Vitrification Assessment			
2.4.1	Pretreatment			
	• Review Documentation	L	S	S
	• Define Processing Systems Bases	L	S	
	• Identify Uncertainties and Unknowns	L	S	S
	• Assess Process Complexity and Technology Maturity	S	L	S
	• Assess Level of Design Definition	L		-
	• Assess Development of Safety and Environmental Documentation	L		
2.4.2	Vitrification			
	• Review Documentation	L	S	S
	• Define Processing Systems Bases	S	L	
	• Identify Uncertainties and Unknowns	L	S	S
	• Assess Process Complexity and Technology Maturity	S	L	
	• Assess Level of Design Definition	L		
	• Assess Development of Safety and Environmental Documentation	L		
2.5	Waste Storage Tank Utilization Assessment	L	S	S
2.6	Risk Analysis			
2.6.1	Postulate Consequences of Uncertainties	L	S	S
2.6.2	Perform Systems Risk Analysis	S	S	L
2.6.3	Identify Schedule to Resolve Uncertainties	L	S	
2.6.4	Define Risks as a Function of Schedule	L	S	S
3.0	Final Report			
3.1	Develop Recommendations	L	S	
3.2	Recommend Assessments of Technical Alternatives	L	S	
3.3	Write Report	L	S	S
3.4	Graphics and Technical Editing	L		

APPENDIX B

PRELIMINARY RESPONSIBILITIES (sheet 5 of 5)

WBS	Task	Responsibility* WHC	PNL	Contr.
3.5	Review and Approval			
3.5.1	Westinghouse Hanford/Pacific Northwest Laboratory/U.S. Department of Energy-Richland Operations Office Review	L	S	S
3.5.2	Peer Review	L	S	S
3.5.3	Comment Resolution and Report Update	L	S	S
3.5.4	U.S. Department of Energy-Richland Operations Office Approval	L		
3.5.5	Publish Initial Document (Revision 0)	L		
4.0	U.S. Department of Energy-Headquarters Review and Concurrence			
4.1	Initial Review	L		
4.2	Comment Resolution and Report Update	L	S	S
4.3	U.S. Department of Energy-Headquarters Approval	L		
4.4	Publish Final Document (Revision 1)	L		

L = Lead
S = Support

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APPENDIX C

PRELIMINARY COST ESTIMATE

NOTE: The cost estimate in Table C-1 is preliminary. A final estimate will be developed in the Work Plan.

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Table C-1. Hanford Waste Vitrification Systems Risk Assessment Preliminary Cost Estimate. (sheet 1 of 3)

WBS	TITLE	WHC and PNL EX MM	WHC and PNL NEX MM	CONTRACT MM	($000)	Basis
1.0	PROJECT MANAGEMENT	13.2	9.0		$177	
1.1	Management	9.5	9.0		$138	
1.1.1	Select Team	0.5			$5	
1.1.2	Project Direction and Oversight	9.0	9.0		$132	
	- Project Manager	9.0	9.0		$132	1 mgr & sec 8 M + .33 m/M for 3 M
1.2	Planning and Reporting	2.7			$29	
1.2.1	Action Plan	0.5			$5	
1.2.2	Work Plan	1.3			$14	1 scheduler 1 M and 1 analyst 1 W
1.2.3	Progress Reports	0.9			$10	1 engr @ .1 m/M for 9 M
1.3	Contractor Selection	1.0			$11	
1.3.1	Statement of Work	0.5			$5	
1.3.2	Select Contractor	0.5			$5	
2.0	RISK ASSESSMENT	72.5	1.0	19.5	$1,111	
2.1	Double Shell Tank Waste Assessment	27.0	0.5	3.5	$350	
	- Team Leader	8.0			$85	1 engr for 8 M
	- Assemble Background Info and Documents	2.0	0.5		$23	4 engr 2 W & 2 W clerk
2.1.1	Characterization	1.0		0.5	$19	1 engr 1 M + 2 W contract
2.1.2	Retrieval	2.0		1.0	$38	1 engr 2 M + 1 M contract
2.1.3	Pretreatment	7.0		1.0	$92	1 engr 5 M & 2 engr 1 M + 1 M contract
2.1.4	Vitrification	7.0		1.0	$92	1 engr 3 M & 4 engr 1 M + 1 M contract
2.2	Single Shell Tank Waste Assessment	21.0	0.5	3.0	$277	
	- Team Leader	8.0			$85	1 engr for 8 M
	- Assemble Background Info and Documents	2.0	0.5		$23	4 engr 2 W & 2 W clerk
2.2.1	Characterization	1.0		0.5	$19	1 engr 1 M + 2 W contract
2.2.2	Retrieval	2.0		0.5	$30	1 engr 2 M + 2 W contract
2.2.3	Pretreatment	4.0		1.0	$60	1 engr 2 M & 2 engr 1 M + 1 M contract
2.2.4	Vitrification	4.0		1.0	$60	1 engr 2 M & 2 engr 1 M + 1 M contract

Table C-1. Hanford Waste Vitrification Systems Risk Assessment Preliminary Cost Estimate. (sheet 2 of 3)

WBS	TITLE	WHC and PNL EX MM	WHC and PNL NEX MM	CONTRACT MM	($000)	Basis
2.3	Grout Assessment	1.5		0.5	$25	1 engr 1.5 M + 2 W contract
2.4	Cesium and Strontium Capsule Vit. Assessment	3.0		0.5	$41	3 engr 1 M + .5 M contract
2.5	Waste Storage Tank Utilization Assessment	2.0			$21	1 engr 2 M
2.6	Risk Analysis	18.0		12.0	$397	
	- Team Leader	6.0			$64	1 engr 6 M
2.6.1	Postulate Consequences of Uncertainties	6.0		2.0	$98	12 engr 2 W + 4 contract 2 W
2.6.2	Perform Systems Risk Analysis	4.0		9.0	$196	1 engr 2 M & 8 engr 2 W + 2 cont 3M & 4 cont 3 W
2.6.3	Identify Schedule to Resolve Uncertainties	1.0			$11	4 engr 1 W
2.6.4	Define Risks as a Function of Schedule	1.0		1.0	$28	4 engr 1 W + 2 contract 2 W
3.0	FINAL REPORT	13.2	4.0	5.0	$242	
	- Team Leader	2.0			$21	1 engr 2 M
3.1	Develop Program Recommendations	1.0			$11	4 engr 1 W
3.2	Recommend Assessments for Program Optimiz	1.0			$11	4 engr 1 W
3.3	Write Report	3.0		3.0	$83	1 engr 3 M + 3 contract 1 M
3.4	Graphics and Technical Editing	1.0	2.0		$19	1 tech ed 1 M, 1 graphics 1 M & 1 M word proc
3.5	Review and Approval	5.2	2.0	2.0	$98	
3.5.1	WHC/PNL/DOE-RL Review	2.0		1.0	$38	8 peer reviewers 1 W + 4 contract 1 W
3.5.2	Comment Resolution and Report Update	2.7	1.0	1.0	$50	
	- Comment Resolution	2.0		1.0	$38	8 engr 1 W + 4 contract 1 W
	- Final Editing	0.5	1.0		$9	1 tech ed .5 M, 1 graphics .5 M & .5 M word proc
	- WHC/PNL Approval	0.2			$2	
3.5.3	DOE-RL Approval	0.3			$3	
3.5.4	Publish Initial Document (Rev. 0)	0.3	1.0		$7	1 tech ed 1 W, 2 W word proc, & 2 W publ

Table C-1. Hanford Waste Vitrification Systems Risk Assessment Preliminary Cost Estimate. (sheet 3 of 3)

WBS	TITLE	WHC and PNL		CONTRACT MM	($000)	Basis
		EX MM	NEX MM			
4.0	DOE-HQ REVIEW AND CONCURRENCE	2.6	1.5	1.5	$59	
4.1	Initial Review	1.0		0.5	$19	4 engr 1 W + 2 contract 1 W
4.2	Comment Resolution and Report Update	1.0		1.0	$28	4 engr 1 W + 4 contract 1 W
4.2.1	Final Editing	0.3	0.5		$5	1 tech ed 1 W & 2 W word proc
4.3	DOE-HQ Approval	0.1			$1	
4.4	Publish Final Document (Rev. 1)	0.3	1.0		$7	1 tech ed 1 W, 2 W word proc, & 2 W publ
	SUBTOTALS	101.5	15.5	26.0	$1,590	
	CONTINGENCY (@10%)				$159	
	TOTAL				$1,749	--> SAY $1,750

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