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1. EDT 602811

2. To: (Receiving Organization) Distribution		3. From: (Originating Organization) Risk Assessment and Environmental Modeling		4. Related EDT No.: N/A													
5. Proj./Prog./Dept./Div.: RE&EM/HTS		6. Cog. Engr.: F. M. Mann		7. Purchase Order No.: N/A													
8. Originator Remarks: APPROVAL/RELEASE				9. Equip./Component No.: N/A													
				10. System/Bldg./Facility: N/A													
11. Receiver Remarks:				12. Major Assm. Dwg. No.: N/A													
				13. Permit/Permit Application No.: N/A													
				14. Required Response Date: 05-10-95													
15. DATA TRANSMITTED																	
(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	(F) Approval Designator	(G) Reason for Transmittal	(H) Originator Disposition	(I) Receiver Disposition									
1	WHC-SD-WM-PAP-062		0	Statements of Work for FY 1995 to 2000	NA	1											
16. KEY																	
Approval Designator (F)		Reason for Transmittal (G)			Disposition (H) & (I)												
1. S, Q, D or N/A (see WHC-CM-3-5, Sec.12.7)		1. Approval 2. Release 3. Information 4. Review 5. Post-Review 6. Dist. (Receipt Acknow. Required)			1. Approved 2. Approved w/comment 3. Disapproved w/comment 4. Reviewed no/comment 5. Reviewed w/comment 6. Receipt acknowledged												
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1	1	Cog.Eng. F. M. Mann	<i>F. M. Mann</i>	4/15/95	H0-36												
1	1	Cog. Mgr. B. N. Anderson	<i>B. N. Anderson</i>	4/19/95	H0-06												
		QA															
		Safety															
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18. F. M. Mann <i>F. M. Mann</i> 4/18/95 Signature of EDT Date Originator												19. G.F. Williamson <i>G.F. Williamson</i> 4-21-95 Authorized Representative Date for Receiving Organization		20. B. N. Anderson <i>B. N. Anderson</i> 4/19/95 Cognizant Manager Date		21. DOE APPROVAL (if required) Ctrl. No. ☐ Approved ☐ Approved w/comments ☐ Disapproved w/comments	

RELEASE AUTHORIZATION

Document Number: WHC-SD-WM-PAP-062, Rev. 0

Document Title: Statements of Work for FY 1995 to 2000

Release Date: April 24, 1995

**This document was reviewed following the
procedures described in WHC-CM-3-4 and is:**

APPROVED FOR PUBLIC RELEASE

WHC Information Release Administration Specialist:

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SUPPORTING DOCUMENT

1. Total Pages 206

2. Title

Statements of Work for FY 1995 to 2000

3. Number

WHC-SD-WM-PAP-062

4. Rev No.

0

5. Key Words

SOW, Hanford Low-Level, Tank Waste,
Performance Assessment

6. Author

Name: F. M. Mann

Fred M. Mann

Signature

Organization/Charge Code OM621/D44AB

7. Abstract

The activities and tasks needed to successfully prepare an interim, preliminary, and final performance assessment on the disposal of the low-level fraction of Hanford tank wastes are given. Included are analytic, experimental, computational, writing, and approval tasks. These statements of work will be revised annually.

8. RELEASE STAMP

<p>OFFICIAL RELEASE</p> <p>DATE APR 26 1995</p> <p>35 Station 21</p>
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**STATEMENTS OF WORK
FOR FY 1995 TO 2000**

June 15, 1994

Hanford Tank Low-Level Waste

Performance Assessment

Group

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MASTER

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**STATEMENT OF WORK
FOR FISCAL YEAR 1995 TO 2000**

INTRODUCTION**I. BACKGROUND**

This report contains the statements of work for fiscal year 1995 through the year 2000 of the Performance Assessment Project for the Hanford Tanks Low Level Glass Waste. There are three functions in this project:

1. Provide guidance from the performance assessment project to other parts of the low level waste project.
2. Prepare an interim performance assessment before construction begins on any low level waste facilities.
3. Prepare a final performance assessment (which is approved by DOE headquarters) prior to the beginning of construction of the low level waste disposal facility.

Appendix A provides a multi-year outline of activities and tasks in this project.

By DOE order 5820.2A (and its proposed successor 5820.2B), before any low-level waste can be disposed, a performance assessment covering the disposal facility must be approved by DOE headquarters. The performance assessment is to provide "reasonable assurance" that the disposal activities will protect long-term human health and safety. Thus along with constraints imposed by the Safety Analysis Report, various state permits, financial matters, and management objectives, the constraints imposed by the performance assessment are a major driver in the low-level waste project.

II. GUIDANCE

Many of the criteria of various components of the low level waste projects are greatly influenced by analyses performed using performance assessment tools, since similar analyses will be used to provide "reasonable assurance". Examples of such components are:

1. Inventory of key radionuclides (which can affect the criteria for separation processes)
2. Glass rate releases (which can affect glass formulation activities)
3. Matrix and vadose zone retardation parameters (which can affect material selection)

4. Groundwater flow (which can affect site selection and groundwater monitoring).

Two activities are part of this function

1. Interim guidance
2. Long-term guidance.

Interim guidance (through the end of fiscal year 1995) begins to use data generated by the low level waste project to refine the range of parameters leading to a successful performance assessment. Besides knowing the likely important parameters in this performance assessment, decisions on disposal concepts, siting, and glass formulations will be being made by various other parts of the low level project.

Final guidance (starting in fiscal year 1996) fine tunes the data ranges so that improved decisions can be made to lower costs or to improve performance.

III. INTERIM PERFORMANCE ASSESSMENT

The Peer Review Panel (the body established by DOE headquarters to judge the technical adequacy of the performance) has determined the performance assessment must contained site-specific and waste form-specific data. It will not be possible to obtain such specific data before the start of construction of the low level waste facilities, presently scheduled for 1997. Instead a performance assessment based on as much specific data as possible will be created using the methods and techniques to be used in the final performance assessment. This performance assessment is designed to demonstrate prior to any construction that there will be a high likelihood that the final performance assessment will be approved.

The activities will be

1. Determine performance objectives (activity 2.1.1)
2. Determine exposure scenarios (activity 2.1.2)
3. Select tools and codes (activity 2.1.3)
4. Gather data (activities 2.1.4 through 2.1.C)
5. Perform calculations and analyses (activity 2.2)
6. Write performance assessment (activity 2.3)
7. Perform review (activity 2.4).

Performance objectives are the criteria against which the postulated performance of the disposal facility is judged. Once these criteria are established, then the various pathways (also known as scenarios) that the waste can travel to the environment and then can cause exposure to humans can be determined. Once the pathways are selected, then the criteria for the tools and codes to be used in the analyses can be determined. Finally the tools and codes are chosen.

A major activity is the gathering and more importantly the selection of data to be used by the tools and codes in the analyses. Each item of data must be

justified. Some will be justified by experiment, others by analysis, and some on expert opinion. The types of data needed for a performance assessment include:

1. The amount of material in the waste (inventory)
2. How quickly the material leaves the waste form (release rates)
3. How fast the water carrying the material flows downward from the waste form into the ground water (recharge and hydraulic data)
4. How fast (relative to the water flow) does the material effectively move (chemical retardation factors)
5. How fast the ground water moves and how does that water get to the surface
6. Converting material concentrations at a well or in the air to dose or human health effects.

After the tools and data have been selected, then final calculations and analyses can start. This should happen in FY 1995. Sections of the interim performance assessment will be written and reviewed. Because the interim performance assessment is not formerly part of the DOE process, it is probable that a body other than the Peer Review Panel (but comparable in expertise) will review the entire document and process.

IV. PRELIMINARY AND FINAL PERFORMANCE ASSESSMENT

By DOE Order 5820.2a (and its draft successor 5820.2B) before waste can be disposed in a facility, the performance assessment that provides reasonable assurance that the disposal action will not harm long-term human health and safety must be approved by DOE headquarters. The new draft order also requires that the local DOE field office approve the preliminary performance assessment before construction can begin on the disposal facility and that updated performance assessments be issued periodically with the last performance assessment being the final closure document.

Thus performance assessments are the among the key documents in the life of a disposal facility.

The main activities in the preliminary and final performance assessment are:

1. Update performance objectives from interim PA (activity 3.1.1)
2. Update scenarios from interim PA (activity 3.1.2)
3. Tool selection (activity 3.1.3)
4. Obtain data for preliminary PA (activities 3.1.4 through 3.1.C)
5. Calculate response and document for preliminary PA (activity 3.2)
6. PRP review of Preliminary PA (activity 3.3)
7. Obtain data for final PA (activity 3.4)

8. Calculate responses and document for final PA (activity 3.5)
9. Internal review (activity 3.6), and
10. PRP/HQ review and approval (activity 3.7).

The pattern of activities follow that of the interim performance assessment, but the emphasis is strongly on justification. Because of the long-lead times for gathering data, activities in the "obtaining data for preliminary performance assessment" are starting this fiscal year. The other activities (see appendix A) will follow in later years.

V. CONTENTS OF THIS REPORT

The remainder of this report contains statements of work for each of the activities and tasks in the performance assessment area in fiscal years 1995 through 2000. The format and contents for each activity and task are the same and are described in Appendix B.

1.2 Interim Guidance

I. SUMMARY

Using tools that will be use in performance assessments, provide guidance after July 1993 and in FY 1995 to other parts of the low-level waste project on how their choices will affect the long-term behavior of the system.

II. GENERALA. Background

One of the main goals of the low-level waste disposal project is to dispose of low-level waste from the Hanford tanks in a manner that provides long-term protection to human health and safety. Thus to understand how each component fits into the system, it must be determine what impact its has on the long-term performance of the system. Using the tools of performance assessment, ranges of acceptable performances can be estimated which can allow early setting of component performance specifications.

B. Organization

The responsible organization will be the Environmental Risk and Performance Assessment Section of the Westinghouse Hanford Company, John Rawlins, Manager. The cognizant scientist will be Fred Mann. Others in the team will represent the major analysis functions in the performance assessment (dosimetry - Paul Rittmann, groundwater transport - Bill McMahon, inventory - Frank Schmittroth, vadose zone transport - Mel Piepho, and waste form - Pete McGrail)

C. Vision

By providing guidance to other parts of the project as their plans start to firm and their activities gear up, proper attention can be applied to critical components and make determinations of needed specifications.

D. Objectives

This activity will advise other parts of the project (project functions and requirements, site selection, waste form selection, separations technology selection, and design criteria) of major problems important in system long-term performance.

E. Deliverables

1. Letter report documenting advice concerning important parameters [groundwater flow, prior contamination, and quality of existing hydrologic parameters] in site selection (Sept. 30, 1995)

2. Letter report documenting advice concerning important parameters [release rate, recharge, vault barriers] in the engineered system (Sept. 30, 1995)
3. Letter report documenting advice concerning important parameters [size, shape, temporal release rate] in glass specifications (Sept. 30, 1995)
4. Letter report documenting advice concerning important parameters [K_d , hydrologic parameters] in matrix specifications (Sept. 30, 1995)
5. Letter report documenting advice concerning important parameters [critical isotopes and their maximum amounts] in inventory and chemical/physical processing (Sept. 30, 1995)
6. Letter report discussing status of the sensitivity of uncertainties to results coming from calculations (Sept. 30, 1995)

III. TASK DESCRIPTIONS

A. Summary list of tasks

1. Advise site selection using PA methods
2. Advise system functions and requirements using PA methods
3. Advise glass development using PA methods
4. Advise matrix development using PA methods
5. Advise characterization and process engineering using PA methods
6. Advise on sensitivity of answers to uncertainties
7. Manage performance assessment activities.

B. Advise site selection using PA methods

This continues the corresponding item under early guidance. Feedback concerning the value of the early guidance will determine the tasks in this activity.

1.9 man-months of professional time costing \$25,000 is the expected to be required.

C. Advise system functions and requirements using PA methods

This continues the corresponding item under early guidance. Feedback concerning the value of the early guidance will determine the tasks in this activity.

4.3 man-months of professional time costing \$56,000 is the expected to be required.

D. Advise glass development using PA methods

This continues the corresponding item under early guidance. Feedback concerning the value of the early guidance will determine the tasks in this activity.

2.4 man-months of professional time costing \$30,000 is expected to be required. Also \$20,000 to cover PNL activities is expected.

E. Advise matrix development using PA methods

This continues the corresponding item under early guidance. Feedback concerning the value of the early guidance will determine the tasks in this activity.

3.2 man-months of professional time costing \$42,000 is expected to be required.

F. Advise characterization and process engineering using PA methods

This continues the corresponding item under early guidance. Feedback concerning the value of the early guidance will determine the tasks in this activity.

1.3 man-months of professional time costing \$25,000 is expected to be required.

G. Advise on sensitivity of answers to uncertainties

1. Detailed Description

Uncertainties arise from uncertainties in the scenarios (what will the land use really be?), uncertainties in the reliability of the models (how well does Darcy's law predict transport in the Hanford vadose zone?), as well as uncertainties in the data used in the model (how well do we know the value of the recharge?). The methodology for understanding these uncertainties, how they interact, and how they affect the final answer is a young, but important field.

The main contributor to this task will be Frank Schmittroth. All members of the team will assist.

2. Interfaces

The main interfaces will be those performing assessments here and off-site as well as the regulators and those who support them (for example, Sandia-Albuquerque).

The output of this ongoing task will feed all other tasks in the performance assessment project.

3. Standards

There are no standards in this area.

4. Quality Assurance

The letter report will be reviewed before issuance.

5. Schedule

The task will start August 1, 1994 with a letter report written by August 30, 1995. The report will be issued September 30, 1995. The task will continue until the end of the project.

6. Cost

1.9 man-months of professional time costing \$25,000 is expected to be required.

H. Manage performance assessment activities

1. Detailed Description

Management of the various tasks is necessary to insure that schedule is met and costs are minimized.

The main contributor to this task will be John Rawlins. Others aiding him will be Dana Ruane, Richard Karnesky, and Fred Mann.

2. Interfaces

The main interfaces will be those performing the tasks and those receiving the output of the tasks.

The output of this ongoing task will feed all other tasks in the performance assessment project.

3. Standards

There are no standards in this area.

4. Quality Assurance

None.

5. Schedule

On-going task.

6. Cost (FY 1995)

6.0 man-months of managerial time, 6.0 man-months of secretarial time, and 4.4 man-months of professional time costing \$211,000 is expected to be required.

\$100,000 of capital funds is requested to purchase 2 color desktop workstations (to replace monochrome workstations) and for a compute server.

Accepted:

Frederick M. Mann

Date: _____

1.3 Long-Term Guidance

I. SUMMARY

Using tools that will be use in performance assessments, provide guidance to other parts of the low-level waste project on how their choices will affect the long-term behavior of the system.

II. GENERALA. Background

One of the main goals of the low-level waste disposal project is to dispose of low-level waste from the Hanford tanks in a manner that provides long-term protection to human health and safety. Thus to understand how each component fits into the system, it must be determine what impact its has on the long-term performance of the system. Using the tools of performance assessment, ranges of acceptable performances can be estimated which can allow early setting of component performance specifications.

B. Organization

The responsible organization will be the Environmental Risk and Performance Assessment Section of the Westinghouse Hanford Company, John Rawlins manager. The cognizant scientist will be Fred Mann. Others in the team will represent the major analysis functions in the performance assessment (dosimetry - Paul Rittmann, groundwater transport - Bill McMahon, inventory - Frank Schmittroth, vadose zone transport - Mel Piepho, and waste form - Pete McGrail)

C. Vision

By providing guidance to other parts of the project as their plans start to firm and their activities gear up, proper attention can be applied to critical components and make determinations of needed specifications.

D. Objectives

This activity will advise other parts of the project (project functions and requirements, site selection, waste form selection, separations technology selection, and design criteria) of major problems important in system long-term performance.

E. Deliverables

Letter reports will be issued on topics and on a schedule that will be determined by the TWRS Low-Level Waste Program Office.

III. TASK DESCRIPTIONS

A. Summary list of tasks

- 1) Advise glass development using PA methods
- 2) Advise matrix development using PA methods
- 3) Advise characterization and process engineering using PA methods
- 4) Advise monitoring efforts
- 5) Advise on sensitivity of answers to uncertainties
- 6) Manage performance assessment activities.

B. Advise glass development using PA methods

The glass release rate is a major detriment on the performance of the disposal system. As more is learned about what affects the release rate (moisture, pH, chemical environment, stress) and by how much, the glass development team and the performance assessment team will interact to improve the system.

3.0 man-months of professional time costing \$39,000 is expected to be required each year. Also \$22,000 to cover PNL activities is also expected to be needed each year. This estimate is based on the importance of the details of the glass behavior to the performance assessment and the need to keep communication strong among the glass development groups.

C. Advise matrix development using PA methods

The matrix will greatly affect the transport of water and chemicals inside the engineered system and hence will also affect the environment that the glass will see. The glass development team and the performance assessment team will interact to achieve a better system.

4.2 man-months of professional time costing \$54,000 is the expected to be required each year. This estimate assumes that the matrix material will have important impacts to the performance assessment in the area of shedding water and limiting solute transport.

D. Advise characterization and process engineering using PA methods

The performance of the disposal system is linearly dependent on the inventory in the glass waste form. As the tanks are characterized, the pretreatment process better defined, and the melter performance measured, the performance assessment team can aid the engineers in tuning the various parts of the system to improve the system at lowest cost.

2.4 man-months of professional time costing \$31,000 is expected to be required each year. It is expected that pretreatment and melter operation operations will evolve through the design activities.

E. Advise monitoring efforts

RCRA requires that the ground water be monitored near the disposal facility. The performance assessment team will aid those developing the plan based on the predicted contaminant flows.

0.72 man-months of professional time costing \$9,000 is the expected to be required for the first 3 years and increasing to 3.0 man-months (costing \$39,000) in FY 1999 and 2000. The early effort is to provide preliminary guidance while in the last two years it is expected that more design work will be performed.

F. Advise on sensitivity of answers to uncertainties

Uncertainties arise from uncertainties in the scenarios (what will the land use really be?), uncertainties in the reliability of the models (how well does Darcy's law predict transport in the Hanford vadose zone?), as well as uncertainties in the data used in the model (how well do we know the value of the recharge?). The methodology for understanding these uncertainties, how they interact, and how they affect the final answer is a young, but important field.

The main contributor to this task will be Frank Schmittroth. All members of the team will assist.

3.6 man-months of professional time costing \$46,000 is expected to be required for the first three years. During the last two years, 0.11 man-months, costing \$1,000 will be needed. Uncertainty and sensitivity analyses will guide efforts in many areas. However, as the design nears completion, the need reduces to problems important for operation.

G. Manage performance assessment activities

Management of the various tasks is necessary to insure that schedule is met and costs are minimized.

6.0 man-months of managerial time, 6.0 man-months of secretarial time, and 6.0 man-months of professional time costing \$229,000 is expected to be required.

Capital costs of \$25,000 are requested in FY 1996, FY 1997, FY 1999, and FY 2000 to replace desktop computer equipment and \$100,000 in FY 1998 to replace the compute server.

Accepted:

Frederick M. MannDate:

2.1.1 Determine Performance Objectives for Interim Performance Assessment

I. SUMMARY

Through reviewing regulations and other performance assessments, interacting with low-level waste project management, and involving the public, develop the performance objectives for the interim performance assessment.

II. GENERALA. Background

Performance objectives are the criteria against which the predicted long-term impact of the disposal action to the environment is judged. Although regulations do set some explicit criteria, most of the criteria are general, for example "protect human health and safety". Thus performance objectives are based upon project vision, prior experience from other performance assessments (particularly the Hanford performance assessments), and from public input.

B. Organization

The responsible organization will be the Environmental Risk and Performance Assessment Section of the Westinghouse Hanford Company, John Rawlins manager. The cognizant scientist will be Fred Mann.

C. Vision

The performance objectives are the criteria against which success or failure of the analyses of the performance assessment are judged. They thus provide not only direction but also the ultimate technical goal for the entire low level waste disposal activity.

D. Objectives

This activity will determine the performance objectives for the interim performance assessment.

E. Deliverables

- 1) Letter report providing performance objectives for the interim performance assessment (Nov. 30, 1994)
- 2) Letter report documenting comments from review boards on the performance objectives as well as responses to comments (Jan. 31, 1995).

III. TASK DESCRIPTIONS**A. Summary list of tasks**

- 1) Determine performance objectives
- 2) Respond to comments on determination of performance objectives.

B. Determine performance objectives**1. Detailed Description**

Based upon regulations, past practices, program office input, and public input, performance objectives for the interim performance assessment will be determined and documented.

Comments from the program office and from the public will be documented and each will receive an individual response.

The main contributor to this task will be Fred Mann.

2. Interfaces

The input for this task was generated in FY 1994 tasks.

The output of this task will be a major determinant in deciding the measures against which the results of the interim performance assessment will be judged. The letter report will be formally reviewed by the standing LLWPA review groups.

3. Standards

There are no relevant standards in this area. However, guidance from the DOE Peer Review Panel and from the NRC staff will be used.

4. Quality Assurance

The letter report will be reviewed internally before issuance.

5. Schedule

The task will start October 1, 1994, with the letter report written by November 5. The report will be issued by November 30, 1994.

6. Cost (FY 1995)

1.0 man-months of professional time costing \$13,000 will be required.

C. Respond to comments on determination of performance objectives

1. Detailed Description

Comments from the review groups on the letter report documenting the determination of performance objectives for the interim performance assessment will be documented. Each will be responded to. A revised letter report will be issued if necessary.

The main contributor to this task will be Fred Mann.

2. Interfaces

The main interfaces will be the internal and external review groups.

The output of this task will be the performance objectives to be used in the interim performance assessment.

3. Standards

There are no relevant standards in this area.

4. Quality Assurance

The letter report will be reviewed before issuance.

5. Schedule

The task will start December 1, 1994, with the letter report written by January 15, 1995. The report will be issued by January 31, 1995.

6. Cost (FY 1995)

0.8 man-month of professional time costing \$10,000 will be required.

IV. OTHER CONSIDERATIONS

Determination of performance objectives is a normal part of doing performance assessments. We hope to use public involvement on this task to obtain early buy-in from all interested parties, thereby reducing the chance of challenges much later in the disposal facility design cycle.

This public involvement will be simultaneous with public involvement in task 2.1.2, determine scenarios and pathways for interim performance assessment.

Accepted: _____
Frederick M. Mann

Date: _____

2.1.2 Determine Pathways and Scenarios for Interim Performance Assessment

I. SUMMARY

Through reviewing regulations and other performance assessments, interacting with other disposal actions at Hanford, and involving the public, develop the pathways and scenarios for the interim performance assessment.

II. GENERALA. Background

Radionuclides and other hazardous substances can reach the environment by a large variety of pathways. In addition, based on demographics and land use, the number of exposure scenarios is also quite large. Although regulations do set some explicit criteria, most of the criteria are general, for example "protect ground water". In addition, there are important parameters and values (such as land use) which only a public involvement process can decide. Thus the pathways and scenarios which should be analyzed are based upon prior experience from other performance assessments (particularly the Hanford performance assessments) and from public input.

B. Organization

The responsible organization will be the Environmental Risk and Performance Assessment Section of the Westinghouse Hanford Company, John Rawlins manager. The cognizant scientist will be Fred Mann.

C. Vision

The pathways and scenarios are the ways that radionuclides and hazardous chemicals move from the disposed waste to the environment and expose mankind. They are the objects which must be analyzed in the performance assessment. They thus provide the "what's" of the performance assessment.

D. Objectives

This activity will determine the pathways and scenarios which will be analyzed in the interim performance assessment.

E. Deliverables

- 1) Letter report providing scenarios for the interim performance assessment (Nov. 30, 1994)
- 2) Letter report documenting comments from review boards on the scenarios as well as responses to those comments (Jan. 31, 1995).

III. TASK DESCRIPTIONS

A. Summary list of tasks

- 1) Determine scenarios
- 2) Respond to comments on determination of scenarios.

B. Determine Scenarios

1. Detailed Description

Based upon regulations, past practices, and public input, scenarios for the interim performance assessment will be determined and documented.

Comments from the public will be documented and each will receive an individual response.

The main contributor to this task will be Fred Mann.

2. Interfaces

The input for this task was generated in FY 1994 tasks.

The output of this task will be a major deterrent in deciding the pathways and scenarios used in the interim performance.

3. Standards

There are no relevant standards in this area. However, guidance from the DOE Peer Review Panel and from the NRC staff will be used.

4. Quality Assurance

The letter report will be reviewed before issuance.

5. Schedule

The task will start October 1, 1994, with the letter report written by November 5. The report will be issued November 30, 1994.

6. Cost (FY 1995)

1.0 man-month of professional time costing \$13,000 will be required.

C. Response to comments on determination of performance objectives

1. Detailed Description

Comments from the review groups on the letter report documenting the determination of scenarios for the interim performance assessment will be documented. Each will be responded to. A revised letter report will be issued if necessary.

The main contributor to this task will be Fred Mann.

2. Interfaces

The main interfaces will be the internal and external review groups.

The output of this task will be the scenarios to be used in the interim performance assessment.

3. Standards

There are no relevant standards in this area.

4. Quality Assurance

The report will be reviewed by the participants in the public involvement process before issuance.

5. Schedule

The task will start December 1, 1994, with the letter report written by January 15, 1995. The report will be issued by January 31, 1995.

6. Cost (FY 1995)

0.8 man-months of professional time costing \$10,000 will be required.

IV. OTHER CONSIDERATIONS

Determination of pathways and scenarios is a normal part of doing performance assessments. We hope to use public involvement on this task to obtain early buy-in from all interested parties, thereby reducing the chance of challenges much later in the disposal facility design cycle.

This public involvement will be simultaneous with public involvement in task 2.1.1, determine performance objectives for interim performance assessment.

Accepted:

Frederick M. Mann

Date: _____

2.1.3 Select and Verify Tools for the Interim Performance Assessment

I. SUMMARY

Through establishing criteria for the tools (probably computer software) needed in the performance assessment, then selecting appropriate tools based on those criteria, and finally verifying those tools meet the criteria, obtain a set of tools usable for the interim performance assessment.

II. GENERALA. Background

Complex computer modeling is usually used in the analysis upon which a performance assessment is based. The DOE Peer Review Panel has determined that a careful and thoughtful process be used in selecting such tools. The process consists of:

- 1) Setting criteria
- 2) Selecting the tools
- 3) Verifying the tools.

B. Organization

The responsible organization will be the Environmental Risk and Performance Assessment Section of the Westinghouse Hanford Company, John Rawlins manager. The cognizant scientist will be Fred Mann. Others in the team will represent the major analysis functions in the performance assessment (dosimetry - Paul Rittmann, groundwater transport - Bill McMahon, inventory - Frank Schmittroth, vadose zone transport - Mel Piepho, and waste form - Pete McGrail)

C. Vision

The tools of a performance assessment form a core component of a performance assessment. However, unlike other components (criteria and data), it is far more difficult to demonstrate that the tools provide reasonable results because they are used to extrapolate past our knowledge base.

D. Objectives

This activity will determine the tools (probably computer codes) to be used in the analyses for the interim performance assessment. The criteria for all functional areas will be established in FY 1994. Some tools (codes) will be selected and verification on those codes will be started in FY 1994. All tools will be selected by the end of first quarter FY 1995 with verification completed on all codes by the end of FY 1995.

E. Deliverables

- 1) Letter reports justifying selection of tools in each analysis area (Dec. 31, 1994).
- 2) Letter reports documenting verification efforts on the selected codes (June 30, 1995).

III. TASK DESCRIPTIONSA. Summary list of tasks

- 1) Select and justify tools in each analysis area.
- 2) Document verification studies of tools in each analysis area.

B. Select and justify tools in each analysis area.

1. Detailed Description

After criteria have been established, a review of possible candidate tools will be performed. These candidates will be rated against the criteria and a tool will be selected. The justification of that tool will be documented.

The main contributors to this task will be those with lead responsibility in each analysis area:

- a) Dosimetry - Paul Rittmann
- b) Groundwater transport - Bill McMahon
- c) Inventory - Frank Schmittroth
- d) Vadose zone transport - Mel Piepho
- e) Waste form - Pete McGrail.

2. Interfaces

The interfaces will be with other team members and with analysts actually performing the work.

The output of this task will be the selection of the tool to be used in the interim performance area for each analysis area.

3. Standards

There are no relevant standards in this area. However, guidance from the DOE Peer Review Panel and from the NRC staff will be used.

4. Quality Assurance

The letter report will be reviewed before issuance.

5. Schedule

The activity will start as soon as general criteria are established in the first task in this activity. Some tools selections will be made and documented in FY 1994; all will be made by the end of 1st quarter FY 1995.

6. Cost (FY 1995)

1.9 man-months of professional time costing \$24,000 is required.

C. Document verification studies of tools in each analysis area

1. Detailed Description

After tools are selected, the tools must be shown that they are appropriate to be used for the tasks assigned to them in the interim performance. Although some additional verification and benchmark calculations are expected, this mainly involves documentation.

It is expected that some code development will be necessary to tune the codes for use in the interim performance assessment. The documentation shall cover the version of the code to be used in the interim performance assessment.

The main contributors to this task will be those with lead responsibility in each analysis area:

- a) Dosimetry - Paul Rittmann
- b) Groundwater transport - Bill McMahon
- c) Inventory - Frank Schmittroth
- d) Vadose zone transport - Mel Piepho
- e) Waste form - Pete McGrail.

2. Interfaces

The interfaces will be with other team members and with analysts actually performing the work.

The output of this task will be documentation verifying the applicability of the code for each analysis area in the interim performance area.

3. Standards

There are no relevant standards in this area. However, guidance from the DOE Peer Review Panel and from the NRC staff will be used.

4. Quality Assurance

The letter report will be reviewed before issuance.

5. Schedule

The task will start as soon as the tool in a given analysis area is selected. For some areas, this task will start in FY 1994; for others in the first quarter of FY 1995. Documentation for all codes will be completed by June 30, 1995.

6. Cost

FY 1995: 5.3 man-months of professional time costing \$68,000 is required.

FY 1996: 4.3 man-months of professional time costing \$55,000 is required.

The above estimates are based upon based code verification and documentation efforts.

IV. OTHER CONSIDERATIONS

The process for selecting and justifying the tools for the interim performance assessment will set the ground work for the selection and justification of the tools for the preliminary and final performance assessment. With computer technology advancing so quickly, it is very unlikely that the tools used in the interim performance assessment will be used without modification in the preliminary or final performance assessments. Thus, a disciplined unbiased approach must be established early.

Accepted: _____
Frederick M. Mann

Date: _____

2.1.4 Inventory

I. SUMMARY

Review tank-waste inventories and preliminary treatment flow sheets in order to determine inventory to be used the Low-Level Waste Interim Performance Assessment.

II. GENERALA. Background

The inventories of hazardous chemicals and radionuclides presently in the Hanford single- and double-shell tanks are the starting point for assessing the inventories that will be in the final waste form that is placed in the disposal facility. These final inventories will also depend on the subsequent pretreatment "splits" along with other losses before the formation of the glass waste form.

Although there have been earlier studies, there are still significant uncertainties and inconsistencies in the tank inventories. Also the status of the process flow sheets will evolve with time.

B. Organization

The cognizant organization is the Environmental Risk and Performance Assessment Section of Westinghouse Hanford; John Rawlins, Manager. The cognizant scientist will be Frank Schmittroth.

C. Vision

An awareness of the tank inventories, treatment options, and secondary melter waste streams is an on-going effort that must be sustained as better knowledge in these activities becomes available. The performance of the disposal depends directly on the inventory of key materials.

D. Objectives

This activity will supply the inventories in the final waste form in a manner that is supported by the on-going programs in tank characterization, in process treatments, and in melter secondary waste streams as well as theoretical analyses.

E. Deliverables

- 1) Letter report documenting the total inventory expected to be the glass waste form (June 30, 1995).
- 2) Letter report documenting the highest level of important materials to be in a single vault (June 30, 1995).

III. TASK DESCRIPTIONS

A. Summary List of Activities

- 1) Determine total inventory.
- 2) Determine extreme inventory.

B. Develop total inventory

1. Detailed Description

The total inventory will be determined by reviewing available tank characterization data (both experimentation measurements and analytical extrapolations) and process flow sheet data. Such process flow data will include the split between high-level and low-level waste and the split among melter losses, off-gas losses, and waste-form incorporation.

The main contributor to this task will be Frank Schmittroth and Truc DeLorenzo.

2. Interfaces

The goal of this task is to determine the total inventory to be in the waste form. Tank characterization data and process flowsheets will be obtained from other parts of the LLW program as well as from TWRS.

3. Standards

Standards will be identified as part of this task.

4. Quality Assurance

The letter report will be peer reviewed.

5. Schedule

The task started in FY 1994. A letter report will be written by August 1995 and issued after review by September 30, 1995.

6. Costs (FY 1995)

10.6 man-months of professional time costing \$136,000 is required.

C. Develop estimate of extreme inventory

1. Detailed Description

For some calculations the maximum amount of key materials in a given disposal unit must be known. This task will determine the

maximum of such key materials that may occur in a disposal unit. Individual tank inventory ratios will form a key input.

The main contributors in these task will be Frank Schmittroth and Truc De Lorenzo.

2. Interfaces

The goal of this task is to find the maximum amount of key materials. The knowledge of the order of tank processing and of individual tank inventories will be important.

3. Standards

Standards will be identified as part of this task.

4. Quality Assurance

The letter report will be reviewed before issuance.

5. Schedule

The task will start January 1, 1995. A letter report documenting the current state of knowledge of extreme inventories will be written by August 30, 1995. The report will be reviewed and then issued by September 30, 1995.

6. Cost (FY 1995)

4.6 man-months of professional time costing \$59,000 is required.

Accepted:

Frank Schmittroth

Date: _____

2.1.5 Obtain Disposal Facility Data for Interim Performance Assessment

I. SUMMARY

Translate design activities into information useful for interim performance assessment activities.

II. GENERALA. Background

The performance assessment must model the disposal facility as it will be built. As concepts are firmed into design, that evolution must be reflected in the models used in the performance assessment.

B. Organization

The responsible organization will be the Environmental Risk and Performance Assessment Section of the Westinghouse Hanford Company, John Rawlins manager. The cognizant scientist will be Fred Mann.

C. Vision

Keep the models used in the performance assessment current with the concepts and designs being considered by the program office and the architect-engineers.

D. Objectives

This activity will translate design information into an usable form for performance assessment activities.

E. Deliverables

- 1) Letter report defining geometry and volume of waste form (March 30, 1995).
- 2) Letter report defining important barriers used in design (March 30, 1995).
- 3) Letter report determining parameters for transport through important barriers (July 31, 1995)
- 4) Letter report acknowledging review of transport parameters (October 30, 1995).

III. TASK DESCRIPTIONSA. Summary list of tasks

- 1) Determine geometry and waste form,
- 2) Determine important barriers used in design

- 3) Determine parameters for transport through barriers
- 4) Review of barrier transport parameters.

B. Determine geometry and waste form

1. Detailed Description

Contact with the people performing conceptual design work will be maintained. After the conceptual design is finished (scheduled for September 1994), the conceptual design will be used to determine the geometry and volume of the waste form used in the interim performance assessment.

2. Interfaces

John Garfield and John Propson have the responsibility for the conceptual design.

The output of this task will be the geometry and volume of the waste form to be used in the interim performance assessment.

3. Standards

There are no relevant standards in this area.

4. Quality Assurance

The letter report will be reviewed before issuance.

5. Schedule

The activity will start February 1, 1995 (the conceptual design being scheduled to be completed in September 1994). The letter report will be issued by March 30, 1995.

6. Cost (FY 1995)

1.1 man-months of professional time costing \$14,000 is required.

C. Determine important barriers used in design

1. Detailed Description

Contact with the people performing conceptual design work will be maintained. After the conceptual design is finished (scheduled for September 1994), the conceptual design will be used to determine the barriers to water and solute transport.

2. Interfaces

John Garfield and John Propson have the responsibility for the conceptual design.

The output of this task will be the determination of barriers in the engineered system which are important for water and solute transport.

3. Standards

There are no relevant standards in this area.

4. Quality Assurance

The letter report will be reviewed before issuance.

5. Schedule

The activity will start February 1, 1995 (the conceptual design being scheduled to be completed in September 1994). The letter report will be issued by March 30, 1995.

6. Cost (FY 1995)

1.1 man-month of professional time costing \$14,000 is required.

D. Determine parameters for transport through barriers

1. Detailed Description

Determine the transport properties of the important barriers identified in the task above. Such properties will include hydraulic and retardation values.

2. Interfaces

The input to this task is the identification of the important barriers and values found in other tasks for hydraulic, retardation, and other parameters.

The output of this task will be the determination of transport parameters for the barriers in the engineered system which are important for water and solute transport.

3. Standards

There are no relevant standards in this area.

4. Quality Assurance

The letter report will be reviewed before issuance.

5. Schedule

The activity will start April 1, 1995 (after the important barriers are determined). The letter report will be issued by July 31, 1995.

6. Cost (FY 1995)

3.2 man-months of professional time costing \$41,000 is required.

E. Review of barrier transport parameters

1. Detailed Description

The transport properties through the barriers will be reviewed by groups external to the Steering Group. Any comments received from the reviewers shall be explicitly addressed and changes in the parameters made and documented.

2. Interfaces

The input to this task are the values of the transport parameters through the barriers and comments received from the review groups.

The output of this task will be the determination of transport parameters for the barriers in the engineered system which are important for water and solute transport as a reviewed data set.

3. Standards

There are no relevant standards in this area.

4. Quality Assurance

Comments to each reviewer response shall be documented.

5. Schedule

The activity will start August 1, 1995 (after the parameters are determined). The letter report will be issued by October 31, 1995.

6. Cost (FY 1995)

0.24 man-months of professional time costing \$3,000 is required.

2.1.6 LLW Glass Source-Term for Interim Performance Assessment

I. SUMMARY

This purpose of this task is to provide estimates of radionuclide release from a LLW glass product that will be used for input to an interim systems performance assessment of the Hanford LLW site. Because many specific characteristics of the glass waste product and disposal system components will be unknown at the time the interim assessment is drafted, the data used to estimate radionuclide releases will be largely based upon values obtained from literature review, expert judgment, or extrapolated from laboratory data obtained on reference LLW glasses.

II. GENERALA. Background

Estimates of radionuclide releases from LLW glass are needed for input to an interim performance assessment of a LLW disposal system at Hanford due in December 1996. However, the specific characteristics of the LLW glass and other disposal system components that can affect release from the glass will be largely unknown at the time this report is drafted. Consequently, the extensive literature on aqueous corrosion of silicate glasses will be the primary source for the data needed to estimate releases from the LLW glass. Where possible, extrapolations will be made from tests conducted as part of LLW glass formulation studies.

B. Organization

The responsible organization will be the Materials and Chemical Sciences Center of the Pacific Northwest Laboratory (PNL), Walt Laity, Manager. The cognizant scientist will be Peter McGrail also of PNL.

C. Vision

In December 1996, an interim performance assessment for a LLW disposal system on the Hanford, Washington LLW site will be submitted for peer and public review. Radionuclide release estimates for the LLW glass product are needed as part of an overall performance assessment for the site that includes far-field transport and radiation dose assessments. The results from the interim performance assessment will also provide feedback to glass developers on data needs and performance criteria for the waste form.

D. Objectives

The objectives for this task include:

- 1) Calculate the release of important contaminants from low-level waste glass disposed of near-surface and provide these data as input to a systems-level performance assessment for the site.

- 2) Conduct literature reviews and interact with staff performing LLW glass formulation tasks to obtain data needed for release rate calculations.
- 3) Identify, modify or adapt models as needed to perform release calculations.
- 4) Plan and conduct verification and certification studies for the selected model.

E. Deliverables

- 1) Letter report justifying selection of a computational tool for LLW glass source-term calculations for the interim performance assessment (December 31, 1994).
- 2) Letter report documenting methods for verification and certification of the computational tool selected for LLW glass source-term calculations (June 30, 1995).
- 3) Letter report describing preliminary model for hydrolysis and contaminant release from LLW glass (September 29, 1995).
- 4) Letter report documenting LLW glass release source-term for interim performance assessment (September 30, 1995).

III. TASK DESCRIPTIONS

A. Summary list of tasks

- 1) Release Model for LLW Glass
- 2) Integrated Source-Term Modeling
- 3) Source-Term Model Verification and Certification

B. Release Model for LLW Glass

1. Detailed Description

Except for the possibility of physical intrusion into the site, radionuclide release from the LLW glass is the essential first step that is required for any subsequent transport to the accessible environment to occur. The release rate from the glass is expected to dominate the overall performance of the site in the long-term so it is essential that a credible method be used to calculate releases from the glass waste form. Because release rates must be projected far into the future and over a range of environmental conditions that cannot be completely investigated in the laboratory, a model must be developed that is a reasonable and defensible representation of the system. Experience has shown that models based on fundamental principles of physics, chemistry, and thermodynamics (mechanistic models) are best suited for this application. Consequently, this task will develop and test a

suitable model describing radionuclide release from LLW glass. It is expected that this model will be implemented in an integrated source-term model for the LLW disposal system.

The main contributor to this task will be Pete McGrail.

2. Interfaces

The input to this task will consist of data derived from laboratory testing done as part of glass formulation studies conducted under the Vitrification Projects of the Tank Waste Remediation System (TWRS). Because the laboratory testing and model development work will be done under different projects, close coordination and planning of the experiments by the modelers and experimentalists is essential. The output from this task will consist of a mathematical model and supporting database that will be implemented by the Integrated Source-term Modeling Task.

3. Standards

There are no relevant standards in this area.

4. Quality Assurance

This task will be conducted in accordance with PNL's PVTD Quality Assurance Plan ETC-001 and applicable WHC Quality Assurance requirements.

5. Schedule

The task will start October 1, 1994, and be completed September 30, 1995, with the issuance of the source-term report for the interim performance assessment.

6. Cost (FY 1995)

1.6 man-months of professional time costing \$20,000 will be required to cover WHC overview of task. PNL costs are covered in tasks listed under 3.1.6.

C. Integrated Source-Term Modeling

1. Detailed Description

The radionuclide release rate from glass waste forms is highly dependent upon the composition of the glass, the chemistry of the water contacting the glass and aqueous chemistry of the particular radionuclide, temperature, and the local hydrologic conditions. Because the glass will be surrounded by soil and most likely other engineered materials, the effects these materials have on the aforementioned parameters will impact release rates from the glass and overall release from the engineered disposal system. The objective of this task is to develop and/or adapt a model that is

a reasonable and defensible representation of the engineered disposal system. The integrated model will incorporate the mechanistic model developed for radionuclide release from LLW glass and models that describe the important physical, chemical, and hydrological properties of the other engineered materials planned for the disposal system. Output from the integrated model will be time-dependent fluxes for radionuclides exiting the engineered disposal system which will be used as inputs for far-field transport and dose assessment modeling.

The main contributors to this task will be Pete McGrail, Jim Fort, and Dave Sevougian.

2. Interfaces

Inputs to this task will come from virtually every task on the Hanford Tank Low-Level Waste project that is responsible for characterizing the physical and chemical properties of the site and the engineered materials being developed for the disposal system. The main outputs will be to the tasks responsible for far-field transport and dose assessments.

3. Standards

There are no relevant standards in this area.

4. Quality Assurance

This task will be conducted in accordance with PNL's PVTD Quality Assurance Plan ETC-001 and applicable WHC quality assurance requirements.

5. Schedule

The task will start October 1, 1994, and be completed September 30, 1995, with the issuance of the source-term report for the interim performance assessment.

6. Cost

1.6 man-months of professional time costing \$20,000 will be required to cover WHC overview of task. PNL costs are covered in tasks listed under 3.1.6.

IV. OTHER CONSIDERATIONS

The inputs to this task will derive mainly from experimental studies being conducted on other tasks in Hanford Tank Low-Level Waste Technology Development Program and from other projects within the Tank Waste Remediation System. As such, close involvement and coordination of efforts between staff working on these projects is essential.

Accepted: _____
Bernard P. McGrail

Date: _____

2.1.7 Compile and interpret flow and transport properties for flow and transport studies

I. SUMMARY

Gather and justify (to the degree possible given the uncertainties in features and location of the disposal facility) the data to be used in flow and transport calculations in the interim performance assessment.

II. GENERAL

A. Background

Flow and transport properties of vadose zone soils exercise major controls on groundwater movement and contaminant transport from a waste disposal site. Based on site characterization work for Environmental Restoration projects, an extensive data base exists, for the 200 Areas plateau, that describe our current state of knowledge on the vadose zone soil properties. The purpose of this study is to compile and interpret the available data in order to make them useable for the low-level performance assessment modeling activities.

B. Organization

The cognizant organization is the Environmental Risk and Performance Assessment Section of Westinghouse Hanford; John Rawlins, manager. The cognizant scientist will be Raz Khaleel. Supporting this effort will be the Geosciences groups of Westinghouse Hanford and of the Pacific Northwest Laboratories.

C. Vision

Insofar as additional borehole requirements and laboratory analyses are concerned, a compilation and interpretation of available data can potentially result in savings of millions of dollars in characterization costs for vadose zone soil properties.

D. Deliverables

Letter report documenting compilation and interpretation of vadose zone flow and transport properties for soils in the 200 Areas plateau (September 30, 1995).

III. TASK DESCRIPTION

A. Summary List Of Activities

- 1) Compile and interpret flow and transport properties for vadose zone soils.

B. Compile and interpret flow and transport properties for vadose zone soils.

1. Detailed Description

Over the years, data have been obtained on soil hydraulic properties at the Hanford Site. These data continue to be obtained for various CERCLA Operable Units under the ER Program. However, the existing data on vadose zone soil properties are fragmented and documented in reports that have not been formally reviewed and released. This task will help identify, compile, and interpret all available data for the principal vadose zone soil horizons, i.e., Hanford Formation, Pleistocene sediments, Palouse soils, Upper Ringold Formation, and Middle Ringold Formation. Once the data for various soil horizons have been cataloged and corrected, curve-fitting parameters will be generated using a nonlinear, a least squares procedure (RETC) to match the measured retention data to van Genuchten models. Both moisture retention and unsaturated hydraulic conductivity data will be considered and van Genuchten parameter ranges determined. The parameter ranges will be useful in characterizing the spatial variability of the hydraulic properties for a given soil horizon and between soil horizons. In addition, available data on dispersivities, saturated hydraulic conductivity, bulk density, particle density will be included.

The main contributor to this task will be Raz Khaleel. Support personnel will John Relyea and Gene Freeman.

2. Interfaces

The primary interfaces for this activity will be personnel of the Westinghouse Hanford Geotechnical Laboratory and Geosciences groups of Westinghouse Hanford and of the Pacific Northwest Laboratories.

3. Standards

There are no relevant standards in this area. However, the detailed procedures for correction of laboratory-measured data for field bulk density and gravel content will be peer-reviewed by Dr. M. Th. van Genuchten, U.S. Salinity Laboratory, Riverside, California. Following peer review, the procedures will be documented in a desk instruction manual for use by Westinghouse personnel.

4. Quality Assurance

The letter report will be reviewed before issuance.

5. Schedule

The activity will start Oct. 1, 1994, with the letter report written by August 31. The report will be issued September 30, 1995.

6. Cost (FY 1995)

9.8 man-months of professional time costing \$127K will be required.

OTHER CONSIDERATIONS

Determination of existing data base on vadose zone soil properties is an important aspect of any potential future site characterization activity for the low-level performance assessment. DOE Order 5820.2A requires background information on the regional hydrology as part of a site-specific performance assessment modeling activity.

2.2 Calculate Responses and Document

I. SUMMARY

This activity performs the actual calculations and analyses that appear in the interim performance assessment and write the document itself.

II. GENERALA. Background

Earlier activities (2.1.X) produced the data and methods to be used in the interim performance assessment.

B. Organization

The responsible organization will be the Environmental Risk and Performance Assessment Section of the Westinghouse Hanford Company, John Rawlins manager. The cognizant scientist will be Fred Mann.

C. Vision

The interim performance assessment will provide the program office assurance that the final performance assessment will be accepted and hence that waste can be disposed into the facility.

D. Objectives

This activity will produce the interim performance assessment.

E. Deliverables

- 1) Interim Performance Assessment as a letter report ready for internal review (Dec. 31, 1996).

III. TASK DESCRIPTIONSA. Summary list of tasks

- 1) Write interim performance assessment

B. Write Interim Performance Assessment

1. Detailed Description

All calculations and analyses performed by the performance assessment team that will appear in the interim performance assessment will be performed.

The interim performance assessment (including required background information, integration, and interpretation) will be written.

The main contributors to this task will be the entire performance assessment team.

2. Interfaces

The input for this task were generated in 2.1.X tasks.

The output of this task will be the interim performance assessment ready for review by the program office, RL, and other internal (Hanford) reviews.

3. Standards

There are no relevant standards in this area. However, guidance from the DOE Peer Review Panel and from the NRC staff will be used.

4. Quality Assurance

The letter report will be reviewed by the performance assessment team before issuance.

5. Schedule

The task will start October 1, 1995, with the letter report written and reviewed by December 31, 1996.

6. Cost

FY 1996:	13.4 man-months of professional time costing \$172,000
FY 1997:	4.3 man-months of professional time costing \$55,000

These costs include analyst's time for calculation, the writer's time, and the use of an editor.

2.3 Define Contingencies

I. SUMMARY

Based on the results of the interim performance assessment, it may be necessary to rethink major components of the disposal system to meet objectives.

II. GENERALA. Background

The purpose of the interim performance assessment is to provide assurance that the final performance assessment will meet the desired performance objectives. However, the analysis may show that with the current designs, approaches, or data that such approval is unlikely.

The timing of this activity is such that recommendations can be reviewed by the program office before the scheduled start of construction of the LLW facilities.

B. Organization

The responsible organization will be the Environmental Risk and Performance Assessment Section of the Westinghouse Hanford Company, John Rawlins manager. The cognizant scientist will be Fred Mann.

C. Vision

Although this activity may not be necessary, it is included so that if the interim performance assessment reveals major problems, there is time to rethink components in the design to increase the chance of success.

D. Objectives

This activity will determine the changes in approach to increase the probability of approval of the final performance assessment if the interim performance assessment shows the existence of serious problems.

E. Deliverables

- 1) Letter report providing suggested changes in approach and design to overcome possible problems revealed in the interim performance assessment (September 30, 1997).

III. TASK DESCRIPTIONSA. Summary list of tasks

- 1) Determine possible contingencies to solve problems revealed from interim performance assessment.

B. Determine possible contingencies to solve problems revealed from interim performance assessment

1. Detailed Description

Define different approaches, methods, or designs that will eliminate or greatly lessen problems revealed by the interim performance assessment.

The main contributors to this task will depend upon the problems revealed in the interim performance assessment. The effort will be lead by Fred Mann.

2. Interfaces

The input for this task is the interim performance assessment.

The output of this task will be a series of options presented to the program office.

3. Standards

There are no relevant standards in this area. However, guidance from the DOE Peer Review Panel and from the NRC staff will be used.

4. Quality Assurance

The letter report will be reviewed internally before issuance.

5. Schedule

The task will start January 1, 1997, with the letter report written by June 30, 1997. The report will be issued by September 30, 1997.

6. Cost (FY 1997)

4.0 man-months of professional time costing \$51,000 will be required.

2.4 Have Internal Review Assessment

I. SUMMARY

The Program Office, the Internal Review Team, RL, and other internal Hanford review teams will review the interim performance assessment.

II. GENERALA. Background

The interim performance assessment will be a large significant document. Because of its purpose to provide assurance that the final performance assessment will be approved, significant levels of review are needed.

It is expected that most of the reviewers will be familiar with the data, methods, and results through on-going prior briefings.

B. Organization

The responsible organization will be the Environmental Risk and Performance Assessment Section of the Westinghouse Hanford Company, John Rawlins manager. The cognizant scientist will be Fred Mann.

C. Vision

The interim performance assessment should withstand any attacks on its methods, data, or interpretations.

D. Objectives

This activity will perform the internal Hanford review for the interim performance assessment.

E. Deliverables

- 1) Communications from review bodies on the adequacy of the interim performance assessment (March 30, 1997)

III. TASK DESCRIPTIONSA. Summary list of tasks

- 1) Internal review of the interim performance assessment

B. Internal review of the interim performance assessment

1. Detailed Description

Hanford groups will review the interim performance assessment. Such groups will be determined by the Program Office but are expected to include the program office itself, the Internal Review Team of the performance assessment activity, and RL.

The main interface to the reviewers will be Fred Mann.

2. Interfaces

The input for this task is the interim performance assessment generated in activity 2.2.

The output of this task will be comments that may lead to changes in the interim performance assessment or may indicate that the document serves its intended purpose.

3. Standards

There are no relevant standards in this area.

4. Quality Assurance

The review groups will establish their own quality assurance.

5. Schedule

The task will start January 1, 1997, with comments received on the interim performance assessment by March 30, 1997.

6. Cost (FY 1997)

Costs covered by other activities.

2.5 External Review with Public Input

I. SUMMARY

An external group will review the interim performance assessment. It is expected that interested parties from the public will also have access to the document and will provide comments.

II. GENERALA. Background

The Peer Review Group established by DOE usually reviews performance assessments generated in the DOE complex. However, this performance assessment is not part of their established procedure. Whether they will review the document is unclear given their schedule. At a minimum, another external review group will be set up and used.

Because of the strong interest of the public in Hanford activities, public interaction is expected and desired.

B. Organization

The responsible organization will be the Environmental Risk and Performance Assessment Section of the Westinghouse Hanford Company, John Rawlins manager. The cognizant scientist will be Fred Mann.

C. Vision

External review is deemed necessary for any document analyzing the impact of such a major Hanford action.

D. Objectives

This activity will provide external review of the interim performance assessment.

E. Deliverables

- 1) Communications from the external review groups on the quality of the interim performance assessment (September 30, 1997).

III. TASK DESCRIPTIONSA. Summary list of tasks

- 1) External review of the interim performance assessment.

B. External review of the interim performance assessment

1. Detailed Description

Groups external to Hanford will review the interim performance assessment and provide comments. Public review is also expected.

The main interface to the review groups will be Fred Mann.

2. Interfaces

The input for this task is the interim performance assessment (possibly modified based on comments received from internal review).

The output of this task will be a thoroughly reviewed document outlining the expected impact of the disposal action given the limited site-, design-, and waste form-specific data available.

3. Standards

There are no relevant standards in this area.

4. Quality Assurance

The review groups will determine their own quality assurance requirements.

5. Schedule

The task will start April 1, 1997, with comments received by September 30, 1997.

6. Cost (FY 1997)

3.2 man-months of professional time costing \$42,000 will be required to interact with the outside reviewers. External costs are covered in activity 3.3.

3.1.1 Update Performance Objectives for Performance Assessment

I. SUMMARY

Through reviewing regulations and other performance assessments, interacting with low-level waste project management, and involving the public, update the performance objectives for the preliminary performance assessment.

II. GENERALA. Background

Performance objectives are the criteria against which the predicted long-term impact of the disposal action to the environment is judged. Although regulations do set some explicit criteria, most of the criteria are general, for example "protect human health and safety". Thus performance objectives are based upon project vision, prior experience from other performance assessments (particularly the Hanford performance assessments), and from public input.

B. Organization

The responsible organization will be the Environmental Risk and Performance Assessment Section of the Westinghouse Hanford Company, John Rawlins manager. The cognizant scientist will be Fred Mann.

C. Vision

The performance objectives are the criteria against which success or failure of the analyses of the performance assessment are judged. They thus provide not only direction but also the ultimate technical goal for the entire low level waste disposal activity.

D. Objectives

This activity will determine the performance objectives for the preliminary performance assessment.

E. Deliverables

- 1) Letter report providing performance objectives for the preliminary performance assessment (March 30, 1996).
- 2) Letter report documenting comments from review boards on the performance objectives as well as responses to comments (June 30, 1996).

III. TASK DESCRIPTIONS

A. Summary list of tasks

- 1) Determine performance objectives.
- 2) Respond to comments on determination of performance objectives.

B. Determine performance objectives

1. Detailed Description

Based upon regulations, past practices, program office input, and public input, performance objectives from the interim performance assessment will be updated and documented.

Comments from the program office and from the public will be documented and each will receive an individual response.

The main contributor to this task will be Fred Mann.

2. Interfaces

The inputs for this task will be evolving regulations, evolving program office viewpoints, and evolving public values.

The output of this task will be a major deterrent in deciding the measures against which the results of the preliminary performance assessment will be judged. The letter report will be formally reviewed by the standing LLWPA review groups.

3. Standards

There are no relevant standards in this area. However, guidance from the DOE Peer Review Panel and from the NRC staff will be used.

4. Quality Assurance

The letter report will be reviewed internally before issuance.

5. Schedule

The task will formally start January 1, 1996, with the letter report written by March 15, 1996. The report will be issued by March 30, 1996. Informally monitoring of regulations, program office requirements, and public values will continue after the performance objectives for the interim performance assessment is completed.

6. Cost (FY 1996)

1.1 man-months of professional time costing \$14,000 will be required.

C. Respond to comments on determination of performance objectives

1. Detailed Description

Comments from the review groups on the letter report documenting the determination of performance objectives for the preliminary performance assessment will be documented. Each will be responded to. A revised letter report will be issued if necessary.

The main contributor to this task will be Fred Mann.

2. Interfaces

The main interfaces will be the internal and external review groups.

The output of this task will be the performance objectives to be used in the preliminary performance assessment.

3. Standards

There are no relevant standards in this area.

4. Quality Assurance

The letter report will be reviewed before issuance.

5. Schedule

The task will start April 1, 1996, with the letter report written by June 15, 1996. The report will be issued by June 30, 1996.

6. Cost (FY 1996)

0.4 man-month of professional time costing \$5,000 will be required.

Accepted:

Frederick M. MannDate:

3.1.2 Update Scenarios for Performance Assessment

I. SUMMARY

Through reviewing regulations and other performance assessments and involving the public, update the scenarios for the preliminary performance assessment.

II. GENERALA. Background

Radionuclides and other hazardous substances can reach the environment by a large variety of pathways. In addition, based on demographics and land use, the number of exposure scenarios is also quite large. Although regulations do set some explicit criteria, most of the criteria are general, for example "protect ground water". In addition, there are important parameters and values (such as land use) which only a public involvement process can decide. Thus the pathways and scenarios which should be analyzed are based upon prior experience from other performance assessments (particularly the Hanford performance assessments) and from public input.

B. Organization

The responsible organization will be the Environmental Risk and Performance Assessment Section of the Westinghouse Hanford Company, John Rawlins manager. The cognizant scientist will be Fred Mann.

C. Vision

The pathways and scenarios are the ways that radionuclides and hazardous chemicals move from the disposed waste to the environment and expose mankind. They are the objects which must be analyzed in the performance assessment. They thus provide the "what's" of the performance assessment.

D. Objectives

This activity will determine the pathways and scenarios which will be analyzed in the preliminary performance assessment.

E. Deliverables

- 1) Letter report providing scenarios for the preliminary performance assessment (March 30, 1996).
- 2) Letter report documenting comments from review boards on the scenarios as well as responses to comments (June 30, 1996).

III. TASK DESCRIPTIONS

A. Summary list of tasks

- 1) Determine scenarios for the preliminary performance assessment.
- 2) Respond to comments on determination of the scenarios.

B. Determine performance objectives

1. Detailed Description

Based upon regulations, past practices, and public input, scenarios from the interim performance assessment will be updated and documented.

Comments from the public will be documented and each will receive an individual response.

The main contributor to this task will be Fred Mann.

2. Interfaces

The inputs for this task will be evolving regulations and evolving public values.

The output of this task will be a major deterrent in deciding the measures against which the results of the preliminary performance assessment will be judged. The letter report will be formally reviewed by the standing LLWPA review groups.

3. Standards

There are no relevant standards in this area. However, guidance from the DOE Peer Review Panel and from the NRC staff will be used.

4. Quality Assurance

The letter report will be reviewed internally before issuance.

5. Schedule

The task will formally start January 1, 1996, with the letter report written by March 15, 1996. The report will be issued by March 30, 1996. Informally monitoring of regulations and public values will continue after the scenarios for the interim performance assessment is completed.

6. Cost (FY 1996)

1.1 man-months of professional time costing \$14,000 will be required.

C. Respond to comments on determination of scenarios

1. Detailed Description

Comments from the review groups on the letter report documenting the determination of scenarios for the preliminary performance assessment will be documented. Each will be responded to. A revised letter report will be issued if necessary.

The main contributor to this task will be Fred Mann.

2. Interfaces

The main interfaces will be the internal and external review groups.

The output of this task will be the scenarios to be used in the preliminary performance assessment.

3. Standards

There are no relevant standards in this area.

4. Quality Assurance

The letter report will be reviewed before issuance.

5. Schedule

The task will start April 1, 1996, with the letter report written by June 15, 1996. The report will be issued by June 30, 1996.

6. Cost (FY 1996)

0.4 man-month of professional time costing \$5,000 will be required.

Accepted:

Frederick M. MannDate:

3.1.3 Tool Selection, Verification, and Certification

I. SUMMARY

Through establishing criteria for the tools (probably computer software) needed in the performance assessment, then selecting appropriate tools based on those criteria, and finally verifying those tools meet the criteria, obtain a set of tools usable for the preliminary performance assessment.

II. GENERALA. Background

Complex computer modeling is usually used in the analysis upon which a performance assessment is based. The DOE Peer Review Panel has determined that a careful and thoughtful process be used in selecting such tools. The process consists of:

- 1) Setting criteria
- 2) Selecting the tools
- 3) Verifying the tools
- 4) Certifying the tools.

B. Organization

The responsible organization will be the Environmental Risk and Performance Assessment Section of the Westinghouse Hanford Company, John Rawlins manager. The cognizant scientist will be Fred Mann. Others in the team will represent the major analysis functions in the performance assessment (dosimetry - Paul Rittmann, groundwater transport - Bill McMahon, inventory - Frank Schmittroth, vadose zone transport - Mel Piepho, and waste form - Pete McGrail)

C. Vision

The tools of a performance assessment form a core component of a performance assessment. However, unlike other components (criteria and data), it is far more difficult to demonstrate that the tools provide reasonable results (a process here call certification) because they are used to extrapolate past our knowledge base.

D. Objectives

This activity will determine the tools (probably computer codes) to be used in the analyses for the preliminary performance assessment.

E. Deliverables

- 1) Letter report reviewing and modifying (if necessary) code selection used for preliminary performance assessment for applicability to the preliminary performance assessment (February 28, 1995).

- 2) Letter reports justifying selection of tools in each analysis area (June 30, 1995).
- 3) Letter reports documenting verification efforts on the selected codes (June 30, 1995).
- 4) Letter reports documenting strategy for certifying codes (June 30, 1995).
- 5) Letter reports documenting experiments conducted for certification (June 30, 1997).
- 6) Letter reports documenting certification of codes (December 31, 1997).

III. TASK DESCRIPTIONS

A. Summary list of tasks

- 1) Review code selection criteria
- 2) Review choice of codes
- 3) Verify codes
- 4) Define strategy for certification of codes
- 5) Perform experiments needed for code certification
- 6) Certify codes.

B. Review Code Selection Criteria

1. Detailed Description

The code selection criteria from the interim performance assessment will be reviewed based on experience in the interim performance assessment and on the experience of other performance assessments in the DOE complex.

The main contributors to this task will be those with lead responsibility in each analysis area:

- a) Dosimetry - Paul Rittmann
- b) Groundwater transport - Bill McMahon
- c) Inventory - Frank Schmittroth
- d) Vadose zone transport - Mel Piepho
- e) Waste form - Pete McGrail.

2. Interfaces

The interfaces will be with other team members and with analysts actually performing the work.

The output of this task will be the code selection criteria for the tool to be used in the preliminary performance assessment area for each analysis area.

3. Standards

There are no relevant standards in this area. However, guidance from the DOE Peer Review Panel and from the NRC staff will be used.

4. Quality Assurance

The letter report will be reviewed before issuance.

5. Schedule

The activity will start January 1, 1995, with a letter report due February 28, 1995.

6. Cost (FY 1995)

2.6 man months of professional time costing \$34,000 are required. An additional \$5,000 is needed for PNL.

C. Review Choice of Codes

1. Detailed Description

The choice of codes selected for the interim performance assessment will be reviewed. Selection of new codes may be necessary.

It is expected that some code development will be necessary to tune the codes for use in the preliminary performance assessment. The documentation shall cover the version of the code to be used in the preliminary performance assessment.

The main contributors to this task will be those with lead responsibility in each analysis area:

- a) Dosimetry - Paul Rittmann
- b) Groundwater transport - Bill McMahon
- c) Inventory - Frank Schmittroth
- d) Vadose zone transport - Mel Piepho
- e) Waste form - Pete McGrail.

2. Interfaces

The interfaces will be with other team members and with analysts actually performing the work.

The output of this task will be the documenting of the selection of the code for each analysis area in the preliminary performance assessment area.

3. Standards

There are no relevant standards in this area. However, guidance from the DOE Peer Review Panel and from the NRC staff will be used.

4. Quality Assurance

The letter report will be reviewed before issuance.

5. Schedule

The task will start January 1, 1995 with the reports due June 30, 1995.

6. Cost (FY 1995)

5.3 man-months of professional time costing \$68,000 are required. The PNL expense is \$11,000.

D. Verify codes

1. Detailed Description

Those codes modified since their verification during the interim performance assessment must be reverified.

The main contributors to this task will be those with lead responsibility in each analysis area:

- a) Dosimetry - Paul Rittmann
- b) Groundwater transport - Bill McMahon
- c) Inventory - Frank Schmittroth
- d) Vadose zone transport - Mel Piepho
- e) Waste form - Pete McGrail.

2. Interfaces

The interfaces will be with other team members and with analysts actually performing the work.

The output of this task will be the documentation showing that modified codes have been verified.

3. Standards

There are no relevant standards in this area. However, guidance from the DOE Peer Review Panel and from the NRC staff will be used.

4. Quality Assurance

The letter report will be reviewed before issuance.

5. Schedule

The activity will start after each code is selected for use in the preliminary performance assessment (March - June, 1995). Letter reports documenting verification for modified codes will be issued by June 30, 1995.

6. Cost (FY 1995)

Costs are covered in each task using code.

E. Define strategy for certification of codes

1. Detailed Description

Normally after a code is verified, it must be validated (shown to agree with experiments which contain the important aspects of the problem). However, due to the long-time periods involved in a performance assessment, codes can only meet a lesser standard, a standard denoted here by the word "certification".

For each analysis area, a strategy for the certification of the code selected for the preliminary performance assessment must be determined and documented. For some areas, certification may approach quite closely the traditional ideal of verification, while in others there may be a larger difference.

The main contributors to this task will be those with lead responsibility in each analysis area:

- a) Dosimetry - Paul Rittmann
- b) Groundwater transport - Bill McMahon
- c) Inventory - Frank Schmittroth
- d) Vadose zone transport - Mel Piepho
- e) Waste form - Pete McGrail.

2. Interfaces

The interfaces will be with other team members and with analysts actually performing the work.

The output of this task will be the strategy for certifying each code used in the preliminary performance assessment.

3. Standards

There are no relevant standards in this area. However, guidance from the DOE Peer Review Panel and from the NRC staff will be used.

4. Quality Assurance

The letter report will be reviewed before issuance.

5. Schedule

The task will start April 1, 1995 with the reports due June 30, 1995.

6. Cost (FY 1995)

3.2 man-months of professional time costing \$42,000 is required.

F. Perform experiments needed for code certification

1. Detailed Description

Some experiments may be needed to certify the codes. It is expected that such experiments will be performed under other tasks in the preliminary and final performance assessment activities.

2. Interfaces

The interfaces will be with other team members and with the people responsible for performing the experiments.

The output of this task will be the documentation describing the experiments, their results, and their uncertainties.

3. Standards

There are no relevant standards in this area.

4. Quality Assurance

The letter report will be reviewed before issuance.

5. Schedule

The activity will start July 1, 1995, with a letter report due June 30, 1997.

6. Cost (FY 1996)

Costs are covered in each task using code.

G. Certify codes

1. Detailed Description

Each code used in the preliminary performance assessment will be certified following the strategy outlined above.

The main contributors to this task will be those with lead responsibility in each analysis area:

- a) Dosimetry - Paul Rittmann
- b) Groundwater transport - Bill McMahon
- c) Inventory - Frank Schmittroth
- d) Vadose zone transport - Mel Piepho
- e) Waste form - Pete McGrail.

2. Interfaces

The interfaces will be with other team members, with analysts actually performing the work, and with the experimenters.

The output of this task will be the documenting of the certification of the code for each analysis area in the preliminary performance assessment area.

3. Standards

There are no relevant standards in this area. However, guidance from the DOE Peer Review Panel and from the NRC staff will be used.

4. Quality Assurance

The letter report will be reviewed before issuance.

5. Schedule

The task will start as soon as code verification occurs and necessary experimental results are available. Letter reports are due December 31, 1997.

6. Cost (FY 1997)

7.5 man-months of professional time costing \$97,000 is required. \$200,000 allocated to WHC/IRM, PNL, and off-site vendors may be needed for code development and further verification of changes made to codes caused from experimental results.

Accepted: _____
Frederick M. Mann

Date: _____

3.1.4 Inventory

I. SUMMARY

Review tank-waste inventories and preliminary treatment flow sheets in order to determine inventory to be used the Low-Level Waste Preliminary Performance Assessment.

II. GENERALA. Background

The inventories of hazardous chemicals and radionuclides presently in the Hanford single- and double-shell tanks are the starting point for assessing the inventories that will be in the final waste form that is placed in the disposal facility. These final inventories will also depend on the subsequent pretreatment "splits" along with other losses before the formation of the glass waste form.

Although there have been earlier studies, there are still significant uncertainties and inconsistencies in the tank inventories. Also the status of the process flow sheets will evolve with time.

B. Organization

The cognizant organization is the Environmental Risk and Performance Assessment Section of Westinghouse Hanford; John Rawlins, manager. The cognizant scientist will be Frank Schmittroth.

C. Vision

An awareness of the tank inventories, treatment options, and secondary melter waste streams is an on-going effort that must be sustained as better knowledge in these activities becomes available. The performance of the disposal depends directly on the inventory of key materials.

D. Objectives

This activity will supply the inventories in the final waste form in a manner that is supported by the on-going programs in tank characterization, in process treatments, and in melter secondary waste streams as well as theoretical analyses.

E. Deliverables

- 1) Letter report documenting the total inventory expected to be the glass waste form (June 30, 1997).
- 2) Letter report documenting the highest level of important materials to be in a single vault (June 30, 1997).

- 3) Letter report documenting review of inventory data for the preliminary performance assessment (September 30, 1997).

III. TASK DESCRIPTIONS

A. Summary List of Activities

- 1) Determine total inventory
- 2) Determine extreme inventory
- 3) Review inventory data

B. Develop total inventory

1. Detailed Description

The total inventory will be determined by reviewing available tank characterization data (both experimentation measurements and analytical extrapolations) and process flow sheet data. Such process flow data will include the split between high-level and low-level waste and the split among melter losses, off-gas losses, and waste-form incorporation.

The main contributor to this task will be Frank Schmittroth and Truc DeLorenzo.

2. Interfaces

The goal of this task is to determine the total inventory to be in the waste form. Tank characterization data and process flowsheets will be obtained from other parts of the LLW program as well as from TWRS.

3. Standards

Standards will be identified as part of this task.

4. Quality Assurance

The letter report will be peer reviewed.

5. Schedule

The task starts after the inventory data is obtained for the interim performance assessment. A letter report will be written by August 1997, and issued after review by September 30, 1997.

6. Costs

12.0 man-months of professional time costing \$154,000 is required for FY 1996 and FY 1997.

C. Develop estimate of extreme inventory

1. Detailed Description

For some calculations the maximum amount of key materials in a given disposal unit must be known. This task will determine the maximum of such key materials that may occur in a disposal unit. Individual tank inventory ratios will form a key input.

The main contributors in these task will be Frank Schmittroth and Truc De Lorenzo.

2. Interfaces

The goal of this task is to find the maximum amount of key materials. The knowledge of the order of tank processing and of individual tank inventories will be important.

3. Standards

Standards will be identified as part of this task.

4. Quality Assurance

The letter report will be reviewed before issuance.

5. Schedule

The task will start after the extreme inventory data for the interim performance assessment are obtained. A letter report documenting the current state of knowledge of extreme inventories will be written by August 30, 1997. The report will be reviewed and then issued by September 30, 1997.

6. Cost

6.7 man-months of professional time costing \$86,000 is required for FY 1996 and FY 1997.

D. Review estimates of inventory

1. Detailed Description

The estimates of the inventory will be reviewed by a group outside of the performance assessment team.

Frank Schmittroth will oversee the process.

2. Interfaces

The goal of this task is to provide independent review. This task depends upon the previous two tasks being completed.

3. Standards

Standards will be established by the review group.

4. Quality Assurance

Not applicable.

5. Schedule

The task will start as soon as the two letter reports on inventory data are issued. The review report will be issued by September 30, 1997.

6. Cost

WHC costs are covered in above costs. External costs covered in 3.3.

Accepted: _____
Frank Schmittroth

Date: _____

3.1.5 Obtain Disposal Facility Data for Preliminary Performance Assessment

I. SUMMARY

Translate design activities into information useful for preliminary performance assessment activities.

II. GENERALA. Background

The performance assessment must model the disposal facility as it will be built. As concepts are firmed into design, that evolution must be reflected in the models used in the performance assessment.

B. Organization

The responsible organization will be the Environmental Risk and Performance Assessment Section of the Westinghouse Hanford Company, John Rawlins manager. The cognizant scientist will be Fred Mann.

C. Vision

Keep the models used in the performance assessment current with the concepts and designs being considered by the program office and the architect-engineers.

D. Objectives

This activity will translate design information into an usable form for performance assessment activities.

E. Deliverables

- 1) Letter report defining geometry and volume of waste form (June 30, 1996).
- 2) Letter report defining important barriers used in design (July 31, 1997).
- 3) Letter report determining parameters for transport through important barriers (September 30, 1997), and
- 4) Letter report acknowledging review of transport parameters (December 31, 1997).

III. TASK DESCRIPTIONS

A. Summary list of tasks

- 1) Determine geometry and waste form
- 2) Determine important barriers used in design
- 3) Determine parameters for transport through barriers
- 4) Review of barrier transport parameters.

B. Determine geometry and waste form

1. Detailed Description

Contact with the architect-engineer will be maintained. After the advanced conceptual design is finished (scheduled for December 1996), the design will be used to determine the geometry and volume of the waste form used in the preliminary performance assessment.

2. Interfaces

Input data will be obtained from the architect-engineer and the interface identified by the program office.

The output of this task will be the geometry and volume of the waste form to be used in the preliminary performance assessment.

3. Standards

There are no relevant standards in this area.

4. Quality Assurance

The letter report will be reviewed before issuance.

5. Schedule

The activity will start January 1, 1997, (the advanced conceptual design being scheduled to be completed in December, 1996). The letter report will be issued by June 30, 1997.

6. Cost

FY 1996: 3.0 man-months of professional time costing \$38,000.
FY 1997: 13. man-months of professional time \$168,000.

These estimates are for all tasks covered in 3.1.5.

C. Determine important barriers used in design

1. Detailed Description

Contact with the architect-engineer will be maintained. After the advanced conceptual design is finished (scheduled for December 1996), the advanced conceptual design will be used to determine the barriers to water and solute transport.

2. Interfaces

Input data will be obtained from the architect-engineer and the interface identified by the program office.

The output of this task will be the determination of barriers in the engineered system which are important for water and solute transport.

3. Standards

There are no relevant standards in this area.

4. Quality Assurance

The letter report will be reviewed before issuance.

5. Schedule

The activity will start January 1, 1997, (the advanced conceptual design being scheduled to be completed in December 1996). The letter report will be issued by June 30, 1997.

6. Cost

Costs are included in cost estimate given above.

D. Determine parameters for transport through barriers

1. Detailed Description

Determine the transport properties of the important barriers identified in the task above. Such properties will be include hydraulic and retardation values.

2. Interfaces

The input to this task is the identification of the important barriers and values found in other tasks for hydraulic, retardation, and other parameters.

The output of this task will be the determination of transport parameters for the barriers in the engineered system which are important for water and solute transport.

3. Standards

There are no relevant standards in this area.

4. Quality Assurance

The letter report will be reviewed before issuance.

5. Schedule

The activity will start April 1, 1997, (3 months after the start of the "determine important barriers" task above). The letter report will be issued by September 30, 1997.

6. Cost

Costs are included in cost estimate given above.

Given the experience on the Grout performance assessment concerning degraded parameters, material properties values will be very important for this performance assessment.

E. Review of barrier transport parameters

1. Detailed Description

The transport properties through the barriers will be reviewed by groups external to the Steering Group. Any comments received from the reviewers shall be explicitly addressed and changes in the parameters made and documented.

2. Interfaces

The input to this task are the values of the transport parameters through the barriers and comments received from the review groups.

The output of this task will be the determination of transport parameters for the barriers in the engineered system which are important for water and solute transport as a reviewed data set.

3. Standards

There are no relevant standards in this area.

4. Quality Assurance

Comments to each reviewer response shall be documented.

5. Schedule

The activity will start October 1, 1997, (after the parameters are determined). The letter report will be issued by December 31, 1997.

6. Cost (FY 1998)

0.4 man-months of professional time costing \$5,000 is required.

3.1.6 Integrated Source-Term for Preliminary Performance Assessment

I. SUMMARY

A performance assessment of the Hanford LLW site will require a determination of the source-term for radionuclide release from the glass waste form. Through literature review, laboratory testing, and model development, this task will develop the necessary data and models for generating source-term calculations that will be used in the preliminary performance assessment.

II. GENERALA. Background

Estimates of radionuclide releases from LLW glass are needed for input to a preliminary performance assessment of a LLW disposal system at Hanford. The performance assessment will be submitted to the DOE Peer Review Panel and the public for comment. The specific characteristics of LLW glass and other disposal system components that can affect release from the glass should be largely known and incorporated in an integrated model of the engineered disposal system for this report.

B. Organization

The responsible organization will be the Materials and Chemical Sciences Center of the Pacific Northwest Laboratory (PNL), Walt Laity, Manager. The cognizant scientist will be Peter McGrail also of PNL.

C. Vision

Defensible radionuclide release calculations are needed for LLW glass in a systems performance assessment. Performing these calculations requires a defensible model that describes the alteration rate of the glass and interactions with the other components of the disposal system. By coordinating with other tasks conducting glass and engineered barrier testing, this task will incorporate the data and models developed under these tasks into a comprehensive source-term model for the engineered disposal system.

D. Objectives

The objectives for this task include:

- 1) Calculate the release of important contaminants from low-level waste glass and the engineered disposal system and provide these data as input to a systems-level performance assessment for the site.
- 2) Conduct literature reviews and interact with staff performing LLW glass and engineered barrier materials development to obtain data and models needed for release rate calculations.

- 3) Identify, modify or adapt models as needed to perform release calculations.
- 4) Plan and conduct verification and certification studies for the selected model.

E. Deliverables

- 1) Topical Report: Laboratory Confirmation Tests in Support of LLW Glass Source-Term Release Modeling (September 30, 1996).
- 2) Letter report justifying selection of a computational tool for LLW glass source-term calculations for the preliminary performance assessment (June 28, 1996).
- 3) Topical Report: Laboratory Confirmation Tests in Support of Integrated Source-Term Modeling (December 31, 1997).
- 4) Topical Report: An Integrated Source-Term Model for the Hanford LLW Engineered Disposal System (March 30, 1998).
- 5) Topical Report: Source-Term Calculations for Radionuclide Release from the Hanford LLW Engineered Disposal System (March 30, 1998).

III. TASK DESCRIPTIONS

A. Summary list of tasks

- 1) Release Model for LLW Glass
- 2) Integrated Source-Term Modeling
- 3) Source-Term Model Verification and Certification

B. Release Model for LLW Glass

1. Detailed Description

Except for the possibility of physical intrusion into the site, radionuclide release from the LLW glass is the essential first step that is required for any subsequent transport to the accessible environment to occur. The release rate from the glass is expected to dominate the overall performance of the site in the long-term so it is essential that a credible method be used to calculate releases from the glass waste form. Because release rates must be projected far into the future and over a range of environmental conditions that cannot be completely investigated in the laboratory, a model must be developed that is a reasonable and defensible representation of the system. Experience has shown that models based on fundamental principles of physics, chemistry, and thermodynamics (mechanistic models) are best suited for this application. Consequently, this task will develop and test a suitable model describing radionuclide release from LLW glass. It is expected that this model will be implemented in an integrated source-term model for the LLW disposal system.

The main contributor to this task will be Pete McGrail.

2. Interfaces

The input to this task will consist of data derived from laboratory testing done as part of glass formulation studies conducted under the Vitrification Projects of the Tank Waste Remediation System (TWRS). Because the laboratory testing and model development work will be done under different projects, close coordination and planning of the experiments by the modelers and experimentalists is essential. The output from this task will consist of a mathematical model and supporting database that will be implemented by the Integrated Source-term Modeling Task.

3. Standards

There are no relevant standards in this area. However, guidance from the DOE Peer Review Panel and from the NRC staff will be used.

4. Quality Assurance

This task will be conducted in accordance with PNL's PVTD Quality Assurance Plan ETC-001 and applicable WHC Quality Assurance Requirements.

5. Schedule

The task will start October 1, 1995, and be completed March 30, 1997, with the issuance of the source-term report for the preliminary performance assessment.

6. Cost

3.0 man-months of PNL professional time costing \$55,000 will be required for FY 1995, 1996, and 1997.

C. Integrated Source-Term Modeling

1. Detailed Description

The radionuclide release rate from glass waste forms is highly dependent upon the composition of the glass, the chemistry of the water contacting the glass and aqueous chemistry of the particular radionuclide, temperature, and the local hydrologic conditions. Because the glass will be surrounded by soil and most likely other engineered materials, the effects these materials have on the aforementioned parameters will impact release rates from the glass and overall release from the engineered disposal system. The objective of this task is to develop and/or adapt a model that is a reasonable and defensible representation of the engineered disposal system. The integrated model will incorporate the mechanistic model developed for radionuclide release from LLW

glass and models that describe the important physical, chemical, and hydrological properties of the other engineered materials planned for the disposal system. Output from the integrated model will be time-dependent fluxes for radionuclides exiting the engineered disposal system which will be used as inputs for far-field transport and dose assessment modeling.

2. Interfaces

Inputs to this task will come from virtually every task on the Hanford Tank Low-Level Waste project that is responsible for characterizing the physical and chemical properties of the site and the engineered materials being developed for the disposal system. The main outputs will be to the tasks responsible for far-field transport and dose assessments.

3. Standards

There are no relevant standards in this area.

4. Quality Assurance

This task will be conducted in accordance with PNL's PVTQ Quality Assurance Plan ETC-001 and applicable WHC quality assurance requirements.

5. Schedule

The task will start October 1, 1996, and be completed September 30, 1997.

6. Cost

FY 1995: PNL costing \$274,000.
Also \$25,000 of capital equipment funds for computers.
FY 1996: PNL costing \$200,000
FY 1997: PNL costing \$200,000

D. Source-Term Model Verification and Certification

1. Detailed Description

The integrated source-term model developed under the Integrated Source-Term Modeling Task will be subjected to verification and certification testing to build confidence in the reliability of the model for calculating release rates from the engineered disposal system. Verification testing will consist of checking code outputs against standard analytical solutions and against benchmark cases run with other computer codes. Verification testing will be performed routinely during model development in accordance with software control procedures.

Certification tests will consist of controlled laboratory experiments designed to test release and migration predictions of radionuclide contaminants through idealizations of the engineered disposal system. The laboratory tests will primarily involve long duration flow-through tests in columns packed with LLW glass, engineered barrier materials and/or Hanford soils. Wierenga columns, modified to accommodate studies under unsaturated conditions and to conduct geochemical analyses are ideally suited to these tests. These columns in conjunction with the Unsaturated Flow Apparatus (UFA) will be used to obtain unsaturated hydraulic property measurements as needed to support modeling calculations. Testing in FY 1997 and FY 1998 will focus on the important radioactive elements that have been identified as key dose contributors in the

The main contributors to this task will be Clark Lindenmeier and Pete McGrail.

2. Interfaces

Inputs to this task will come from virtually every task on the Hanford Tank Low-Level Waste project associated with development and application of engineered materials for processing and final disposal of LLW. Additionally, this task will be closely coordinated with the Integrated Source-Term Modeling Task to help define the test configurations and test parameters that will best evaluate the underlying assumptions and theories incorporated in the integrated source-term model.

3. Standards

There are no relevant standards in this area.

4. Quality Assurance

This task will be conducted in accordance with PNL's PVTD Quality Assurance Plan ETC-001 and applicable WHC quality assurance requirements.

5. Schedule

The task will start October 1, 1996, and be completed September 30, 1998.

6. Cost

FY 1995:	PNL costing \$137,000
FY 1996:	PNL costing \$300,000
FY 1997:	PNL costing \$205,000

IV. OTHER CONSIDERATIONS

The inputs to this task will derive mainly from experimental studies being conducted on other tasks in Hanford Tank Low-Level Waste Technology Development Program and from other projects within the Tank Waste Remediation System. As such, close involvement and coordination of efforts between staff working on these projects is essential.

Accepted: _____
Bernard P. McGrail

Date: _____

3.1.7 Hydrologic Data and Conceptual Model Testings

I. SUMMARY

Design experiments to determine site-specific hydrologic data needed for near-field media (matrix, walls, and back-filled soil) and for vadose zone (far-field media). Note that glass release rate, recharge rate, and retardation factors are covered in other activities. Design experiments to evaluate whether we have the appropriate and necessary conceptual model for the LLW performance assessment.

II. GENERALA. Background

The Peer Review Panel (the group selected by the Department of Energy to judge whether a performance assessment is technically adequate) has mandated that site-specific data used in the analyses of water flow and contaminant transport be selected and justified. Such selection and justification can be based on expert judgement, available literature, or project-specific experiments.

The hydraulic properties of backfill materials (matrix) emplaced as part of engineered disposal system require a close study. The materials selected might present very different flow field to the contaminant transport. To examine the effect on the contaminant transport, conceptual models have to be developed and evaluated by numerical models. Methods for dealing with characteristics of fractures will be explored, if the material that is selected may experience fracturing.

Vadose zone flow and transport models are recognized as necessary tools for baseline risk assessments. The purpose of these models is, in part, to "...evaluate the potential migration of contaminants within vadose zone soils to the water table..." (DOE 91). Confidence in the predictions of these models improves progressively as they are repeatedly shown to represent reality.

The proposed experiments are designed to help resolve outstanding technical issues related to current vadose zone flow and transport modeling at Hanford such as: (1) how to resolve differences between field and laboratory measurements of water retention characteristics and unsaturated hydraulic conductivities, (2) how representative are laboratory measurements of unsaturated hydraulic conductivity determined using centrifugation techniques relative to estimates obtained using other methods, and 3) how to address the issue of scale and to build up the confidence in the predictions of the vadose zone flow and transport models.

B. Organization

The cognizant organization is the Environmental Risk and Performance Assessment Section of Westinghouse Hanford; John Rawlins, Manager. The cognizant scientists will be Allen Lu. Supporting this effort will be the Geosciences groups of Westinghouse Hanford and of the Pacific Northwest Laboratory.

C. Vision

As noted above, the acquisition of justifiable data and build-up of confidence of the model prediction are essential aspects for a successful performance assessment.

D. Objectives

This activity will supply an activity and budget plan for the fiscal years 95 through 97 for obtaining justifiable hydrologic data and performing field experiments to check whether we have the appropriate and necessary conceptual model for the performance assessment.

E. Deliverables

- 1) A letter report describing the methodology of the field experiment and the results of the hydraulic property measurements will be prepared by September 30, 1995.
- 2) Manuscripts describing the hydraulic properties estimated using the different field and laboratory methods and the observed and simulated flow and transport results from the proposed experiments will be prepared for submittal to a peer reviewed journal(s).
- 3) Letter report describing the entire process, from data collection to model prediction of the Injection Site (Sisson and Lu, 1984), will be prepared by Sept. 30, 1995.
- 4) An interim report summarizing the field data and analysis of the controlled experiment at the adjacent to the Glass disposal facility will be prepared by September 30, 1997.
- 5) A report on conceptual model of hydraulic properties from literature and description of evaluation and output of flow field for preliminary performance assessment (June 30, 1995).
- 6) A report on hydraulic property measurement results (September 30, 1996).
- 7) A report on conceptual model of hydraulic properties from literature and description of evaluation and output of flow field for preliminary performance assessment (September 30, 1997).
- 8) A letter report describing increased capabilities at the Geotechnical Engineering Laboratory (September 1995).

- 9) A letter report documenting and justifying hydraulic properties of matrix materials to be used in preliminary performance assessment (september, 1997).

III. TASK DESCRIPTIONS

A. Summary List of Activities

- 1) Field measurement of unsaturated hydraulic conductivities using a modified Instantaneous Profile Method (IPM).
- 2) Controlled field testing of flow and transport models.
- 3) Disposal site testing of flow and transport model.
- 4) Development of conceptual models for flow in the near field.
- 5) Upgrade tools for measurement of hydraulic properties at the Geotechnical Engineering Laboratory.
- 6) Determination of hydraulic properties of matrix materials.

B. Field measurement of unsaturated hydraulic conductivities using modified IPM

1. Detailed Description

A series of field experiments at or near the anticipated location for siting of the LLW disposal facility will be conducted. The experiments will be based on a modification of the instantaneous profile method for estimating unsaturated hydraulic properties. The proposed experiments should be conducted at different depths as the site for the LLW disposal facility is excavated, to obtain depth profiles of the hydraulic properties, and to ensure that the estimated hydraulic properties are site-specific.

Field plots will be instrumented with neutron probe access tubes and tensiometer for measurements of water content and pressure head, respectively. In addition, the field plots will be instrumented with probes for measuring water content and tracer breakthrough curves using time domain reflectometry (TDR). Chloride will be used as a conservative tracer in the experiments. The tensiometer will be fitted with transducers, and the TDR system will be automated and multiplexed for continuous, near real-time data acquisition.

A staged approach is recommended for the proposed experiments. Potential test sites should be located during the early part of FY 1995. The automated TDR system will also be developed and tested during the early part of FY 1995. A preliminary field experiment will then be conducted at the selected test site.

Additional field experiments will be conducted in early FY 1996 at a location near or within the actual area proposed for the LLW disposal facility (preferably at different depths as the area is excavated, and at the base of the excavation).

Allen Lu will oversee the task. The principal investigators on this activity will be Mark Rockhold (PNL). Mike Fayer (PNL), Raz Khaleel (WHC), Andy Ward (PNL), and Randy Kirkham (PNL will provide TDR, field data acquisition, and data analysis support. John Relyea (WHC) and Paula Heller (WHC) will provide support for laboratory measurements of physical and hydraulic properties. Jim Conca (WSU) will provide support for centrifuge measurements.

2. Interfaces

Interfaces will be maintained with other team members dealing with parameters not covered in this task to understand the possible range of parameters and with the Geosciences groups of Westinghouse Hanford and of Pacific Northwest Laboratory to understand the ranges of parameters important in this work.

3. Standards

There are no standards in this area. However, past experience with risk and performance assessments will be used to guide activities.

4. Quality Assurance

The progress report will be reviewed frequently. In FY 1997, a more formal report will be generated which will be peer-reviewed and submitted for external publication.

5. Schedule

FY 1995: Potential field sites for the instantaneous profile experiments (IPM) will be identified by March 30. The automated TDR system will be developed and tested by April 30. A field experiment will be initiated at a selected test site in May.

FY 1996: The results from these experiments and parameter estimates will be provided for performance assessment calculations by July 15, 1996.

FY 1997: The journal manuscripts describing the results of the proposed experiments and measurements will be completed and submitted to a peer-reviewed journal by April 30. Peer review comments will be addressed as needed.

6. Costs

FY 1995: 2.3 man-months of WHC time costing \$29,000. Additional costs are PNL \$183,000 and external \$46,000 for a total of \$258,000.

The costs for FY 1996 and FY 1997 are \$297,000 and \$47,000, respectively.

C. Controlled field testing of flow and transport models

1. Detailed Description

The 1980 injection experiment (Sisson and Lu 1980) was an ambitious attempt to collect field data for model calibration and testing, but a thorough analysis of the data was never completed and published. Given the advances in knowledge, computational capabilities, and models over the last 14 years, it is important that a present-day analysis of the data be completed. During the last several years, researchers have revisited this data set, but as yet, no definitive conclusions have been published. Before proceeding to other experiments and history-matching exercises, this analysis must be completed.

A recent review of the data set from the injection experiment indicated concerns about the neutron probe calibration (Fayer et al. 1993). Relogging the site with better instrumentation and, at the same time, relogging with the original neutron probes (i.e., cross-calibrating), will provide much better estimates of water contents during the experiment. In turn, the better water content estimates will allow for a better check of the overall mass balance of the experiment. More sensitive gamma detectors will better delineate variations in stratigraphy and bulk density. In particular, the slope and aspect of individual layers will be determined. With the knowledge gained from this analysis, we can determine whether it would be fruitful to continue studies at the injection site, propose a new site, or cease testing altogether.

In addition to the 1980 injection experiment, a new injection experiment with objectives oriented to the needs of the Glass performance assessment project will be considered. Monitoring equipment today is vastly improved. Instruments such as TDR probes enable us to take more or less instantaneous measurements of water content distributions, something that is not possible with the neutron probe method. TDR measurements can also be taken at a much higher spatial and temporal frequency than the neutron probe.

Allen Lu will oversee the task. Principal Investigators Mike Fayer, Charley Kincaid, Mark Rockhold, Rick Lewis, Bob Engelman, John Smoot, Jeff Serne

2. Interfaces

Results will be presented to technical community and reviews and comments will be solicited. The findings will be provided to the vadose zone modeling team so they may be used directly in the preliminary and final performance assessment.

3. Standards

There are no standards in this area. However, past experience with risk and performance assessments will be used to guide activities.

4. Quality Assurance

The progress report will be reviewed frequently. A more formal report will be generated which will be peer-reviewed and submitted for external publication.

5. Schedule

FY 1995: The 32 wells at the injection site will be logged for water content, bulk density, and natural gamma. This information will be used to revise the conceptual model. The experiment will be simulated once more and the predictions compared quantitatively with the measurements. The entire process, from data collection to model prediction, will be published. This report will include an evaluation of the injection experiment for model testing.

FY 1996: A new field experiment will be designed with objectives oriented to the needs of the Glass performance assessment project and at a site appropriate to the proposed disposal site. This experiment will utilize new monitoring equipment such as TDR probes, which enable more or less instantaneous measurements of water content distributions and thus measurements with a much higher spatial and temporal frequency than the neutron probe. The proposed test will be coordinated with the task on hydraulic property characterization. The test may utilize an existing instrumented site. A test plan will be prepared and submitted for review.

FY 1997: The controlled field test will be initiated and an interim report summarizing the field data and analysis will be prepared by September 30, 1997.

FY 1998: Future activities covered in 3.4.7.1.

6. Cost

FY 1995: 3.1 man-months of WHC time costing \$41,000. PNL costs are \$202,000. Total FY 1995 costs are \$243,000.

The total costs for FY 1996 and 97 are \$64,000 and \$194,000, respectively.

D. Disposal site testing of flow and transport model

1. Detailed Description

Of concern to the Glass Pa project must be the issue of scale. The 1980 injection experiment looked at transport 1 to 2 m from the injection well in a period of less than 1 year. In contrast, the actual site dimensions could be as much as 100 m from the waste to the water table, occurring over 100's to 1000's of years. To overcome these scale differences, we propose analyzing one or more past events such as tank leaks and crib discharges. The length scales should be appropriate but the time scales will necessarily be shorter than 1000's of years. However, at 20 to 30 years, the time scale would be far better than that of the 1980 injection experiment. The estimates of the inventory will be reviewed by a group outside of the performance assessment team.

Allen Lu will oversee the task. Principal Investigators Mike Fayer, Charley Kincaid, Mark Rockhold, Rick Lewis, Bob Engelman, John Smoot, Jeff Serne.

2. Interfaces

Results will be presented to technical community and reviews and comments will be solicited. The findings will be provided to the vadose zone modeling team so they may be used directly in the preliminary and final performance assessments.

3. Standards

There are no standards in this area. However, past experience with risk and performance assessments will be used to guide activities.

4. Quality Assurance

The progress report will be reviewed frequently. A more formal report will be generated which will be peer-reviewed and submitted for external publication.

5. Schedule

FY 1995: The available information on past contaminant releases to the vadose zone will be reviewed. This review will build on the initial data screening reported by Kincaid et al. (1993). It

will also summarize all previous attempts at history matching at the Hanford Site and report the lessons learned. Following this review, a test plan will be prepared that identifies and prioritizes three releases to the vadose zone that will serve as tests of vadose zone models. The test plan will specify the testing objectives to be achieved (e.g., matching water contents and concentrations) and the accuracy desired; these goals will be consistent with the performance objectives of the interim LLW performance assessment (WHC 1994). The test plan will be submitted for review and concurrence before proceeding.

FY 1996: All available data for the three sites will be obtained and analyzed. The disposal sites will be simulated and the predictions compared with the available data. The comparison will be evaluated quantitatively.

FY 1997: The sites will be cored to characterize the distribution of selected contaminants from the disposal zone to the water table. To the extent practicable, this activity will be coordinated with ongoing activities (e.g., RI/FS work) to minimize sampling redundancy.

FY 1998: Future activities covered in task 3.4.7.2.

6. Cost

FY 1995: 1.0 man-moth of WHC time costing \$12,000. PNL costs are \$35,000 for a total of \$47,000.

The total costs for FY 1996 and 97 are \$201,000 \$825,000, respectively.

E. Development of conceptual models for flow in the near field

1. Detailed Description

The glass waste form will be placed in the ground with backfill materials. The backfill materials will be selected with specific engineering and contaminant transport properties to limit release from the waste form. Work has been performed for both high-level and low-level waste programs to determine hydraulic properties of materials emplaced as part of engineered disposal systems. The output of this task activity will be input to reactive transport modeling for determining release rates. Criteria for the end product of this task will be specified by the Release Rates Task (McGrail).

Allen Lu, Frank Schmittroth and Mel Piepho will oversee the task. Contributors include unidentified PNL Scientists and other potential contributors.

2. Interfaces

Primary interfaces consist of the architect-engineer selecting matrix materials for consideration and the scientist performing release-rate calculations.

The output of this task will be flow fields used by the staff performing release rate calculations for the preliminary performance assessment.

3. Standards

There are no relevant standards in this area. However, guidance from the DOE Peer Review Panel and from the NRC staff will be used.

4. Quality Assurance

The report will be subjected to peer review before it is issued. Periodic reviews of work in progress

5. Schedule

FY 1995: Conceptual model formulation for different materials proposed for the matrix surrounding the glass waste form, identification of hydraulic properties based on literature review, and evaluate with numerical models for output of flow fields to reactive transport models for the preliminary performance assessment.

FY 1996: Conceptual and numerical models will be developed to evaluate performance and provide flow fields for the release rate calculations. Once the field of proposed matrix materials is narrowed to several, hydraulic properties will be measured in the laboratory. A sufficient number of measurements will be made to characterize uncertainties in the hydraulic properties. The data will be analyzed with standard retention relationships and the unsaturated hydraulic conductivity curves calculated. Methods for dealing with characteristics of fractures will be explored, if the matrix material that is selected may experience fracturing.

FY 1997: Contact with the architect-engineer will be maintained for specification of the materials to be considered. After the final materials are selected for consideration, conceptual and numerical models will be developed to evaluate performance and provide flow fields for the release rate calculations.

6. Cost

FY 1995: \$82,000 is requested. The distribution is unknown until the matrix material is better defined.

The total costs for FY 1996 and FY 1997 are \$150,000 each.

F. Upgrade Tools for Measurement of Hydraulic Properties at the Geotechnical Engineering Laboratory

1. Detailed Description

The Westinghouse Hanford Company Geotechnical Engineering Laboratory needs upgrading, especially for hydraulic properties measurements. The current situation is scientifically not competitive, overly expensive, and is not structured for delivering a large number of data of minimum acceptable quality. A relatively modest investment in laboratory equipment can make the facility competitive and yield reliable and accurate measurements. Especially attractive is the use of the multi-step outflow method for measuring the unsaturated hydraulic conductivity function. This procedure permits simultaneous measurements of the moisture retention and hydraulic conductivity functions. The equipment needed, among others, are pressure cells, ceramic plants and cups, valves, transducers, microloggers, multiplexers, and tensionmeters. An example of a fully automated system is that of Dr. Hopmans of the Department of Land, Air, and Water Resources, University of California, Davis.

The cognizant organization will be the Geotechnical Engineering Laboratory; Harold Benny, Manager. The cognizant engineer will be John Relyea. Raz Khaleel will oversee the task.

2. Interfaces

Besides interacting with Dr. Hopmans, the task leader will interact with the team needing hydraulic measurements to fine tool the upgrades..

The output of this task will be improved and cheaper data measurements.

3. Standards

There are no relevant standards in this area. However, previous laboratory experience will be utilized.

4. Quality Assurance

The report will be subjected to peer review before it is issued.

5. Schedule

The upgrade will be completed in FY 1995 with a letter report issued documenting the new capabilities.

6. Cost

The requested amount is \$88,000.

Accepted: _____
Allen Lu

Date: _____

3.1.8 Recharge

I. SUMMARY

Generating defensible estimates of recharge rates at the Hanford Site for use in the preliminary performance assessment.

II. GENERALA. Background

Recharge is a major driver for contaminant transport through the vadose zone to the water table. A clear understanding of recharge under potential future climate, soil, and vegetation is therefore of great importance to the performance assessment activities.

B. Organization

The cognizant organization is the Environmental Risk and Performance Assessment Section of Westinghouse Hanford Company; John Rawlins, Manager. The cognizant scientist will be Raz Khaleel. Supporting this effort will be the Geosciences Group of the Pacific Northwest Laboratory (in particular, M.L. Rockhold, M.J. Fayer, G.W. Gee, C.T. Kincaid, and Ellyn Murphy).

C. Vision

A lack of accurate and technically defensible recharge estimates will result in the use of conservative data in performance assessment modelling.

D. Objectives

The objective of this task is to provide defensible estimates of recharge rates for current and long-term conditions applied to the shallow-land disposal of LLW at the Hanford Site.

E. Deliverables

- 1) Proceedings from the recharge workshop will be published by September 1995.
- 2) A letter report describing the present status of the lysimetry experiments by July 31, 1997.
- 3) A letter report describing the present status of the understanding of evapotranspiration at Hanford by July 31, 1997.
- 4) A letter report describing the present status of tracer measurements by July 31, 1997.
- 5) A letter report describing the present status of the understanding of recharge at Hanford December 31, 1997.

III. TASK DESCRIPTIONS**A. Summary List of Activities**

- 1) Recharge Workshop
- 2) Lysimetry
- 3) Evapotranspiration Studies
- 4) Tracer Measurements
- 5) Integrated Recharge Assessment

B. Recharge Workshop**1. Detailed Description**

A recharge workshop is scheduled for March 1995. This workshop will focus specifically on recharge issues that will affect LLW disposal actions. During the workshop, a qualified external peer review panel will review the completed PNL summary report and all other available recharge information. Proposals and options for a comprehensive field test will be made to evaluate the effects of spatial variability and measurement uncertainties on estimated recharge rates.

Raz Khaleel will lead the organization of the workshop. Others involved in others tasks in these activities will also play leading roles.

2. Interfaces

Because the local Hanford experts mentioned above, other nationally known experts will be invited.

3. Standards

There are no standards in this area.

4. Quality Assurance

Not applicable

5. Schedule

The workshop is scheduled for March 1995. Proceedings from the workshop will be published by September 1995.

6. Costs (FY 1995)

1.3 man-months of professional time costing \$17,000. PNL costs are \$16,000 while external costs are estimated to be \$33,000.

C. Lysimetry

1. Detailed Description

Data from the weighing lysimeters at the FLTF and several other sites will be compiled and analyzed to support the process evaluation and numerical modeling efforts described below under task 3. A formal test plan will also be prepared outlining options for retrofitting several of the lysimeters at the Field Lysimeter Test Facility (FLTF) to reflect potential land use change scenarios (i.e., irrigated agriculture) and future climate change. The FLTF is located between the 200 East and West areas, adjacent to the Hanford Meteorological Station (HMS). The lysimeters at the facility are currently configured to test the performance of various capillary barrier cover systems under ambient and 2 or 3 times long-term average precipitation.

The lead contributor to this task will be Gleedon Gee.

2. Interfaces

This supplements long-standing work at Hanford.

3. Standards

There are no standards in this area.

4. Quality Assurance

The reports documenting this work will be peer-reviewed.

5. Schedule

The work will begin October 1, 1994, with a letter report describing the present status of the experiments by July 31, 1997.

6. Cost

FY 1995: 66,000

Fiscal year costs are included in section F.

D. Evapotranspiration

1. Detailed Description

One of the most important processes affecting recharge estimates obtained using numerical simulation models is evaporation (or evapotranspiration). Potential evapotranspiration (PET) is a measure of the maximum amount of water that can be absorbed into the atmosphere given the atmospheric vapor density and radiant energy condition. PET at the Hanford Site has typically been calculated from solar radiation, wind speed, and other weather

data recorded by the HMS. Estimates of PET rates under arid site conditions have been shown to be significantly greater than actual evapotranspiration rates, except when the soil is close to saturation. Therefore, a need exists for quantifying actual rates of evapotranspiration for specific soil and vegetation types and climatic conditions typical of the Hanford Site. Data from the weighing lysimeters at the FLTF and other locations on the Hanford Site provide the only direct method for measuring actual soil evapotranspiration rates. However, rigorous analyses of data from these weighing lysimeters specifically for evaluating evapotranspiration rates have not been conducted. Selected subsets of data from these weighing lysimeters will be analyzed to quantify actual evapotranspiration rates. Detailed numerical simulations of the soil-water dynamics in the weighing lysimeters will then be conducted using the UNSAT-H computer model. Observed and simulated results will be compared and the most accurate mechanistic and/or empirical descriptions of evapotranspiration will be determined and documented.

The lead contributor to this task will be Mark Rockhold.

2. Interfaces

These analyses will be based on past and continuing lysimeter work at Hanford.

3. Standards

There are no standards in this area.

4. Quality Assurance

The reports documenting this work will be peer-reviewed.

5. Schedule

The work will begin October 1, 1994, with a letter report describing the present status of the understanding of evapotranspiration at Hanford by July 31, 1997.

6. Cost

FY 1995: \$ 82,000 for PNL

Fiscal year 1996 and 1997 costs are included under section F.

E. Tracer Measurements

1. Detailed Description

Lysimeter measurements provide information on understanding recharge in a controlled environment during the recent past. At Hanford, where the record is among the longest, the recent past is

measured in years. Measurements covering longer times are possible using radioactive and chemical tracers (for example, chlorine, ^{36}Cl , and tritium). This work will determine recharge rates as a function of time since the last glacier reflood (approximately 13,000 years ago) by determining the location and amount of natural and artificial tracers in relatively near surface boreholes. Information at other Hanford sites (performed by Battelle and by the United States Geological Survey) indicate a long-term recharge rate significantly below that used in previous performance assessments.

The lead contributor to this task will be Ellen Murphy.

2. Interfaces

These analyses will be based on past and continuing tracer work at Hanford.

3. Standards

There are no standards in this area.

4. Quality Assurance

The reports documenting this work will be peer-reviewed.

5. Schedule

The work will begin October 1, 1994, with a letter report describing the present status of the understanding of long-term recharge using tracer techniques at Hanford July 31, 1997.

6. Cost

FY 1995: \$59,000 for PNL and \$37,000 for external.

FY 1996: \$250,000 total

FY 1997: 90,000 total

F. Integrated Recharge Assessment

1. Detailed Description

The objective of this task is to integrate and evaluate the recharge estimates made using various techniques (i.e., lysimetry, tracers, numerical simulation, etc.). This task will also investigate issues regarding the effects of spatial variability and measurement uncertainty on the recharge estimates made using various techniques. This work will be conducted in collaboration with the environmental tracers task to identify and select appropriate sites for field sampling. A trench will be excavated adjacent to a selected borehole used for sampling of environmental tracers. Detailed characterization and analyses of

plant types, surface coverage, rooting depths and distributions, chloride concentrations, bulk densities, particle-size distributions, hydraulic properties, etc., will be conducted using samples collected during excavation of the trench. The characterization data will be used to estimate parameters for numerical simulations of soil-water dynamics at the site. Predicted recharge rates will be compared with estimates obtained using the chloride mass balance method and other techniques to provide independent confirmation and confidence in the recharge rate predictions. The variability in the recharge rates generated using the various techniques will provide estimates of uncertainties associated with both spatial variability and measurement errors.

The lead contributor to this task will be Mark Rockhold.

2. Interfaces

These analyses will be based on past and continuing lysimeter and tracer work at Hanford.

3. Standards

There are no standards in this area.

4. Quality Assurance

The reports documenting this work will be peer-reviewed.

5. Schedule

The work will begin October 1, 1994, with a letter report describing the present status of the understanding of recharge at Hanford December 31, 1997.

6. Cost

FY 1995: \$104,000 for PNL

Fiscal year 1996 and 1997 include costs for sections C (Lysimetry) and section D (Evapotranspiration) as well as this section:

FY 1996:	\$347,000 total
FY 1997:	\$265,000 total

3.1.9 Determination of Chemical Transport Data for the Preliminary Performance Assessment

I. SUMMARY

The Hanford LLW performance assessment requires knowledge on site-specific chemical retardation of contaminants that leach from the vitrified glass wastes and percolate through the vadose zone sediments into the upper unconfined aquifer. Chemical retardation of the contaminants through native sediments and engineered barriers emplaced in the near-field will be quantified in this activity. The data will be obtained through literature review, bench-scale laboratory testing, and mechanistic and empirical modeling. Long-term confirmation analyses will be attempted using critical analyses of available thermodynamic and natural analogue information gleaned from the literature. The major activity will be empirical laboratory testing using traditional batch and column techniques and the newly developed UFA (unsaturated flow apparatus) to generate site-specific and waste-form-specific chemical retardation data compatible with the needs of near- and far-field transport computer codes. The emphasis for the preliminary performance assessment will be on obtaining accurate measurements of distribution coefficients (K_d or R_f values) for Tc, Np, and U in Hanford soils and engineered waste-form materials/barriers. The empirical data will be generated in an iterative fashion such that some chemical retardation data of key contaminants will be available to other groups at each time that the performance assessment calculations are planned.

The second most important effort will be to provide a cohesive technical defense of the approach to resolve technical issues. Several geochemical issues that need discussion include: (a) appropriate lab methods to obtain accurate K_d/R_f results for low absorbing contaminants, i.e., the "small- K_d issue", (b) dependency of K_d on moisture content, (c) appropriate treatment of sorption on coarse material, i.e., the "gravel-corrected- K_d issue", (d) long-term extrapolation of short-term laboratory data using thermodynamic and natural analogues, (e) adequacy of the K_d approach versus more mechanistic adsorption conceptual models, and (f) influence of colloids on facilitating contaminant transport.

II. GENERAL

A. Background

Contaminant retardation describes the rate of contaminant transport relative to that of groundwater or vadose-zone water. It includes processes such as surface adsorption, matrix diffusion into internal pores, precipitation and physical filtration of colloids. Many contaminants react strongly with natural and engineered adsorbents and are found to migrate 10^2 to 10^6 times more slowly than the water. For radionuclides, decay to stable daughter products can often reduce the potential hazards below levels of consequence. A simple method used to quantify retardation is to perform bench-scale laboratory tests using simulated waste form leachates and representative adsorbents (sediments, rocks, engineered barriers) to measure distribution coefficients, K_d/R_d

values. Simply stated, K_d values are a direct measurement of the partitioning of a contaminant between the solid (adsorbents) and aqueous phases. Although a simple concept, measurement of K_d values and their correct use in subsequent transport calculations can be quite challenging. Technical issues and complexities of the K_d approach will be summarized with emphasis on issues relevant to Hanford LLW glass vitrification in the September 1994 report. Briefly, some of the complexities associated with the K_d approach include: they are applicable to only trace amounts of contaminants in the aqueous and solid phases, the relationship between the amount of contaminant in the solid and liquid phases must be linear, and equally rapid adsorption and desorption kinetics must exist. Perhaps the greatest limitation of K_d values is that they are only appropriate for a single species (either as a free ion, e.g., Pu^{4+} , or as a complex, e.g., PuO_2^{2+}) under the solution and solid phase conditions they were measured in the laboratory.

Site specific studies are necessary because the K_d concept is an empirical metric that attempts to account for various chemical and physical retardation mechanisms that are influenced by a myriad of variables. It is therefore essential to use representative materials (adsorbents and aqueous leachates) and to perform laboratory tests under realistic geochemical and hydrological conditions. Sensitivity studies that vary key variables over realistic ranges are important to build technical defensibility. Such tests and supporting analyses (thermodynamic and natural analogues) will be the goal of this activity.

Previous to the UFA method, few efficient and direct measurements of transport properties in any porous media over the entire range of fluid contents from saturated to unsaturated conditions were available. As a result, few direct measurements have been obtained under unsaturated conditions, and none under highly unsaturated conditions, leading to use of non-defensible (or very conservative) estimates for predictive modeling. The UFA technology was developed to fill this void in characterization. The PNL UFA, located in a zone approved for experimenting with radioactive materials in the 300 Area, together with UFAs at the WSU Tri-Cities can perform chemical transport experiments necessary to predict contaminant transport in the near-field matrix/barriers and far-field vadose zone.

Data of increasing detail and pedigree will be available for each of the three system performance assessment calculations scheduled for completion September, 1997. Ancillary analyses and discussion that justifies the K_d values chosen and addresses the long-term validity of the values will be prepared for consideration of the various internal and external peer reviewer panels.

B. Organization

The cognizant organization is the Environment Risk and Performance Assessment Section of Westinghouse Hanford Company; John Rawlins, Manager. The cognizant scientist will be Mel Piepho.

The lead for the bench-scale laboratory testing and data synthesis will be the Geochemical Transport Group within PNL's Earth and Environmental Sciences Center. The melding of the Kd data within the transport codes, sensitivity calculations, and technical issues discussions will be performed by M. G. Piepho of the WHC Environmental Risk and Performance Assessment (ERPA) Section. Washington State University-TriCities Campus staff will aid in the UFA experiments.

Key technical staff and their affiliations include R. J. Serne and D. I. Kaplan (PNL), M. G. Piepho and J. W. Shade (WHC) and J. A. Conca (WSU).

C. Vision

The acquisition of all chemical retardation data for many species is a very expensive endeavor. By performing only those experiments and tests really needed, planned budgets may be able to be reduced and unnecessary conservatism in transport calculations can be avoided.

D. Objectives

The objective of this task is to determine the waste-form-specific chemical retardation data for vadose zone transport in the near (matrix, engineered barriers, and back-filled sediments) and far fields. This activity will supply the defensible Kd values and appropriate technical justification for the chosen values. Using retardation factors (derived from Kd values) in the performance assessment calculations greatly reduces unnecessary conservatism.

E. Deliverables

- 1) WHC report (or letter report) on geochemical software needs and availability (September 1995).
- 2) WHC report on geochemical workshop (December 1995).
- 3) WHC report on geochemical issues and their resolutions (June 1996).
- 4) Progress letter reports on geochemical data measurements (September 1996 and September 1997).
- 5) PNL letter report of the effective diffusion coefficient values for the preliminary performance assessment.
- 6) PNL letter report of updated pedigreed data set of effective diffusion coefficient values will be issued for the preliminary performance assessment (September 1997).
- 7) A topical paper of "Proper Treatment of Reactive Contaminant Diffusion in Partially Saturated Sediments" (September 1996).

- 8) A topical paper of "Influences of Moisture Content on Measured Kd Values" (June 1996).
- 9) A topical paper of "Technical Rationale for Chemical Retardation Values Used in the preliminary performance assessment (March 1997).
- 10) A topical paper of "Technical Rationale for Chemical Retardation Values Used in the preliminary performance assessment" (July 1997).
- 11) A topical paper of "Importance of Colloid-facilitated Transport of Contaminants for Hanford LLW Performance Assessment" (June 1997).

III. TASK DESCRIPTION

A. Summary List of Activities

- 1) Measure chemical retardation of Tc, Np, and U in Hanford soils/engineered materials with Hanford water to determine accurate small Kd values or retardation factors, Rf values. Determine or confirm conceptual model for moisture-dependent Rf/Kd values and gravel-corrected Rf/Kd values, and develop "variable Kd values". Longer-term develop data for other contaminants and solubility/precipitation of contaminants in near field barriers.
- 2) Hold geochemical workshop to help determine the best data acquisition methods for geochemical data for Hanford soils and for matrix/engineered barriers, and help resolve or confirm geochemical issues.
- 3) Determine geochemical-software needs and search for geochemical software for use at Hanford.
- 4) Apparent Diffusion Coefficients for Contaminants in the Vadose Zone Sediments at the Hanford LLW Site.
- 5) Natural Analog and Technical Defensibility and Final Resolution of Technical Issues and Engineered Barriers.

B. Determination of Kd/Rd Values for Key Contaminants in Vadose Zone Sediments and Engineered Barriers

1. Detailed Description

Current batch adsorption test methodology, which are performed at high water to solid ratios, may not accurately measure small Kd values in the zero to one range, which is a very important (sensitive) range for performance assessment results. Conducting column studies to measure breakthrough curves of key species is an alternative way to indirectly obtaining Kd values. The breakthrough curve provides a retardation factor, which is the ratio of groundwater velocity to species velocity, and then a Kd

value can be calculated from the retardation factor. The UFA method may be very efficient in calculating these breakthrough curves. The UFA reaches hydraulic steady-state rapidly and easily in most porous medium and fluid over the hydraulic conductivity range of 0.1 cm/s to $1\text{E-}12$ cm/s in hours to days. The UFA combines the large driving forces obtainable from ultracentrifugation techniques with precision fluid flow through rotating seals (Conca and Wright, 1992). The UFA consists of an ultracentrifuge with an external constant, ultra low, high-precision flow-rate pump which provides fluid to the sample surface through a rotating seal assembly and microdispersal system. Accelerations up to 20,000 G at temperatures from -20 to 150 degrees C and non-pulsating flow rates as low as 0.001 ml/hr are attainable. Sample sizes up to 130 cm³ can be used. Various sample holders made of different materials (e.g., teflon, titanium, stainless steel, copolymers, and nylon) are available to address the many chemical compatibility requirements of various situations. The effluent is collected for chemical analyses in a transparent, volumetrically calibrated container at the bottom of the sample assembly which can be observed during centrifugation using a strobe light. K_d values will also be determined under unsaturated conditions through the use of the Wierenga flow-through column. Values determined by these two methods will be compared to each other as well as to those generated under saturated conditions.

Radionuclide retardation is strongly dependent on the chemistry of the mobile (groundwater) and immobile (sediment) phases, the degree of saturation, and the unique solubility/precipitation and adsorption properties of each contaminant. No single K_d can adequately describe the partitioning of a contaminant in the range of environmental conditions likely present in both the near and far fields of the Hanford LLW Site. To address this issue, "variable K_d values" will be developed, that is K_d values that will vary with the aqueous and solid phase conditions of the flow path. Variable K_d values will be developed through a systematic series of bench-scale laboratory studies by determining the empirical relationships between K_d values and various important geochemical parameters, such as ionic strength, competing ions, pH, number of sorption sites, etc. (thus variable $K_d = f[\text{ionic strength, competing ions, pH, number of sorption sites, etc.}]$).

The solubility of some contaminants of interest may be sufficiently low that release from the barrier material form will be limited by a solid phase that has precipitated. If so, the maximum solution concentration is time invariant (assuming chemical conditions remain constant in the area where precipitation has occurred) and determined by the equilibrium reaction between the phase and recharge water. The equilibrium solution concentration can then be used as the source-term for release from the precipitate.

Estimates of solubilities are necessary for all radionuclides or contaminants so that a decision on the appropriate source-term can be made. To perform sorption experiments unambiguously, it is also necessary to ensure that initial radionuclide or contaminant concentrations do not exceed solubility. If concentrations exceed solubility, sorption effects cannot be distinguished from precipitation effects when the element is removed from the aqueous phase.

We recommend only a few solubility experiments be done because solubility values from the literature or geochemical code calculations for Hanford specific conditions can likely be used for most radionuclides and contaminants of interest. A typical solubility experiment will involve spiking a slurry of the barrier material and leachate water with varying initial concentrations of the contaminant of interest. The empirical solubility value can be determined by observing the relationship between the initial and final solution compositions. When the final solution concentration cannot be increased as the initial concentration continues to be increased, that concentration value will be taken as the solubility value. A similar experiment can also be completed without the solids present. Alternatively, excess suspected precipitate can be placed in the slurry and the final steady state solution concentration measured. When all these three tests yield similar results, one can be fairly certain that an accurate solubility value has been determined for the given conditions. The parameters to be considered in solubility experiments for a given element are solids present, choice of radionuclide or contaminant solid phase, and types of effluent solutions.

As with K_d values, empirical solubility concentrations can easily be placed in transport codes as the source-term and provide conservative estimates of release unless environmental conditions change such that solubility is increased. This points out the importance of justifying the likely range of chemical conditions over time in the near field and vadose zone soil column. A disadvantage of the empirical solubility experiment is that other factors such as colloid formation may artificially increase observed concentration thereby increasing release estimates and possibly leading to unnecessary and costly remedial action.

The main contributor to this subtask will be M. G. Piepho and J. W. Shade of WHC, R. J. Serne, D. I. Kaplan, D. Rai, and A. R. Felmy of PNL and J. A. Conca of the WSU-TC.

2. Interfaces

Information will be exchanged with other team members dealing with parameters not covered in this subtask to understand the possible range of parameters. Interaction with the field geologists who are responsible for getting sediment cores and with the engineers in charge of choosing barrier materials will be maintained.

As activity 3.1.6 LLW Glass Release Source-Term defines the chemical composition of the glass leachate, we will ensure that our retardation studies use waters that cover the range of actual glass leachate compositions. We will also consider the flow rates (hydrologic data activity from Section 3.1.7 and recharge estimates from Section 3.1.8) that will likely occur in the near field and vadose zone sediments while performing retardation tests. We will also contribute to and perhaps perform laboratory tests on integrated systems should activity 3.1.C (Integrated Testing) become a key activity.

3. Standards

There are no laboratory standards per se in this area to follow. Past experience with chemical retardation aspects of risk and performance assessments will be used to guide activities (Serne et al., 1973; Serne et al., 1990).

4. Quality Assurance

This subtask will be conducted in accordance with PNL's PVTD Quality Assurance Plan ETC-001 and applicable WHC quality assurance requirements.

5. Schedule

The subtask will start in FY 1995 and be completed during FY 1997 once the chemical composition of the glass and its leachates are better known vadose zone sediments from the chosen site and engineered barrier materials are selected. Pedigree values for the preliminary performance assessment will be issued by July 1997. A PNL topical report will be submitted on December 1997 to describe PNL work on this subtask.

A literature search of the available Hanford-site specific data for chemical retardation will be generated will be completed in early FY 1995. Select key dose/health effects contributors and applicable range of variables for key parameters will be completed during the first half of FY 1995. "Variable Kd values" for already identified contaminants will be determined during FY 1995 and FY 1996 via a factorial series of batch experiments in which the effect of a number of aqueous and solid phase parameters will be investigated. If necessary, "variable Kd values" for newly identified contaminants will be determined during FY 1997 and FY 1998. Evaluation of the influence of moisture content using Wierenga flow-through columns will be completed by FY 1997. Evaluation of the influence of moisture content using UFA will be completed by FY 1997. Confirmatory tests with actual glass waste form leachate will be completed by early FY 1999. A report of the site specific retardation of studied contaminants and of the results of expert opinion on lesser contaminants will be issued by July 1997.

6. Cost

FY 1995: \$271,000 for WHC, PNL, and WSU-TC.

C. Organize Geochemical Workshop

1. Detailed Description

Some of the key issues to be discussed in the workshop are:
(a) appropriate lab methods to obtain accurate Kd/Rf results for low absorbing contaminants, i.e., the "small-Kd issue",
(b) dependency of Kd on moisture content, (c) appropriate treatment of sorption on coarse material, i.e., the "gravel-corrected-Kd issue", (d) long-term extrapolation of short-term laboratory data using thermodynamic and natural analogues, (e) adequacy of the Kd approach versus more mechanistic adsorption conceptual models, and (f) influence of colloids on facilitating contaminant transport. All of these issues need discussion and confirmation by technical peers. A geochemical workshop would be a convenient way to elucidate, prioritize the importance or perhaps dismiss most of these issues. Furthermore, existing techniques and Hanford Site approaches could be reviewed by strong technical peers which would be the best review that one can get.

2. Interfaces

Interaction between staff from universities, consulting companies and other laboratories will take place at this workshop.

3. Standards

To be determined.

4. Quality Assurance

None

5. Schedule

The date of the workshop needs to be determined, but most likely it would be in the second half of FY 1995, after some progress has been made on activities described in B.

6. Cost (FY 1995)

1.3 man-months of WHC time for \$20,000. PNL costs will be \$16,000, while external costs are \$22,000.

D. Determine Geochemical-software Needs and Availability

1. Detailed Description

Geochemical codes for use in both the near and far fields at Hanford need to be investigated. With geochemistry playing an important role in the choice of matrix and barriers around the glass waste form, the use of a geochemical code would be required to assess different chemical compositions without having to actually do the experiment. The choice of the geochemical code will depend on several factors, such as what data bases can it access, what data bases are available, kinetics or equilibrium assumptions, hydraulic capability or hydraulic interface, etc. This task will survey the available geochemical codes that are available (there is no intent to do development here) and the corresponding data bases, document the pros and cons of each code, weigh the needs of the LLW Performance assessment and choose a code that best fits the needs of the PA. With the variable Kd being developed by PNL, a geochemical code that will predict and keep track of the variables (pH, competing ions, etc.) that the variable Kd needs, will be useful. As the factors that affect Kd values change over time and space, the Kd will change accordingly.

2. Interfaces

WHC staff will coordinate with PNL and other geochemists at outside laboratories who have experience in using geochemical codes and their linking with flow/transport codes.

3. Standards

Not applicable.

4. Quality Assurance

Only codes with complete, publicly available user's guides that address code verification exercises will be considered.

5. Schedule

A WHC letter report will be prepared for comment by September 1995.

6. Cost

3.2 man-months of WHC time costing \$42,000 for each of FY 1995, FY 1996, and FY 1997.

E. Apparent Diffusion Coefficients for Contaminants in the Vadose Zone Sediments at the Hanford LLW Site

1. Detailed Description

When the transport of matter in the absence of bulk flow is driven by a concentration gradient it is referred to as diffusion. Diffusion is likely the dominant process in some parts of the vadose zone because of the sporadic nature of recharge over contaminated soil sites and the likely construction of impermeable surface barriers over these sites. These impermeable surface barriers will effectively limit infiltration into and immediately surrounding the contaminated soil zone.

Diffusional transport is quantified through the measurement of diffusion coefficients whose values are dependent on several factors such as the type of contaminant, physical (e. g., moisture content, tortuosity, pore size, porosity) and chemical properties of the soil, and water composition. Methods to measure diffusion coefficients of contaminants in unsaturated conditions have not been fully developed. For this activity, diffusion coefficients will be determined using ring electrodes and half-cell tests. During these test, the following parameters will be investigated: soil types, contaminants and their concentration, groundwater and rainwater compositions, and moisture content. Particular attention will be paid to mobile elements (e.g., Tc and I) under partially saturated conditions because the greatest potential benefit in reducing the conservatism in release estimates appears to exist where partial saturation and diffusion dominated transport could limit the movement of mobile contaminants.

The main contributors to this subtask will be R. J. Serne and D. I. Kaplan.

2. Interfaces

We will coordinate this work with efforts at WSU-TC (J. A. Conca) and we will consult with soil physics experts at PNL (G. W. Gee, M. H. Rockhold), WHC (J. F. Relyea), and elsewhere while reviewing literature and designing Hanford specific lab experiments.

3. Standards

There are no laboratory standards per se in this area to follow, but several laboratory methods have been published to guide activities. Past experience with chemical retardation aspects of risk and performance assessments will be used to guide activities (Serne 1989; Serne et al., 1989a; Serne et al., 1989b).

4. Quality Assurance

This subtask will be conducted in accordance with PNL's PVTD Quality Assurance Plan ETC-001 and applicable WHC quality assurance requirements.

5. Schedule

A review of the literature will be conducted during FY 1996 on the effect of moisture content on diffusion. Laboratory experiments, if necessary, will be conducted in FY 1997. A pedigreed data set will be issued by July 1997 for the preliminary performance assessment.

6. Cost

FY 1995: \$29,000 for PNL.

F. Natural Analog and Technical Defensibility

1. Detailed Description

In this subtask we will produce written justification/rationale for the specific chemical retardation data offered to the transport code users. In addition we will respond to various geochemical issues that crop up during the performance assessment process. Specific issues that already merit discussion include: proper method to measure low sorption ("small-Kd issue"), the gravel and moisture content dependencies of Kd, and defending the long-term extrapolation of short-term laboratory data, proper conceptual model for diffusion of reactive constituents in partially saturated sediments, influence of colloids on contaminant transport, and adequacy of Kd versus more mechanistic adsorption conceptual models. These geochemical issues and others that emanate from the reviewers of the performance assessments will be addressed using letter reports or topical reports that draw from literature and project specific laboratory studies. The first discussions will occur in subtask C and the status of issues described in the WHC report on the Geochemical Workshop available December 1995. In subtask G we will address issues that merit more detailed discussion and those for which significant new progress is expected.

The main contributors to this subtask will be R. J. Serne, K. M. Krupka, D. I. Kaplan, J. M. Zachara, and D. Rai of PNL and J. W. Shade and M. G. Piepho of WHC.

2. Interfaces

We will monitor reviewer comments/concerns and general geochemical literature to extract information that pertain to geochemistry issues and their resolution. Contacts at other DOE facilities who are active in DOE Order.

3. Standards

There are no laboratory standards in this area to follow. Products will be written discussions that rely upon descriptions of scientific principles, empirical data, and clear logic to explain our rationale for choosing Hanford specific conceptual models and specific values for parameters within the models. The discussions will avoid being overly technical and will avoid using jargon.

4. Quality Assurance

This subtask will be conducted in accordance with PNL's PVTD Quality Assurance Plan ETC-001 and applicable WHC quality assurance requirements.

5. Schedule

The following letter reports/topic reports are forecast. Others may be identified as issues surface.

- a. Proper Treatment of Reactive Contaminant Diffusion in Partially Saturated Sediments (September 1996).
- b. Influences of Moisture Content on Measured Kd Values (June 1996).
- c. Technical Rationale for Chemical Retardation Values Used in preliminary performance assessment (March 1997).
- d. Importance of Colloid-facilitated Transport of Contaminants for Hanford LLW Performance Assessment (June 1997)

6. Cost

Accepted: _____
Mel Piepho

Date: _____

3.1.A Ground Water Data for Preliminary Performance Assessment

I. SUMMARY

Obtain the ground water data needed to perform flow and transport calculations for the preliminary performance assessment/

II. GENERALA. Background

The Hanford Future Site Uses Working Group made several recommendations tied to ground water flow and transport. Number one on the list was the protection of the Columbia River, and number two was dealing realistically and forcefully with ground water contamination. Clearly, ground water flow and contaminant transport issues weigh heavily in the future use of the Hanford site. The low level waste performance assessment must deal with these issues in a convincing manner if the performance assessment is to win the confidence and acceptance of the regulators and the working group. The impact of the disposal facility on the ground water must be determined, according to the general land use envisioned for the central plateau. The Columbia River must be protected from contaminated ground water leaving the disposal area. The public must be adequately protected if the central plateau aquifer is exploited for water supply by individuals or communities. Ground water modelling will best answer questions concerning the fate of contaminants leaving the disposal area, and the travel time of contaminated ground water to points of compliance. By combining quality data with suitable technical expertise, the ground water flow and transport modelling effort can provide defensible results for the envisioned future use scenarios.

B. Organization

The cognizant organization is unknown at this time, being dependent of the reallocation of resources between Westinghouse Hanford Company and Bechtel Hanford Company. The cognizant scientist will be Bill McMahon.

C. Vision

Defence of ground water and transport modelling depends on the acquisition and implementation of adequate and appropriate data.

D. Objectives

Supply data needed for ground water modelling for the preliminary performance assessment.

1. Impact of Omission.

Without the ground water flow and transport modelling, credible estimates of travel times, contaminant plume extent, and contaminant concentration will be almost impossible to obtain.

Without these estimates, it is highly unlikely that the performance objectives of the performance assessment can be met, or the performance assessment will satisfy the regulators and working group.

2. Impact of Scheduling Delays.

For the modelling to be conducted in a worthwhile manner, the program must remain reasonably within schedule. Sufficient time must be allotted for data collection and analysis. Modelers must have sufficient time to develop their conceptualization and to confer with additional expertise to bring the final model into working order. The regulators and working group must agree that the model adequately represents hydrologic conditions and future use scenarios, and have confidence in the results. This confidence comes from thorough parameter sensitivity testing and evaluating alternative approaches to the conceptualization. All of these activities require time up front which cannot be compensated for later on. The modelling effort must proceed in a logical and orderly manner if the results are to win the confidence of the regulators and future site uses working group.

E. Deliverables

- 1) A letter report will be prepared describing the ground water modeling task, the information currently available, and the data collection necessary for the low level waste performance assessment. The letter report will be written by August 1, 1995, and issuance by September 30, 1995 (after peer review).
- 2) A letter report will be prepared describing the ground water modelling task, the information currently available, and the data collection necessary for the low level waste performance assessment. The letter report will be written by August 1, 1995, and issuance by September 30, 1995 (after peer review).

III. TASK DESCRIPTIONS

A. Summary List of Activities

- 1) Identify ground water modelling requirements and approach.
- 2) Obtain ground water data for Preliminary performance assessment.

B. Identify ground water modelling requirements and approach

1. Detailed Description

Identify ground water flow and transport modelling purpose, requirements, and approach; select appropriate modelling program; develop initial conceptual model; compile, review, and evaluate existing hydrologic data and identify additional data needs.

The objectives govern the modelling requirements, which direct the modelling approach and theoretical conceptualization. As those objectives become delineated, preliminary decisions about the modelling requirements (and subsequent approach and conceptualization) can be made. The suitability of each proposed ground water flow and transport modelling program can be judged according to the criteria set forth in the delineation. The reasonableness and feasibility of the preliminary decisions can be studied and evaluated, with the requirements consequently finding the proper balance between desired expectation and modelling feasibility. During this period, modelling scenarios which provide bounds for the analysis can be developed, tested and compared until a suitable match between the conceptualization and the real world is made. The initial conceptual model growing out of this balance will help identify the information that needs to be collected, either by literature review or hydrologic testing.

2. Interfaces

Data needs will be determined with help of the Low Level Waste Performance Assessment Steering Group. The people performing the activity will depend upon the reorganization of Westinghouse Hanford And Bechtel Hanford Companies. The output of this task will feed into the next activity.

3. Standards

There are no standards in this area.

4. Quality Assurance

The letter report will be peer reviewed.

5. Schedule

A letter report will be prepared describing the ground water modelling task, the information currently available, and the data collection necessary for the low level waste performance assessment. The letter report will be written by August 1, 1995, and issuance by September 30, 1995 (after peer review).

6. Costs (FY 1995)

12 man-months of WHC time costing \$154,000.

C. Obtain ground water data for Preliminary performance assessment

1. Detailed Description

Refine the conceptual model; plan and begin data acquisition field work, including well drilling, sample collection, and laboratory analysis. Begin data analysis.

The conceptual model will identify those areas requiring field work to collect necessary information. Plans to perform field work to collect data must be written, approved, and implemented. Certain areas may require drilling, if no wells currently exist in the area of concern, or the existing wells are unsuitable. Expert consultation will be used to assist in the model development and enhance the credibility of the model results.

2. Interfaces

The approach will be determined from the previous task. Boreholes will be drilled and samples taken from the borehole task of the integrated borehole active (see 3.1.C). The people performing the activity will depend upon the reorganization of Westinghouse Hanford And Bechtel Hanford Companies. The output of this task will feed the modelling of the preliminary performance assessment.

3. Standards

There are no standards in this area.

4. Quality Assurance

The letter report will be peer reviewed.

5. Schedule

A letter report will be prepared describing the ground water modelling task, the information currently available, and the data collection necessary for the low level waste performance assessment. The letter report will be written by August 1, 1996, and issuance by September 30, 1996 (after peer review).

6. Costs

FY 1996:	20 man-months of WHC time costing \$258,000. External costs total \$86,000 for instrumentation and consulting.	External
FY 1997:	12 man-months of WHC-time costing \$154,000.	

3.1.B Dose Modeling Data for the Preliminary Performance Assessment

I. SUMMARY

Continue upgrades to the food chain data base used for performance assessment calculations. Areas of specific interest are special receptors, such as native americans.

II. GENERALA. Background

Select groups of local residents may have customs which could lead to larger doses than typical residents used in performance assessment exposure scenarios. These typical performance assessment residents are assumed to have larger doses. Nevertheless, potential exposures to the special groups must be evaluated individually to determine whether they might be bounding.

B. Organization

The responsible organization will be the Environmental Risk and Performance Assessment Section of the Westinghouse Hanford Company, John Rawlins manager. The cognizant scientist will be Paul D. Rittmann.

C. Vision

Protection of the public requires that all members of the public be considered, as far as possible. Knowing the key nuclides and their likely concentrations in plants and animals allows consideration of any special groups of people who might somehow be vulnerable.

D. Objectives

Determine the important nuclides and the associated plant and animal products which might affect special groups of people adversely.

E. Deliverables

Letter report summarizing (1) the key nuclides and the environmental media, plants, and animals which may accumulate significant concentrations, and (2) the potential for special groups of people to receive more dose than the standard receptors.

III. TASK DESCRIPTIONS

A. Summary List of Tasks

Identify key nuclides and bounding effects on special groups.

B. Key Nuclides and Special Populations

1. Detailed Description

Select groups of local residents may have customs which could lead to larger doses than typical residents used in performance assessment exposure scenarios. Such factors as food types and quantities, food preparation methods, and direct exposure to environmental media must be considered when evaluating doses from these groups.

Knowledge of key nuclides from the waste source and their behavior in environmental media (soil, water, air) is crucial in assessing the potential impacts on target populations.

2. Interfaces

There will be discussions with qualified experts such as J. K. Soldat and B. A. Napier who have considered similar topics for the Hanford Dose Reconstruction project. There are no interfaces with other activities which will affect completion of this task.

3. Standards

There are no relevant standards in this area.

4. Quality Assurance

The letter report will be reviewed before issuance. Impact Level NA is appropriate for this effort.

5. Schedule

The task will start in October 1995, with the letter report issued by September 1996.

6. Cost

6.0 man-months of professional time costing \$75,000 will be required.

3.1.C Integrated Testing of the Low Level Waste Form, Disposal System, and Integration of Disposal Site Characterization

I. SUMMARY

The establishing the release rates of radioactive waste constituents and hazardous constituents from the engineered Low-Level Waste disposal system and establishing how these materials move in the environment are critical to assessing the long term performance and potential environmental and human health impacts of the Low-Level Tank Waste storage/disposal system. The activities described by this statement of work are directed at the integration of waste form performance testing and the collection of the disposal site characterization data needed to develop and validate constituent release and migration models for the low level glass waste form, the low level waste form matrix, and any engineered barrier system incorporated into the low-level tank waste storage/disposal system design. The activity also includes the integration and coordination of site characterization activities through the DQO process.

II. GENERAL

A. Background

An assessment of the long term performance of the low-level tank waste disposal system is being developed as required by DOE Order 5820.2a. This DOE order establishes the requirement for the preparation and maintenance of a site specific Performance Assessment that shows through measurement, experiment and analyses that the engineered disposal system and the natural environment work in concert to protect the health and safety of the public by preventing excessive release of contaminants in accordance with State, Local, and Federal regulations and ALARA principles.

Among the key inputs required to support the preparation of the Performance Assessment are experimental data, physical models, and computational models describing the release of constituents from the low-level glass waste form and the influence of various design features incorporated into the engineered storage/disposal system. A long term effort is needed to develop physical and computational models that describe the release of constituents from the engineered disposal system. Testing protocols are also needed that reflect the conditions in the LLW disposal system to validate these models constituent release models under conditions closely approximating the conditions expected to prevail in the low level waste disposal system. This activity is directed at meeting these programmatic needs through the development of a plan for integrated testing of the engineered disposal system.

Characterization data from the waste disposal site also play key rolls in supporting both the Performance Assessment and in licensing of the site under State and Federal regulations. Development of an integrated

site characterization plan to meet all programmatic needs, while minimizing testing and characterization costs, constitutes the second portion of this activity.

C. Organization

Richard Karnesky of Nuclear Technology will be the cognizant engineer or these activities. Work supporting these activity will be preformed within PNL, other Westinghouse Hanford organizations and thorough the TWRS Technology Development Program Office (PNL) and other outside contractors to take advantage of expertise within the Department of Energy Complex and in the commercial sector.

D. Vision

This task will provide two important bridge for integration of the characterization and testing activities and promote feedback between glass developers, glass performance modelers and performance assessment modelers. Part of the task objectives will be to evaluate and recommend testing protocol for LLW waste glasses and disposal matrix, development of the data needed to validate constituent release models for the low level glass waste form, the disposal matrix, and any engineered barrier system incorporated into the low-level tank waste storage/disposal system, and integration and coordination of the testing and site characterization needed for performance modeling. Including the initiation of site characterization activities.

E. Objectives

The objectives for this task include direction and cognizance of activities incorporated into the glass constituent release and release testing as they interface with the development and testing of matrix materials and engineered barrier systems. This task will also address the development and initiation of a site soil characterization activity. These activities include,

- 1) Integration and coordinated of the testing activities directed at the development and validation of constituent release models as they relate to the integrated testing of the waste form matrix and waste glass, and any engineered barriers incorporated into the disposal system.
- 2) Integrate site characterization activities to minimize cost while assuring that the data needs of the Performance Assessment are obtained on schedule, including,
- 3) Development of a site characterization plan, and
- 4) Initiation of site characterization, specifically as it relates to bore holes to characterize the site geology and wells to characterize the properties of the aquifer under the disposal site.

F. Deliverables

- 1) The DQO methodology will be employed to develop an integrated characterization plan for site geology and hydrology. The plan will address the needs of the Performance Assessment as well as the needs to the site licensing activities. (March 1995)
- 2) Contracts will be placed and the necessary paperwork completed to allow initiation of site characterization in October 1995.
- 3) Site characterization will be monitored and directed, reports documenting the progress of the characterization activities will be issued monthly. (October 1995 through September 1996)
- 4) Site characterization data will be collected and evaluated. A summary report describing the findings of these evaluations will be issued in September 1997. This report will be the principal source of site characterization data to support both licensing and Performance Assessment activities.
- 5) A plan for testing the integrated performance of the disposal system will be developed following the selection of a reference and backup disposal system design. (June 1995)
- 6) The testing undertaken to develop and validate the constituent release models for the disposal system will be directed and monitored. Semiannual letter reports will be issued to document progress in this area. (A continuing activity through at least FY 1997)

III. TASK DESCRIPTIONS

A. Summary List of Tasks

1. The DQO methodology will be employed to develop an integrated site characterization plan that addresses the needs of the Performance Assessment as well as the needs to the site licensing activities.
2. Development of integrated plan for testing the integrated performance of the disposal system will be developed following the selection of a reference disposal system design.

B. Site Characterization

1. Detailed Description

An integrated plan for the characterization of the Low Level Waste disposal site's geology and hydrology will be developed utilizing the DQO process. This plan will provide the basis for conduct of site characterization activities in FY 1996 and documentation of the characterization results in FY 1997. While the requirements for site characterization will be developed as a part of this

activity, utilizing the DQO process, it is anticipated that as many as 5 bore hole/well will be required to fully characterize the low level waste disposal site. As a part of the process samples will be taken during the "drilling" process to characterize the geologic and hydraulic properties of the strata underlying the disposal site. From analyses of these samples, data on how water and other constituents are transported to the aquifer underlying the site will be collected.

2. Interfaces

The main interfaces for this activity will be PNL and WHC staff responsible for LLW site modeling and licensing activities. These activities will also be coordinated with the DQO control office for the Hanford Site. Richard Karnesky, WHC, will be the cognizant engineer for this task. During the "drilling" activities and sample analysis, the cognizant engineer, or a responsible engineer designated by the cognizant engineer will interact with and direct the work of those doing the drilling, collecting the samples and analyzing the samples.

3. Standards

To be determined

4. Quality Assurance

To be determined

5. Schedule

- a) The DQO methodology will be employed to develop an integrated characterization plan for site geology and hydrology. The plan will address the needs of the Performance Assessment as well as the needs to the site licensing activities. (March 1995)
- b) Contracts will be placed and the necessary paperwork completed to allow initiation of site characterization in October 1995.
- c) Site characterization will be monitored and directed, reports documenting the progress of the characterization activities will be issued monthly. (October 1995 through September 1996).
- d) Site characterization data will be collected and evaluated. A summary report describing the findings of these evaluations will be issued in September 1997. This report will be the principal source of site characterization data to support both licensing and Performance Assessment activities.

6. Cost

FY 1995: 13.2 man-months of WHC time costing \$169,000.

FY 1996: 12 man-months costing \$154,000. The borehole drilling costs are estimated at \$1,200,000. This assumes that 5 characterization wells will be required. If as the result of the DQO process it is determined that fewer characterization wells are needed or the competitive bid process results in lower costs this cost may be reduced.

FY 1997: 12 man-months of WHC time costing 154,000.

7. Risk

This activity involves very little technical or programmatic risk. Drilling and sample collection are well established technologies as is sample analysis. There is, however, a moderate level of scheduler risk associated with the use of a yet to be determined commercial firm to complete the characterization activities.

C. Development of a test plan and methodologies for testing the performance of the integrated disposal system and its components.

1. Detailed Description

A test plan will be developed for characterizing the release of constituents from the integrated LLW disposal system. This activity is contingent on the development of a reference disposal system design for testing.

2. Interfaces

The main interfaces will be with PNL and WHC staff responsible for LLW glass product and waste form matrix development, engineered barrier development and Performance Assessment activities.

3. Standards

There are no applicable standards in this area.

4. Quality Assurance

The reports produced through this activity will be peer reviewed before issuance.

5. Schedule

The activity will start October 1, 1994, based on the results of the disposal system design study currently being conducted by LATA.

- a) A plan for testing the integrated performance of the disposal system will be developed following the selection of a reference and backup disposal system design. (June 1995)
- b) The testing undertaken to develop and validate the constituent release models for the disposal system will be directed and monitored. Semiannual letter reports will be issued to document progress in this area. (A continuing activity through at least FY 1997)

6. Cost

FY 1995: 6.6 man-months costing \$84,000.

FY 1996: 8.0 man-months costing \$103,000. \$140,000 is estimated for external costs.

FY 1997: 6.0 man-months costing \$77,000. \$300,000 is estimated for external costs.

7. Risk

The development and validation of testing techniques that will directly support the validation of the Performance Assessment models is critical to the development of a defensible Performance Assessment. This task incorporates a substantial technical challenge since the anticipated constituent release rates of the proposed waste form are expected to be difficult to measure with existing techniques and accelerated testing always raises the potential for activating release mechanisms that are only active under the accelerated test conditions producing skewed test results. As such the technical risk associated with this activity is deemed to be moderate. The Programmatic and scheduler risk are deemed to be low to moderate in that it is likely that any accelerated testing technique developed for the will probably result in enhanced constituent release and tend to suggest higher release rates than will actually occur. The primary source of scheduler risk is associated with the current lack of definition of the matrix material to be used in the low level waste disposal system. The lack of a defined matrix material will tend to delay the timely initiation of this activity and the development of the data needed to validate the constituent release models.

3.2 Calculate Responses and Document

I. SUMMARY

This activity performs the actual calculations and analyses that appear in the preliminary performance assessment and write the document itself.

II. GENERALA. Background

Earlier activities (3.1.X) produced the data and methods to be used in the preliminary performance assessment.

B. Organization

The responsible organization will be the Environmental Risk and Performance Assessment Section of the Westinghouse Hanford Company, John Rawlins manager. The cognizant scientist will be Fred Mann.

C. Vision

The preliminary performance assessment is needed before construction of the disposal facility (per draft DOE Order 5820.2B) and is used as by the Peer Review Panel to guide the preparation of the final performance assessment.

D. Objectives

This activity will produce the preliminary performance assessment.

E. Deliverables

- 1) Preliminary Performance Assessment as a letter report ready for review (June 30, 1998).

III. TASK DESCRIPTIONSA. Summary list of tasks

- 1) Write preliminary performance assessment.

B. Write Preliminary Performance Assessment

1. Detailed Description

All calculations and analyses performed by the performance assessment team that will appear in the preliminary performance assessment will be performed.

The preliminary performance assessment (including required background information, integration, and interpretation) will be written.

The main contributors to this task will be the entire performance assessment team.

2. Interfaces

The input for this task were generated in 2.1.X tasks.

The output of this task will be the preliminary performance assessment ready.

3. Standards

There are no relevant standards in this area.

4. Quality Assurance

The letter report will be reviewed by the performance assessment team before issuance.

5. Schedule

The task will start October 1, 1997 with the letter report written and reviewed by June 30, 1998.

6. Cost

49 man-months of professional time costing \$634,000 will be required in FY 1997 with additional 20 man-months (\$260,000) in FY 1998. These costs all analysis, writing, and editing costs.

3.3 RL/PRP Review

I. SUMMARY

The Program Office, the Internal Review Team, RL, and other internal Hanford review teams will review the preliminary performance assessment.

II. GENERALA. Background

The preliminary performance assessment will be a large significant document. Under the draft DOE Order 5820.2B, a preliminary performance assessment must be approved by the local operations before the construction of the disposal facility can begin. Under current practice the Peer Review Panel also reviews the preliminary performance assessment.

B. Organization

The responsible organization will be the Environmental Risk and Performance Assessment Section of the Westinghouse Hanford Company, John Rawlins manager. The cognizant scientist will be Fred Mann.

C. Vision

The preliminary performance assessment should withstand any attacks on its methods, data, or interpretations.

D. Objectives

This activity will perform the review for the preliminary performance assessment.

E. Deliverables

- 1) Communications from review bodies on the adequacy of the preliminary performance assessment (December 1, 1998)

III. TASK DESCRIPTIONSA. Summary list of tasks

- 1) Review of the preliminary performance assessment

B. Review of the preliminary performance assessment

1. Detailed Description

RL, the Peer Review Panel, and other groups will review and provide comments on the preliminary performance assessment.

The main interface to the reviewers will be Fred Mann.

2. Interfaces

The input for this task is the preliminary performance assessment generated in activity 3.2.

The output of this task will be comments that may lead to changes in the final performance assessment or may indicate that the preliminary performance assessment is adequate.

3. Standards

There are no relevant standards in this area.

4. Quality Assurance

The review groups will establish their own quality assurance.

5. Schedule

The task will start July 1997 with comments received on the preliminary performance assessment by December 31, 1998.

6. Cost (FY 1998)

0.8 man-months of professional time costing \$31,000 will be required. Costs include any rewriting and reanalysis.

3.4.1 Update Performance Objectives

I. SUMMARY

The same performance objectives used in the preliminary performance assessment are expected to be used in the final performance assessment. This activity reviews that selection and determines whether modifications should be made.

II. GENERALA. Background

Performance objectives are the criteria against which expected performance is judged. Although unlikely, it is possible that the reasons for choosing the performance objectives for the preliminary performance assessment may be different for the final performance assessment.

B. Organization

The responsible organization will be the Environmental Risk and Performance Assessment Section of the Westinghouse Hanford Company, John Rawlins manager. The cognizant scientist will be Fred Mann.

C. Vision

The performance objectives are the criteria against which we measure whether the waste can be disposed or simply stored.

D. Objectives

This activity will determine the performance objectives for the final performance assessment.

E. Deliverables

- 1) Letter report justifying selection of performance objectives for the final performance assessment (March 30, 1999).

III. TASK DESCRIPTIONSA. Summary list of tasks

- 1) Review choice of performance objectives

B. Review Choice of Performance Objectives

1. Detailed Description

The choice of performance objectives selected for the preliminary performance assessment will be reviewed.

2. Interfaces

The input for this task will be the performance objectives from the preliminary performance assessment plus any new information affecting performance objectives since that selection was made.

The output of this task will be the documenting of the selection of the performance objectives for the final performance assessment.

3. Standards

There are no relevant standards in this area. However, guidance from the DOE Peer Review Panel and from the NRC staff will be used.

4. Quality Assurance

The letter report will be reviewed before issuance.

5. Schedule

The task will start January 1, 1999, with the report due March 30, 1999.

6. Cost (FY 1999)

0.7 man-months of professional time costing \$9,000 is required.

3.4.2 Update Scenarios

I. SUMMARY

The same scenarios used in the preliminary performance assessment are expected to be used in the final performance assessment. This activity reviews that selection and determines whether modifications should be made.

II. GENERALA. Background

Scenarios are the various projections into the future on how events will occur. Although unlikely, it is possible that the reasons for choosing the scenarios for the preliminary performance assessment may be different for the final performance assessment.

B. Organization

The responsible organization will be the Environmental Risk and Performance Assessment Section of the Westinghouse Hanford Company, John Rawlins manager. The cognizant scientist will be Fred Mann.

C. Vision

The scenarios are the events and pathways used in the analyses.

D. Objectives

This activity will determine the scenarios for the final performance assessment.

E. Deliverables

- 1) Letter report justifying selection of scenarios for the final performance assessment (March 30, 1999).

III. TASK DESCRIPTIONSA. Summary list of tasks

- 1) Review choice of scenarios

B. Review Choice of Scenarios

1. Detailed Description

The choice of scenarios selected for the preliminary performance assessment will be reviewed.

2. Interfaces

The input for this task will be the scenarios from the preliminary performance assessment plus any new information affecting performance objectives since that selection was made.

The output of this task will be the documenting of the selection of the scenarios for the final performance assessment.

3. Standards

There are no relevant standards in this area. However, guidance from the DOE Peer Review Panel and from the NRC staff will be used.

4. Quality Assurance

The letter report will be reviewed before issuance.

5. Schedule

The task will start January 1, 1999 with the report due March 30, 1999.

6. Cost (FY 1999)

0.7 man-months of professional time costing \$9,000 is required.

3.4.3 Update Tools

I. SUMMARY

The same analysis tools used in the preliminary performance assessment are expected to be used in the final performance assessment. This activity enforces the discipline of consciously making the decision of which tools to be used. All tools used in the final performance assessment must be verified and certified.

II. GENERALA. Background

Complex computer modeling is usually used in the analysis upon which a performance assessment is based. The DOE Peer Review Panel has determined that a careful and thoughtful process be used in selecting such tools. The process consists of:

- 1) Setting criteria
- 2) Selecting the tools
- 3) Verifying the tools
- 4) Certifying the tools.

All areas of analysis will have had tools that have been verified and certified. During the activities in the preliminary performance assessment, it is possible that some of the tools were found inadequate. This activity allows the modification of such tools but requires that such modified tools still meet the requirements of verification and certification.

B. Organization

The responsible organization will be the Environmental Risk and Performance Assessment Section of the Westinghouse Hanford Company, John Rawlins, Manager. The cognizant scientist will be Fred Mann. Others in the team will represent the major analysis functions in the performance assessment (dosimetry - Paul Rittmann, groundwater transport - Bill McMahon, inventory - Frank Schmittroth, vadose zone transport - Mel Piepho, and waste form - Pete McGrail)

C. Vision

The tools of a performance assessment form a core component of a performance assessment. However, unlike other components (criteria and data), it is far more difficult to demonstrate that the tools provide reasonable results (a process here call certification) because they are used to extrapolate past our knowledge base.

D. Objectives

This activity will determine the tools (probably computer codes) to be used in the analyses for the final performance assessment.

E. Deliverables

- 1) Letter reports justifying selection of tools in each analysis area for the final performance assessment. The report will include any needed verification and certification information for codes changed from those used in the preliminary performance assessment.

III. TASK DESCRIPTIONSA. Summary list of tasks

- 1) Review choice of codes

B. Review Choice of Codes

1. Detailed Description

The choice of codes selected for the preliminary performance assessment will be reviewed. If different codes from those used in the preliminary performance assessment are used, then they must be verified and certified.

The main contributors to this task will be those with lead responsibility in each analysis area:

- a) Dosimetry - Paul Rittmann
- b) Groundwater transport - Bill McMahon
- c) Inventory - Frank Schmittroth
- d) Vadose zone transport - Mel Piepho
- e) Waste form - Pete McGrail.

2. Interfaces

The interfaces will be with other team members and with analysts actually performing the work.

The output of this task will be the documenting of the selection of the code for each analysis area in the preliminary performance assessment area. Also included in the documentation for those codes which differ from the codes used in the preliminary performance assessment will be verification and certification information.

3. Standards

There are no relevant standards in this area. However, guidance from the DOE Peer Review Panel and from the NRC staff will be used.

4. Quality Assurance

The letter report will be reviewed before issuance.

5. Schedule

The task will start January 1, 1998 with the reports due March 1999.

6. Cost (FY 1999)

3.4 man-months of professional time costing \$44,000 is required.

3.4.4 Inventory

I. SUMMARY

Review tank-waste inventories and preliminary treatment flow sheets in order to determine inventory to be used the Low-Level Waste Final Performance Assessment.

II. GENERALA. Background

The inventories of hazardous chemicals and radionuclides presently in the Hanford single- and double-shell tanks are the starting point for assessing the inventories that will be in the final waste form that is placed in the disposal facility. These final inventories will also depend on the subsequent pretreatment "splits" along with other losses before the formation of the glass waste form.

Although there have been earlier studies, there are still significant uncertainties and inconsistencies in the tank inventories. Also the status of the process flow sheets will evolve with time.

B. Organization

The cognizant organization is the Environmental Risk and Performance Assessment Section of Westinghouse Hanford; John Rawlins, Manager. The cognizant scientist will be Frank Schmittroth.

C. Vision

An awareness of the tank inventories, treatment options, and secondary melter waste streams is an on-going effort that must be sustained as better knowledge in these activities becomes available. The performance of the disposal depends directly on the inventory of key materials.

D. Objectives

This activity will supply the inventories in the final waste form in a manner that is supported by the on-going programs in tank characterization, in process treatments, and in melter secondary waste streams as well as theoretical analyses.

E. Deliverables

- 1) Letter report documenting the total inventory expected to be the glass waste form (March 30, 1999).
- 2) Letter report documenting the highest level of important materials to be in a single vault (March 30, 1999).

- 3) Letter report documenting review of inventory data for the preliminary performance assessment (June 30, 1999).

III. TASK DESCRIPTIONS

A. Summary List of Activities

- 1) Determine total inventory
- 2) Determine extreme inventory
- 3) Review inventory data

B. Develop total inventory

1. Detailed Description

The total inventory will be determined by reviewing available tank characterization data (both experimentation measurements and analytical extrapolations) and process flow sheet data. Such process flow data will include the split between high-level and low-level waste and the split among melter losses, off-gas losses, and waste-form incorporation.

The main contributor to this task will be Frank Schmittroth and Truc DeLorenzo.

2. Interfaces

The goal of this task is to determine the total inventory to be in the waste form. Tank characterization data and process flowsheets will be obtained from other parts of the LLW program as well as from TWRS.

3. Standards

Standards will be identified as part of this task.

4. Quality Assurance

The letter report will be peer reviewed.

5. Schedule

The task started after the inventory data for the preliminary performance data are obtained. A letter report will be written by February, 1999 and issued after review by March 30, 1999.

6. Costs

12.0 man-months of professional time costing \$154,000 is required in FY 1998 with half that amount for FY 1999.

C. Develop estimate of extreme inventory

1. Detailed Description

For some calculations the maximum amount of key materials in a given disposal unit must be known. This task will determine the maximum of such key materials that may occur in a disposal unit. Individual tank inventory ratios will form a key input.

The main contributors in these task will be Frank Schmittroth and Truc De Lorenzo.

2. Interfaces

The goal of this task is to find the maximum amount of key materials. The knowledge of the order of tank processing and of individual tank inventories will be important.

3. Standards

Standards will be identified as part of this task.

4. Quality Assurance

The letter report will be reviewed before issuance.

5. Schedule

The task started after the inventory data for the preliminary performance data are obtained. A letter report will be written by February 1999 and issued after review by March 30, 1999.

6. Cost

4.0 man-months of professional time costing \$51,000 is required for FY 1998 with half that amount for FY 1999.

D. Review estimates of inventory

1. Detailed Description

The estimates of the inventory will be reviewed by a group outside of the performance assessment team.

Frank Schmittroth will oversee the process.

2. Interfaces

The goal of this task is to provide independent review. This task depends upon the previous two tasks being completed.

3. Standards

Standards will be established by the review group.

4. Quality Assurance

Not applicable.

5. Schedule

The task will start as soon as the two letter reports on inventory data are issued. The review report will be issued by June 30, 1999.

6. Cost

1.0 man-month of professional time costing \$13,000 is required in FY 1999.

Accepted:

Frank Schmittroth

Date: _____

3.4.5 Obtain Disposal Facility Data for Final Performance Assessment

I. SUMMARY

Translate design activities into information useful for final performance assessment activities.

II. GENERALA. Background

The performance assessment must model the disposal facility as it will be built. As concepts are firmed into design, that evolution must be reflected in the models used in the performance assessment.

B. Organization

The responsible organization will be the Environmental Risk and Performance Assessment Section of the Westinghouse Hanford Company, John Rawlins, Manager. The cognizant scientist will be Fred Mann.

C. Vision

Keep the models used in the performance assessment current with the concepts and designs being considered by the program office and the architect-engineers.

D. Objectives

This activity will translate design information into an usable form for performance assessment activities.

E. Deliverables

- 1) Letter report defining geometry and volume of waste form (December 31, 1998).
- 2) Letter report defining important barriers used in design (December 31, 1998).
- 3) Letter report determining parameters for transport through important barriers (March 30, 1999).
- 4) Letter report acknowledging review of transport parameters (June 30, 1999).

III. TASK DESCRIPTIONS

A. Summary list of tasks

- 1) Determine geometry and waste form,
- 2) Determine important barriers used in design,
- 3) Determine parameters for transport through barriers, and
- 4) Review of barrier transport parameters.

B. Determine geometry and waste form

1. Detailed Description

Contact with the architect-engineer will be maintained. The latest version of the design will be used to determine the geometry and volume of the waste form used in the final performance assessment.

2. Interfaces

Input data will be obtained from the architect-engineer and the interface identified by the program office.

The output of this task will be the geometry and volume of the waste form to be used in the final performance assessment.

3. Standards

There are no relevant standards in this area.

4. Quality Assurance

The letter report will be reviewed before issuance.

5. Schedule

The activity will start October 1, 1998. The letter report will be issued by December 31, 1998.

6. Cost (FY 1999)

0.6 man-months of professional time costing \$8,000 is required.

C. Determine important barriers used in design

1. Detailed Description

Contact with the architect-engineer will be maintained. The latest version of the design will be used to determine the barriers to water and solute transport.

2. Interfaces

Input data will be obtained from the architect-engineer and the interface identified by the program office.

The output of this task will be the determination of barriers in the engineered system which are important for water and solute transport.

3. Standards

There are no relevant standards in this area.

4. Quality Assurance

The letter report will be reviewed before issuance.

5. Schedule

The activity will start October 1, 1998. The letter report will be issued by December 31, 1998.

6. Cost (FY 1999)

3.6 man-months of professional time costing \$46,000 is required.

D. Determine parameters for transport through barriers

1. Detailed Description

Determine the transport properties of the important barriers identified in the task above. Such properties will include hydraulic and retardation values.

2. Interfaces

The input to this task is the identification of the important barriers and values found in other tasks for hydraulic, retardation, and other parameters.

The output of this task will be the determination of transport parameters for the barriers in the engineered system which are important for water and solute transport.

3. Standards

There are no relevant standards in this area.

4. Quality Assurance

The letter report will be reviewed before issuance.

5. Schedule

The activity will start January 1, 1999 (after the important barriers are determined from the task above). The letter report will be issued by March 30, 1999.

6. Cost

0.6 man-months of professional time costing \$8,000 is required.

E. Review of barrier transport parameters

1. Detailed Description

The transport properties through the barriers will be reviewed by groups external to the Steering Group. Any comments received from the reviewers shall be explicitly addressed and changes in the parameters made and documented.

2. Interfaces

The input to this task are the values of the transport parameters through the barriers and comments received from the review groups.

The output of this task will be the determination of transport parameters for the barriers in the engineered system which are important for water and solute transport as a reviewed data set.

3. Standards

There are no relevant standards in this area.

4. Quality Assurance

Comments to each reviewer response shall be documented.

5. Schedule

The activity will start April 1, 1999 (after the parameters are determined). The letter report will be issued by June 30, 1999.

6. Cost

0.6 man-months of professional time costing \$8,000 is required.

3.4.6 Integrated Source-Term for Final Performance Assessment

I. SUMMARY

A performance assessment of the Hanford LLW site will require a determination of the source-term for radionuclide release from the glass waste form. Through literature review, laboratory testing, and model development, this task will develop the necessary data and models for generating source-term calculations that will be used in an overall performance assessment for the site to be completed in 1998.

II. GENERALA. Background

Estimates of radionuclide releases from LLW glass are needed for input to a preliminary performance assessment of a LLW disposal system at Hanford due in June 1998 and a final performance assessment due in July 1999. The performance assessment will be submitted to the DOE Peer Review Panel and the public for comment. The specific characteristics of LLW glass and other disposal system components that can affect release from the glass should be largely known and incorporated in an integrated model of the engineered disposal system for this report.

B. Organization

The responsible organization will be the Materials and Chemical Sciences Center of the Pacific Northwest Laboratory (PNL), Walt Laity, Manager. The cognizant scientist will be Peter McGrail also of PNL.

C. Vision

Defensible radionuclide release calculations are needed for LLW glass in a systems performance assessment. Performing these calculations requires a defensible model that describes the alteration rate of the glass and interactions with the other components of the disposal system. By coordinating with other tasks conducting glass and engineered barrier testing, this task will incorporate the data and models developed under these tasks into a comprehensive source-term model for the engineered disposal system.

D. Objectives

The objectives for this task include

- 1) Calculate the release of important contaminants from low-level waste glass and the engineered disposal system and provide these data as input to a systems-level performance assessment for the site.

- 2) Conduct literature reviews and interact with staff performing LLW glass and engineered barrier materials development to obtain data and models needed for release rate calculations.
- 3) Identify, modify or adapt models as needed to perform release calculations.
- 4) Plan and conduct verification and certification studies for the selected model

E. Deliverables

- 1) Letter report justifying selection of a computational tool for LLW glass source-term calculations for the preliminary performance assessment (June 28, 1996).
- 2) Topical Report: Laboratory Confirmation Tests in Support of Integrated Source-Term Modeling (December 31, 1997).
- 3) Topical Report: An Integrated Source-Term Model for the Hanford LLW Engineered Disposal System (March 30, 1998).
- 4) Topical Report: Source-Term Calculations for Radionuclide Release from the Hanford LLW Engineered Disposal System (March 30, 1998).

III. TASK DESCRIPTIONS

A. Summary list of tasks

- 1) Release Model for LLW Glass
- 2) Integrated Source-Term Modeling
- 3) Source-Term Model Verification and Certification
- 4) Source-Term For Final Performance Assessment

B. Release Model for LLW Glass

1. Detailed Description

Except for the possibility of physical intrusion into the site, radionuclide release from the LLW glass is the essential first step that is required for any subsequent transport to the accessible environment to occur. The release rate from the glass is expected to dominate the overall performance of the site in the long-term so it is essential that a credible method be used to calculate releases from the glass waste form. Because release rates must be projected far into the future and over a range of environmental conditions that cannot be completely investigated in the laboratory, a model must be developed that is a reasonable and defensible representation of the system. Experience has shown that models based on fundamental principles of physics, chemistry, and thermodynamics (mechanistic models) are best suited for this application. Consequently, this task will develop and test a

suitable model describing radionuclide release from LLW glass. It is expected that this model will be implemented in an integrated source-term model for the LLW disposal system.

The main contributor to this task will be Pete McGrail.

2. Interfaces

The input to this task will consist of data derived from laboratory testing done as part of glass formulation studies conducted under the Vitrification Projects of the Tank Waste Remediation System (TWRS). Because the laboratory testing and model development work will be done under different projects, close coordination and planning of the experiments by the modelers and experimentalists is essential. The output from this task will consist of a mathematical model and supporting database that will be implemented by the Integrated Source-term Modeling Task.

3. Standards

There are no relevant standards in this area. However, guidance from the DOE Peer Review Panel and from the NRC staff will be used.

4. Quality Assurance

This task will be conducted in accordance with PNL's PVTQ Quality Assurance Plan ETC-001 and applicable WHC Quality Assurance Requirements.

5. Schedule

The task will start October 1, 1996, and be completed March 30, 1998, with the issuance of the source-term report for the preliminary performance assessment.

6. Cost

FY 1997: 3.0 man-months of PNL time costing \$60,000 will be required

FY 1998: 3.0 man-months of PNL time costing \$60,000 will be required

C. Integrated Source-Term Modeling

1. Detailed Description

The radionuclide release rate from glass waste forms is highly dependent upon the composition of the glass, the chemistry of the water contacting the glass and aqueous chemistry of the particular radionuclide, temperature, and the local hydrologic conditions. Because the glass will be surrounded by soil and most likely other

engineered materials, the effects these materials have on the aforementioned parameters will impact release rates from the glass and overall release from the engineered disposal system. The objective of this task is to develop and/or adapt a model that is a reasonable and defensible representation of the engineered disposal system. The integrated model will incorporate the mechanistic model developed for radionuclide release from LLW glass and models that describe the important physical, chemical, and hydrological properties of the other engineered materials planned for the disposal system. Output from the integrated model will be time-dependent fluxes for radionuclides exiting the engineered disposal system which will be used as inputs for far-field transport and dose assessment modeling.

2. Interfaces

Inputs to this task will come from virtually every task on the Hanford Tank Low-Level Waste project that is responsible for characterizing the physical and chemical properties of the site and the engineered materials being developed for the disposal system. The main outputs will be to the tasks responsible for far-field transport and dose assessments.

3. Standards

There are no relevant standards in this area.

4. Quality Assurance

This task will be conducted in accordance with PNL's PVTD Quality Assurance Plan ETC-001 and applicable WHC quality assurance requirements.

5. Schedule

The task will start October 1, 1996, and be completed September 30, 1998.

6. Cost

FY 1997: 12 man-months of PNL time costing \$200,000 will be required.

FY 1998: 6 man-months of PNL time costing \$100,000 will be required.

D. Source-Term Model Verification and Certification

1. Detailed Description

The integrated source-term model developed under the Integrated Source-Term Modeling Task will be subjected to verification and certification testing to build confidence in the reliability of

the model for calculating release rates from the engineered disposal system. Verification testing will consist of checking code outputs against standard analytical solutions and against benchmark cases run with other computer codes. Verification testing will be performed routinely during model development in accordance with software control procedures.

Certification tests will consist of controlled laboratory experiments designed to test release and migration predictions of radionuclide contaminants through idealizations of the engineered disposal system. The laboratory tests will primarily involve long duration flow-through tests in columns packed with LLW glass, engineered barrier materials and/or Hanford soils. Wierenga columns, modified to accommodate studies under unsaturated conditions and to conduct geochemical analyses are ideally suited to these tests. These columns in conjunction with the Unsaturated Flow Apparatus (UFA) will be used to obtain unsaturated hydraulic property measurements as needed to support modeling calculations. Testing in FY 1997 and FY 1998 will focus on the important radioactive elements that have been identified as key dose contributors in the interim performance assessment.

The main contributors to this task will be Clark Lindenmeier and Pete McGrail.

2. Interfaces

Inputs to this task will come from virtually every task on the Hanford Tank Low-Level Waste project associated with development and application of engineered materials for processing and final disposal of LLW. Additionally, this task will be closely coordinated with the Integrated Source-Term Modeling Task to help define the test configurations and test parameters that will best evaluate the underlying assumptions and theories incorporated in the integrated source-term model.

3. Standards

There are no relevant standards in this area.

4. Quality Assurance

This task will be conducted in accordance with PNL's PVTQ Quality Assurance Plan ETC-001 and applicable WHC quality assurance requirements.

5. Schedule

The task will start October 1, 1996, and be completed September 30, 1998.

6. Cost

FY 1997: 9.6 man-months of PNL time costing \$180,000.
Equipment and supplies adds \$20,000.

FY 1998: 12 man-months of PNL time costing \$220,000. Equipment
and supplies add \$30,000.

E. Source-Term For Final Performance Assessment

1. Detailed Description

In July 1999, a final performance assessment report will be submitted for peer and public review. This task provides for making any necessary changes to the source-term calculations completed as part of the preliminary performance assessment that result from the peer and public review process. It is anticipated that only minor changes to the source-term calculations will be needed because of the extensive peer review that will have taken place prior to release of the preliminary performance assessment.

The main contributor to this task will be Peter McGrail.

2. Interfaces

Inputs to this task will come from peer and public review of the preliminary performance assessment report. The main outputs will be updated source-term calculations to the tasks responsible for far-field transport and dose assessments.

3. Standards

There are no relevant standards in this area.

4. Quality Assurance

This task will be conducted in accordance with PNL's PVTD Quality Assurance Plan ETC-001 and applicable WHC quality assurance requirements.

5. Schedule

The task will start October 1, 1998, and be completed September 30, 1999.

6. Cost

Costs for this task are difficult to estimate because of uncertainty in the amount of changes or additional calculations that will be required as a result of comments from peer and public reviewers. An estimate of \$50,000 for FY 1999 is provided for planning purposes.

IV. OTHER CONSIDERATIONS

The inputs to this task will derive mainly from experimental studies being conducted on other tasks in Hanford Tank Low-Level Waste Technology Development Program and from other projects within the Tank Waste Remediation System. As such, close involvement and coordination of efforts between staff working on these projects is essential.

Accepted:

Bernard P. McGrail

Date: _____

3.4.7 Hydrologic Data and Conceptual Model Testings

I. SUMMARY

Design experiments to determine site-specific hydrologic data needed for near-field media (matrix, walls, and back-filled soil) and for vadose zone (far-field media). Note that glass release rate, recharge rate, and retardation factors are covered in other activities. Design experiments to evaluate whether we have the appropriate and necessary conceptual model for the LLW Performance Assessment.

II. GENERALA. Background

The Peer Review Panel (the group selected by the Department of Energy to judge whether a performance assessment is technically adequate) has mandated that site-specific data used in the analyses of water flow and contaminant transport be selected and justified. Such selection and justification can be based on expert judgement, available literature, or project-specific experiments.

The hydraulic properties of backfill materials (matrix) emplaced as part of engineered disposal system require a close study. The materials selected might present very different flow field to the contaminant transport. To examine the effect on the contaminant transport, conceptual models have to be developed and evaluated by numerical models. Methods for dealing with characteristics of fractures will be explored, if the material that is selected may experience fracturing.

Vadose zone flow and transport models are recognized as necessary tools for baseline risk assessments. The purpose of these models is, in part, to "...evaluate the potential migration of contaminants within vadose zone soils to the water table..." (DOE 91). Confidence in the predictions of these models improves progressively as they are repeatedly shown to represent reality.

The proposed experiments are designed to help resolve outstanding technical issues related to current vadose zone flow and transport modeling at Hanford such as: (1) how to resolve differences between field and laboratory measurements of water retention characteristics and unsaturated hydraulic conductivities, (2) how representative are laboratory measurements of unsaturated hydraulic conductivity determined using centrifugation techniques relative to estimates obtained using other methods, and (3) how to address the issue of scale and to build up the confidence in the predictions of the vadose zone flow and transport models.

B. Organization

The cognizant organization is the Environmental Risk and Performance Assessment Section of Westinghouse Hanford; John Rawlins, Manager. The cognizant scientists will be Allen Lu. Supporting this effort will be the Geosciences groups of Westinghouse Hanford and of the Pacific Northwest Laboratory.

C. Vision

As noted above, the acquisition of justifiable data and build-up of confidence of the model prediction are essential aspects for a successful performance assessment.

D. Objectives

This activity will supply an activity and budget plan for the fiscal years 98 through 99 for obtaining justifiable hydrologic data and performing field experiments to check whether we have the appropriate and necessary conceptual model for the final Glass performance assessment.

E. Deliverables

- 1) A final report summarizing the field data and analysis of the controlled experiment will be prepared by September 30, 1998. A conclusion will be drawn whether we have the appropriate and necessary model for flow and transport in the vadose zone.
- 2) Letter report documenting the comparison of the model predictions with the observed contaminant distributions for selected disposal sites (September 30, 1998). A conclusion will be drawn for the issue of scale and the model prediction accuracy for the performance assessment.

III. TASK DESCRIPTIONS**A. Summary List of Activities**

- 1) Controlled field testing of flow and transport models
- 2) Disposal site testing of flow and transport model

B. Controlled field testing of flow and transport models**1. Detailed Description**

The 1980 injection experiment (Sisson and Lu 1980) was an ambitious attempt to collect field data for model calibration and testing, but a thorough analysis of the data was never completed and published. Given the advances in knowledge, computational capabilities, and models over the last 14 years, it is important

that a present-day analysis of the data be completed. During the last several years, researchers have revisited this data set, but as yet, no definitive conclusions have been published. Before proceeding to other experiments and history-matching exercises, this analysis must be completed.

A recent review of the data set from the injection experiment indicated concerns about the neutron probe calibration (Fayer et al. 1993). Relogging the site with better instrumentation and, at the same time, relogging with the original neutron probes (i.e., cross-calibrating), will provide much better estimates of water contents during the experiment. In turn, the better water content estimates will allow for a better check of the overall mass balance of the experiment. More sensitive gamma detectors will better delineate variations in stratigraphy and bulk density. In particular, the slope and aspect of individual layers will be determined. With the knowledge gained from this analysis, we can determine whether it would be fruitful to continue studies at the injection site, propose a new site, or cease testing altogether.

In addition to the 1980 injection experiment, a new injection experiment with objectives oriented to the needs of the Glass Performance Assessment project will be considered. Monitoring equipment today is vastly improved. Instruments such as TDR probes enable us to take more or less instantaneous measurements of water content distributions, something that is not possible with the neutron probe method. TDR measurements can also be taken at a much higher spatial and temporal frequency than the neutron probe.

Allen Lu will oversee the task. Principal Investigators Mike Fayer, Charley Kincaid, Mark Rockhold, Rick Lewis, Bob Engelman, John Smoot, Jeff Serne

2. Interfaces

This is a continuation of the activities in task 3.1.7.2.

Results will be presented to technical community and reviews and comments will be solicited. The findings will be provided to the vadose zone modeling team so they may be used directly in the final performance assessment.

3. Standards

There are no standards in this area. However, past experience with risk and performance assessments will be used to guide activities.

4. Quality Assurance

The progress report will be reviewed frequently. A more formal report will be generated which will be peer-reviewed and submitted for external publication.

5. Schedule

FY 1998: The controlled field test will be monitored and an interim report summarizing the field data and analysis will be prepared by September 30.

FY 1999: The controlled field test will be monitored and a final report summarizing the field data and analysis will be prepared for submittal to a peer review journal(s) by September 30.

6. Cost

FY 1998: 3 man-months of WHC time costing \$37,000, \$315,000 for PNL, and 300 for other.

FY 1999: 3 man-months of WHC time costing \$37,000 and \$135,000 for PNL.

These costs cover other activities in 3.4.7 as well.

C. Disposal site testing of flow and transport model

1. Detailed Description

Of concern to the Glass performance assessment is the issue of scale. The 1980 injection experiment looked at transport 1 to 2 m from the injection well in a period of less than 1 year. In contrast, the actual site dimensions could be as much as 100 m from the waste to the water table, occurring over 100's to 1000's of years. To overcome these scale differences, we propose analyzing one or more past events such as tank leaks and crib discharges. The length scales should be appropriate but the time scales will necessarily be shorter than 1000's of years. However, at 20 to 30 years, the time scale would be far better than that of the 1980 injection experiment. The estimates of the inventory will be reviewed by a group outside of the performance assessment team.

Allen Lu will oversee the task. Principal Investigators Mike Fayer, Charley Kincaid, Mark Rockhold, Rick Lewis, Bob Engelman, John Smoot, Jeff Serne.

2. Interfaces

This is a continuation of the activities in 3.1.7.3.

Results will be presented to technical community and reviews and comments will be solicited. The findings will be provided to the

vadose zone modeling team so they may be used directly in the final performance assessment.

3. Standards

There are no standards in this area. However, past experience with risk and performance assessments will be used to guide activities.

4. Quality Assurance

The progress report will be reviewed frequently. More formal reports will be generated which will be peer-reviewed and submitted for external publication.

5. Schedule

FY 1998: Incorporate the measured contaminant distributions in the analyses, simulate the sites again, compare the model predictions with the observed contaminant distributions, evaluate the model predictions relative to the available data and the testing objectives, and publish the results.

FY 1999: Simulate the experiment to date and compare with observations. A final report will be issued by September 30.

6. Cost

The costs are given in the first task of this activity.

Accepted:

Allen Lu

Date:

3.4.8 Recharge

I. SUMMARY

Generating defensible estimates of recharge rates at the Hanford Site for use in the final performance assessment.

II. GENERALA. Background

Recharge is a major driver for contaminant transport through the vadose zone to the water table. A clear understanding of recharge under potential future climate, soil, and vegetation is therefore of great importance to the performance assessment activities.

B. Organization

The cognizant organization is the Environmental Risk and Performance Assessment Section of Westinghouse Hanford Company; John Rawlins, Manager. The cognizant scientist will be Raz Khaleel. Supporting this effort will be the Geosciences Group of the Pacific Northwest Laboratory (in particular, M.L. Rockhold, M.J. Fayer, G.W. Gee, C.T. Kincaid, and Ellyn Murphy).

C. Vision

A lack of accurate and technically defensible recharge estimates will result in the use of conservative data in performance assessment modeling.

D. Objectives

The objective of this task is to provide defensible estimates of recharge rates for current and long-term conditions applied to the shallow-land disposal of LLW at the Hanford Site.

E. Deliverables

- 1) A letter report describing the present status of the lysimetry experiments by December 31, 1998.
- 2) A letter report describing the present status of the understanding of evapotranspiration at Hanford by December 31, 1998.
- 3) A letter report describing the present status of tracer measurements by December 31, 1998.
- 4) A letter report describing the present status of the understanding of recharge at Hanford March 30, 1999.

III. TASK DESCRIPTIONS**A. Summary List of Activities**

- 1) Lysimetry
- 2) Evapotranspiration Studies
- 3) Tracer Measurements
- 4) Integrated Recharge Assessment

B. Lysimetry**1. Detailed Description**

Data from the weighing lysimeters at the FLTF and several other sites will be compiled and analyzed to support the process evaluation and numerical modeling efforts described below under task 3. A formal test plan will also be prepared outlining options for retrofitting several of the lysimeters at the Field Lysimeter Test Facility (FLTF) to reflect potential land use change scenarios (i.e., irrigated agriculture) and future climate change. The FLTF is located between the 200 East and West areas, adjacent to the Hanford Meteorological Station (HMS). The lysimeters at the facility are currently configured to test the performance of various capillary barrier cover systems under ambient and 2 or 3 times long-term average precipitation.

The lead contributor to this task will be Gleedon Gee.

2. Interfaces

This continues the activities in 3.1.8.2.

3. Standards

There are no standards in this area.

4. Quality Assurance

The reports documenting this work will be peer-reviewed.

5. Schedule

The work will begin July 1997 with a letter report describing the present status of the experiments by December 31, 1998.

6. Cost

2.4 man-months of WHC time costing \$31,000 and \$285,000 for PNL for each each FY 1998 and FY 1999.

These costs are for all recharge activities (this task and others in this activity)

C. Evapotranspiration

1. Detailed Description

One of the most important processes affecting recharge estimates obtained using numerical simulation models is evaporation (or evapotranspiration). Potential evapotranspiration (PET) is a measure of the maximum amount of water that can be absorbed into the atmosphere given the atmospheric vapor density and radiant energy condition. PET at the Hanford Site has typically been calculated from solar radiation, wind speed, and other weather data recorded by the HMS. Estimates of PET rates under arid site conditions have been shown to be significantly greater than actual evapotranspiration rates, except when the soil is close to saturation. Therefore, a need exists for quantifying actual rates of evapotranspiration for specific soil and vegetation types and climatic conditions typical of the Hanford Site. Data from the weighing lysimeters at the FLTF and other locations on the Hanford Site provide the only direct method for measuring actual soil evapotranspiration rates. However, rigorous analyses of data from these weighing lysimeters specifically for evaluating evapotranspiration rates have not been conducted. Selected subsets of data from these weighing lysimeters will be analyzed to quantify actual evapotranspiration rates. Detailed numerical simulations of the soil-water dynamics in the weighing lysimeters will then be conducted using the UNSAT-H computer model. Observed and simulated results will be compared and the most accurate mechanistic and/or empirical descriptions of evapotranspiration will be determined and documented.

The lead contributor to this task will be Mark Rockhold.

2. Interfaces

These analyses continue the work of 3.1.8.3.

3. Standards

There are no standards in this area.

4. Quality Assurance

The reports documenting this work will be peer-reviewed.

5. Schedule

The work will begin July 1997 with a letter report describing the present status of the understanding of evapotranspiration at Hanford by December 1998..

6. Cost

The costs are given in the first task of this activity.

D. Tracer Measurements

1. Detailed Description

Lysimeter measurements provide information on understanding recharge in a controlled environment during the recent past. At Hanford, where the record is among the longest, the recent past is measured in years. Measurements covering longer times are possible using radioactive and chemical tracers (for example, chlorine, ^{36}Cl , and tritium). This work will determine recharge rates as a function of time since the last glacier reflood (approximately 13,000 years ago) by determining the location and amount of natural and artificial tracers in relatively near surface boreholes. Information at other Hanford sites (performed by Battelle and by the United States Geological Survey) indicate a long-term recharge rate significantly below that used in previous performance assessments.

The lead contributor to this task will be Ellen Murphy.

2. Interfaces

These analyses will continue the activities of 3.1.8.4.

3. Standards

There are no standards in this area.

4. Quality Assurance

The reports documenting this work will be peer-reviewed.

5. Schedule

The work will begin July 1997 with a letter report describing the present status of the understanding of long-term recharge using tracer techniques at Hanford December 31, 1998.

6. Cost

The costs are given in the first task of this activity.

E. Integrated Recharge Assessment

1. Detailed Description

The objective of this task is to integrate and evaluate the recharge estimates made using various techniques (i.e., lysimetry, tracers, numerical simulation, etc.). This task will also investigate issues regarding the effects of spatial variability and measurement uncertainty on the recharge estimates made using various techniques. This work will be conducted in collaboration

with the environmental tracers task to identify and select appropriate sites for field sampling. A trench will be excavated adjacent to a selected borehole used for sampling of environmental tracers. Detailed characterization and analyses of plant types, surface coverage, rooting depths and distributions, chloride concentrations, bulk densities, particle-size distributions, hydraulic properties, etc., will be conducted using samples collected during excavation of the trench. The characterization data will be used to estimate parameters for numerical simulations of soil-water dynamics at the site. Predicted recharge rates will be compared with estimates obtained using the chloride mass balance method and other techniques to provide independent confirmation and confidence in the recharge rate predictions. The variability in the recharge rates generated using the various techniques will provide estimates of uncertainties associated with both spatial variability and measurement errors.

The lead contributor to this task will be Mark Rockhold.

2. Interfaces

These analyses will be based on past and continuing lysimeter and tracer work at Hanford. It continue activity 3.1.8.5.

3. Standards

There are no standards in this area.

4. Quality Assurance

The reports documenting this work will be peer-reviewed.

5. Schedule

The work will begin December 1997 will a letter report describing the present status of the understanding of recharge at Hanford March 30, 1999.

6. Cost

The costs are given in the first task of this activity.

3.4.9 Determination of Chemical Transport Data for the Final Performance Assessment

I. SUMMARY

The Hanford LLW performance assessment requires knowledge on site-specific chemical retardation of contaminants that leach from the vitrified glass wastes and percolate through the vadose zone sediments into the upper unconfined aquifer. Chemical retardation of the contaminants through native sediments and engineered barriers emplaced in the near-field will be quantified in this activity. The data will be obtained through literature review, bench-scale laboratory testing, and mechanistic and empirical modeling. Long-term confirmation analyses will be attempted using critical analyses of available thermodynamic and natural analogue information gleaned from the literature.

II. GENERAL

A. Background

See Section 3.1.9 [Background]

B. Organization

The lead for the bench-scale laboratory testing and data synthesis will be the Geochemical Transport Group within PNL's Earth and Environmental Sciences Center. The melding of the Kd data within the transport codes, sensitivity calculations, and technical issues discussions will be performed by M. G. Piepho of the WHC Environmental Risk and Performance Assessment (ERPA) Section. Washington State University-TriCities Campus staff will aid in the UFA experiments.

Key technical staff and their affiliations include R. J. Serne and D. I. Kaplan (PNL), M. G. Piepho and J. W. Shade (WHC) and J. A. Conca (WSU).

C. Vision

The acquisition of all chemical retardation data for many species is a very expensive endeavor. By performing only those experiments and tests really needed, planned budgets may be able to be reduced and unnecessary conservatism in transport calculations can be avoided.

D. Objectives

The objective of this task is to determine the waste-form-specific chemical retardation data for vadose zone transport in the near (matrix, engineered barriers, and back-filled sediments) and far fields. This activity will supply the defensible Kd values and appropriate technical justification for the chosen values. Using retardation factors (derived from Kd values) in the performance assessment calculations greatly reduces unnecessary conservatism.

E. Deliverables

- 1) Progress letter reports on geochemical data measurements (September 1998 and September 1999).
- 2) PNL Letter report of the site specific Kd values of studied contaminants and of the results of expert opinion on lesser contaminants (July 1998).
- 3) A topical paper of "Technical Rationale for Chemical Retardation Values Used in Final Performance Assessment" (January 1999).
- 4) A topical paper of "Importance of Colloid-facilitated Transport of Contaminants for Hanford LLW Performance Assessment" (June 1997).
- 5) A topical paper of "Use of Natural Analogues and Thermodynamics to Defend Long-term Extrapolation of Laboratory Chemical Retardation Data" (November 1997).
- 6) A topical paper of "Applicability of Mechanistic Adsorption Models for Key Contaminants in Hanford LLW Glass Disposal" (September 1998).

III. TASK DESCRIPTION

A. Summary List of Activities

- 1) Measure chemical retardation of Tc, Np, and U in Hanford soils/engineered materials with Hanford water to determine accurate small Kd values or retardation factors, Rf values. Determine or confirm conceptual model for moisture-dependent Rf/Kd values and gravel-corrected Rf/Kd values, and develop "variable Kd values". Longer-term develop data for other contaminants and solubility/precipitation of contaminants in near field barriers.
- 2) Determine geochemical-software needs and search for geochemical software for use at Hanford.
- 3) Apparent Diffusion Coefficients for Contaminants in the Vadose Zone Sediments at the Hanford LLW Site.
- 4) Colloid-facilitated Transport of Contaminants Through the Vadose Zone Sediments in the Hanford LLW Site.
- 5) Natural Analog and Technical Defensibility and Final Resolution of Technical Issues and Engineered Barriers.

B. Determination of Kd/Rd Values for Key Contaminants in Vadose Zone Sediments and Engineered Barriers

1. Detailed Description

This is a continuation of task 3.1.9.2. For the detailed description see that section.

The main contributor to this subtask will be M. G. Piepho and J. W. Shade of WHC, R. J. Serne, D. I. Kaplan, D. Rai, and A. R. Felmy of PNL and J. A. Conca of the WSU-TC.

2. Interfaces

This is a continuation of the corresponding task of 3.1.9.

Information will be exchanged with other team members dealing with parameters not covered in this subtask to understand the possible range of parameters. Interaction with the field geologists who are responsible for getting sediment cores and with the engineers in charge of choosing barrier materials will be maintained.

As activity 3.1.6 LLW Glass Release Source-Term defines the chemical composition of the glass leachate, we will ensure that our retardation studies use waters that cover the range of actual glass leachate compositions. We will also consider the flow rates (hydrologic data activity from Section 3.1.7 and recharge estimates from Section 3.1.8) that will likely occur in the near field and vadose zone sediments while performing retardation tests. We will also contribute to and perhaps perform laboratory tests on integrated systems should activity 3.1.C (Integrated Testing) become a key activity.

3. Standards

There are no laboratory standards per se in this area to follow. Past experience with chemical retardation aspects of risk and performance assessments will be used to guide activities (Serne et al., 1973; Serne et al., 1990).

4. Quality Assurance

This subtask will be conducted in accordance with PNL's PVTD Quality Assurance Plan ETC-001 and applicable WHC quality assurance requirements.

5. Schedule

The subtask will start in FY 1998 and be completed during FY 1999. Pedigree values for the final performance assessment will be issued by September 1998. A PNL topical report will be submitted by December 1998.

6. Cost

FY 1998: 4.8 man-months of WHC time costing \$62,000 and \$467,000 for PNL.

FY 1999: 4.8 man-months of WHC-time costing \$62,000 and \$450,000 for PNL.

This covers all tasks in this activity.

C. Determine Geochemical-software Needs and Availability

1. Detailed Description

Geochemical codes for use in both the near and far fields at Hanford need to be investigated. With geochemistry playing an important role in the choice of matrix and barriers around the glass waste form, the use of a geochemical code would be required to assess different chemical compositions without having to actually do the experiment. The choice of the geochemical code will depend on several factors, such as what data bases can it access, what data bases are available, kinetics or equilibrium assumptions, hydraulic capability or hydraulic interface, etc. This task will survey the available geochemical codes that are available (there is no intent to do development here) and the corresponding data bases, document the pros and cons of each code, weigh the needs of the LLW Performance Assessment and choose a code that best fits the needs of the Performance Assessment. With the variable Kd being developed by PNL, a geochemical code that will predict and keep track of the variables (pH, competing ions, etc.) that the variable Kd needs, will be useful. As the factors that affect Kd values change over time and space, the Kd will change accordingly.

2. Interfaces

This is a continuation of the corresponding task in 3.1.9.

WHC staff will coordinate with PNL and other geochemists at outside laboratories who have experience in using geochemical codes and their linking with flow/transport codes.

3. Standards

Not applicable.

4. Quality Assurance

Only codes with complete, publicly available user's guides that address code verification exercises will be considered.

5. Schedule

The activity will build upon the work performed in 3.1.9.

6. Cost

Costs are given in the first task in this activity.

D. Apparent Diffusion Coefficients for Contaminants in the Vadose Zone Sediments at the Hanford LLW Site

1. Detailed Description

When the transport of matter in the absence of bulk flow is driven by a concentration gradient it is referred to as diffusion. Diffusion is likely the dominant process in some parts of the vadose zone because of the sporadic nature of recharge over contaminated soil sites and the likely construction of impermeable surface barriers over these sites. These impermeable surface barriers will effectively limit infiltration into and immediately surrounding the contaminated soil zone.

Diffusional transport is quantified through the measurement of diffusion coefficients whose values are dependent on several factors such as the type of contaminant, physical (e. g., moisture content, tortuosity, pore size, porosity) and chemical properties of the soil, and water composition. Methods to measure diffusion coefficients of contaminants in unsaturated conditions have not been fully developed. For this activity, diffusion coefficients will be determined using ring electrodes and half-cell tests. During these test, the following parameters will be investigated: soil types, contaminants and their concentration, groundwater and rainwater compositions, and moisture content. Particular attention will be paid to mobile elements (e.g., Tc and I) under partially saturated conditions because the greatest potential benefit in reducing the conservatism in release estimates appears to exist where partial saturation and diffusion dominated transport could limit the movement of mobile contaminants.

The main contributors to this subtask will be R. J. Serne and D. I. Kaplan.

2. Interfaces

We will coordinate this work with efforts at WSU-TC (J. A. Conca) and we will consult with soil physics experts at PNL (G. W. Gee, M. H. Rockhold), WHC (J. F. Relyea), and elsewhere while reviewing literature and designing Hanford specific lab experiments.

3. Standards

There are no laboratory standards per se in this area to follow, but several laboratory methods have been published to guide

activities. Past experience with chemical retardation aspects of risk and performance assessments will be used to guide activities (Serne 1989; Serne et al., 1989a; Serne et al., 1989b).

4. Quality Assurance

This subtask will be conducted in accordance with PNL's PVTD Quality Assurance Plan ETC-001 and applicable WHC quality assurance requirements.

5. Schedule

Laboratory experiments, if found necessary in activity 3.1.9, will be conducted. Pedigree effective diffusion coefficient values for the final performance assessment will be issued by July 1998.

6. Cost

The costs are given in the first task in this activity.

E. Colloid-facilitated Transport of Contaminants Through the Vadose Zone Sediments in the Hanford LLW Site

1. Detailed Description

Contaminant transport models generally treat the subsurface environment as a two-phase system in which contaminants are distributed between a mobile aqueous phase and an immobile solid phase (sediment). Contaminants with a high affinity for sorbing to rock or vadose zone sediments are assumed to be retarded relative to the rate of groundwater flow. However, an increasing body of evidence indicates that under some subsurface conditions, components of the solid phase may exist as colloids and particles suspended in and transported with the flowing water. Association of contaminants with this additional mobile phase may enhance the rate of contaminant transport; conversely, deposition of the colloidal particles may reduce the permeability of a formation and thereby decrease transport. Accurate assessment of current contamination problems, engineering and safety assessment of containment and disposal options, and development of cost effective remediation strategies all require fundamental understanding of the potential role of colloidal particles in enhancing or diminishing contaminant transport in the subsurface.

The distinction between colloidal and dissolved phases is arbitrary, that is there is a continuum of particle sizes down to the single free ion and an operational definition must be imposed to define the colloidal fraction. Because mobile colloids can flow only where water flows and water in unsaturated conditions is limited to film flow, only very small (perhaps less than 100 nm) mobile colloids could possibly exist in the Hanford unsaturated system to be modelled. This immediately limits the types of colloids that are likely to exist as vectors for contaminant

transport. Unlikely mobile colloids are those composed of detrital inorganic minerals which are typically greater than 100 nm in diameter and are the most commonly reported types of mobile colloid under saturated conditions. Real colloids (precipitates of contaminants) and colloids composed of contaminants sorbed to naturally occurring organic substances might be better candidates for sources of mobile colloids in the system to be modelled. Since naturally occurring organic substances are generally quite low in the vadose zone of the Hanford site, as a first approximation, real colloids might be the only source for mobile colloids in this system.

The extent of precipitation likely to occur in these systems will be determined in the activity described above (Solubility and precipitation of contaminants during transport through the near field). Should precipitation be likely and therefore the formation of real colloids be possible, column studies will be conducted under unsaturated conditions. The influent and effluent will then be ultrafiltered and the contaminants will be measured in the resultant size fractions.

The main contributors to this subtask will be R. J. Serne and D. I. Kaplan.

2. Interfaces

This task was NOT included in 3.1.9.

Currently no other Hanford scientists are involved in colloid transport but we are familiar with several activities at other national laboratories/universities. We will consult with appropriate colleagues.

3. Standards

There are no laboratory standards in this area to follow. Past experience (Kaplan et al., 1993; Kaplan et al., 1994a; Kaplan et al., 1994b; Kaplan et al., 1994c; Kaplan et al., 1994d) with laboratory, large-scaled lysimeters, and large-scale field experiments at other national laboratory sites will be used to guide activities.

4. Quality Assurance

This subtask will be conducted in accordance with PNL's PVTQ Quality Assurance Plan ETC-001 and applicable WHC quality assurance requirements.

5. Schedule

This subtask will not be started until a majority of the solubility data becomes available, which will be by FY 1998. Column studies will be completed in the first half of FY 1999. A topical report will be issued by September 1998.

6. Cost

The costs are included in the first task of this activity.

F. Natural Analog and Technical Defensibility

1. Detailed Description

In this subtask we will produce written justification/rationale for the specific chemical retardation data offered to the transport code users. In addition we will respond to various geochemical issues that crop up during the performance assessment process. Specific issues that already merit discussion include: proper method to measure low sorption ("small-Kd issue"), the gravel and moisture content dependencies of Kd, and defending the long-term extrapolation of short-term laboratory data, proper conceptual model for diffusion of reactive constituents in partially saturated sediments, influence of colloids on contaminant transport, and adequacy of Kd versus more mechanistic adsorption conceptual models. These geochemical issues and others that emanate from the reviewers of the performance assessments will be addressed using letter reports or topical reports that draw from literature and project specific laboratory studies. The first discussions will occur in subtask C and the status of issues described in the WHC report on the Geochemical Workshop available December, 1995. In subtask G we will address issues that merit more detailed discussion and those for which significant new progress is expected.

The main contributors to this subtask will be R. J. Serne, K. M. Krupka, D. I. Kaplan, J. M. Zachara, and D. Rai of PNL and J. W. Shade and M. G. Piepho of WHC.

2. Interfaces

This continues work begun in activity 3.1.9.

We will monitor reviewer comments/concerns and general geochemical literature to extract information that pertain to geochemistry issues and their resolution. Contacts at other DOE facilities who are active in DOE Order.

3. Standards

There are no laboratory standards in this area to follow. Products will be written discussions that rely upon descriptions

of scientific principles, empirical data, and clear logic to explain our rationale for choosing Hanford specific conceptual models and specific values for parameters within the models. The discussions will avoid being overly technical and will avoid using jargon.

4. Quality Assurance

This subtask will be conducted in accordance with PNL's PVTD Quality Assurance Plan ETC-001 and applicable WHC quality assurance requirements.

5. Schedule

The following letter reports/topic reports are forecast. Others may be identified as issues surface.

- a. Technical Rationale for Chemical Retardation Values Used in Final Performance Assessment (September 1998).
- b. Use of Natural Analogues and Thermodynamics to Defend Long-term Extrapolation of Laboratory Chemical Retardation Data (November 1997).
- c. Applicability of Mechanistic Adsorption Models for Key Contaminants in Hanford LLW Glass Disposal (September 1998).

6. Cost

The costs are included in the first task in this activity.

Accepted: _____, Date: _____
Mel Piepho

3.4.A Ground Water Data for Final Performance Assessment

I. SUMMARY

Obtain the ground water data needed to perform flow and transport calculations for the final performance assessment.

II. GENERALA. Background

The Hanford Future Site Uses Working Group made several recommendations tied to ground water flow and transport. Number one on the list was the protection of the Columbia River, and number two was dealing realistically and forcefully with ground water contamination. Clearly, ground water flow and contaminant transport issues weigh heavily in the future use of the Hanford site. The low level waste performance assessment must deal with these issues in a convincing manner if the performance assessment is to win the confidence and acceptance of the regulators and the working group. The impact of the disposal facility on the ground water must be determined, according to the general land use envisioned for the central plateau. The Columbia River must be protected from contaminated ground water leaving the disposal area. The public must be adequately protected if the central plateau aquifer is exploited for water supply by individuals or communities. Ground water modelling will best answer questions concerning the fate of contaminants leaving the disposal area, and the travel time of contaminated ground water to points of compliance. By combining quality data with suitable technical expertise, the ground water flow and transport modelling effort can provide defensible results for the envisioned future use scenarios.

B. Organization

The cognizant organization is unknown at this time, being dependent of the reallocation of resources between Westinghouse Hanford Company and Bechtel Hanford Company. The cognizant scientist will be Bill McMahon.

C. Vision

Defence of ground water and transport modelling depends on the acquisition and implementation of adequate and appropriate data.

D. Objectives

Supply data needed for ground water modelling for the preliminary performance assessment.

1. Impact of Omission.

Without the ground water flow and transport modelling, credible estimates of travel times, contaminant plume extent, and

contaminant concentration will be almost impossible to obtain. Without these estimates, it is highly unlikely that the performance objectives of the performance assessment can be met, or the performance assessment will satisfy the regulators and working group.

2. Impact of Scheduling Delays.

For the modelling to be conducted in a worthwhile manner, the program must remain reasonably within schedule. Sufficient time must be allotted for data collection and analysis. Modelers must have sufficient time to develop their conceptualization and to confer with additional expertise to bring the final model into working order. The regulators and working group must agree that the model adequately represents hydrologic conditions and future use scenarios, and have confidence in the results. This confidence comes from thorough parameter sensitivity testing and evaluating alternative approaches to the conceptualization. All of these activities require time up front which cannot be compensated for later on. The modelling effort must proceed in a logical and orderly manner if the results are to win the confidence of the regulators and future site uses working group.

E. Deliverables

- 1) A letter report detailing all data collection activity performed in support of the ground water flow and transport portion of the low level waste performance assessment will be written September 30, 1998, with peer review by December 31, 1998, and full review by March 30, 1999.

III. TASK DESCRIPTIONS

A. Summary List of Activities

- 1) Obtain ground water data for final performance assessment.

B. Obtain ground water data for Preliminary performance assessment

1. Detailed Description

Complete all data collection field activity and data analysis; finalize the conceptual model; and begin ground water flow and transport modelling.

All field work performed in support of the ground water portion of the performance assessment will be completed, and the information incorporated into the conceptual model. Once the conceptual model is completed, the numerical model will be developed, and the actual modelling can begin.

3. Standards

There are no standards in this area.

4. Quality Assurance

The letter report will be peer reviewed.

5. Schedule

A letter report detailing all data collection activity performed in support of the ground water flow and transport portion of the low level waste performance assessment will be written September 30, 1998, with peer review by December 31, 1998, and full review by March 30, 1999. This activity continues from 3.1.4.2 and hence starts in July 1997.

6. Costs

Twelve man-months of effort costing \$154,000 is expected in both FY 1998 and FY 1999.

3.4.B Dose Modeling Data for the Final Performance Assessment

I. SUMMARY

Continue upgrades to the food chain data base used for performance assessment calculations. Areas of specific interest are stochastic methods for dose determination.

II. GENERALA. Background

An area of increasing interest is quantifying the range of potential dose consequences as a probability distribution. The basis for the output distribution is the variation of the input parameters. A database must be constructed with credible distribution functions and ranges for the parameters used in the dose calculations.

This is also called "sensitivity studies". They are recommended by the DOE Peer Review Panel.

B. Organization

The responsible organization will be the Environmental Risk and Performance Assessment Section of the Westinghouse Hanford Company, John Rawlins, Manager. The cognizant scientist will be Paul D. Rittmann.

C. Vision

Probability distributions answer the question, "How bad could it get?". They also show the more likely doses and how the doses are distributed between the largest and smallest values. These are important aspects of protection of the public.

D. Objectives

The primary objective is to determine the parameter ranges and distribution functions for each of the parameters used in the dose calculation.

E. Deliverables

Letter report describing the parameter ranges and functions chosen for the final performance assessment.

III. TASK DESCRIPTIONSA. Summary List of Tasks

Determine parameter distributions

B. Determine Parameter Distributions

1. Detailed Description

Each of the data values used in the performance assessment dose calculations has a range and probability function associated with it. Reviews of relevant literature should be sufficient.

2. Interfaces

There will be discussions with qualified experts such as J. K. Soldat and B. A. Napier who have considered similar topics for the Grout Performance Assessment. There are no interfaces with other activities which will affect completion of this task.

3. Standards

There are no relevant standards in this area.

4. Quality Assurance

The letter report will be reviewed before issuance. Impact Level NA is appropriate for this effort.

5. Schedule

The task will start in October 1996, with the letter report issued by March 1999.

6. Cost

12.0 man-months of professional time costing \$154,000 will be required for each of FY 1998 and FY 1999.

3.5 Calculate Responses and Document

I. SUMMARY

This activity performs the actual calculations and analyses that appear in the final performance assessment and write the document itself.

II. GENERALA. Background

Earlier activities (3.4.X) produced the data and methods to be used in the final performance assessment.

B. Organization

The responsible organization will be the Environmental Risk and Performance Assessment Section of the Westinghouse Hanford Company, John Rawlins, Manager. The cognizant scientist will be Fred Mann.

C. Vision

The final performance assessment is the document required by DOE order to allow waste disposal.

D. Objectives

This activity will produce the final performance assessment.

E. Deliverables

- 1) Final Performance Assessment as a letter report ready for internal review (July 30, 1999).

III. TASK DESCRIPTIONSA. Summary list of tasks

- 1) Write final performance assessment.

B. Write Final Performance Assessment

1. Detailed Description

All calculations and analyses performed by the performance assessment team that will appear in the final performance assessment will be performed.

The final performance assessment (including required background information, integration, and interpretation) will be written.

The main contributors to this task will be the entire performance assessment team.

2. Interfaces

The input for this task were generated in 3.4.X tasks.

The output of this task will be the final performance assessment ready for review by the program office, RL, and other internal Hanford reviews.

3. Standards

There are no relevant standards in this area. However, guidance from the DOE Peer Review Panel and from the NRC staff will be used.

4. Quality Assurance

The letter report will be reviewed by the performance assessment team before issuance.

5. Schedule

The task will start April 1, 1999, with the letter report written and reviewed by July 31, 1999.

6. Cost (FY 1999)

4.7 man-months of professional time costing \$60,000 will be required.

Appendix D

Budgets

APPENDIX D
Manpower Estimates and Costs (\$1000s)

FY 95

Activity	WHC	WHC	PNL	Other	Total	
1.2A-F	1.27	196	22		218	Advise
1.2G	1.37	211	0	0	211	Manage
1.2	2.64	407	22	0	429	Interim Guidance
2.1.1-.3	0.91	140	0	0	140	PO, Scen, Tool
2.1.4	1.26	194	0	0	194	Inventory
2.1.5	0.47	73	0	0	73	Facility
2.1.6	0.27	42	in 3.1.6	0	42	Release
2.1.7	0.82	127	0	0	127	Transport
2.	3.74	576	0	0	576	IPA
3.1.3	0.93	144	16	0	160	Tool
3.1.6		0	466	0	466	Release
3.1.7	0.53	81	420	216	717	Hydraulic
3.1.8	0.11	17	339	83	439	Recharge
3.1.9	0.84	130	316	99	545	Chemical
3.1.A	1.10	169	0	0	169	Ground Water
3.1.B	0.55	84	0	0	84	Dosimetry
3.1.C	1.65	253	0	0	253	Integrated
3.1	5.70	878	1558	398	2834	Preliminary PA
total	12.09	1861	1579	398	3839	total
					3839	Budget

WHC labor given in man-years, costed at \$154,000 per man-year.
Costs are given in \$1000s

B. Internal review of the final performance assessment

1. Detailed Description

Hanford groups will review the final performance assessment. Such groups will be determined by the Program Office but are expected to include the program office itself, the Internal Review Team of the performance assessment activity, and RL.

The main interface to the reviewers will be Fred Mann.

2. Interfaces

The input for this task is the final performance assessment generated in activity 3.5.

The output of this task will be comments that may lead to changes in the final performance assessment or may indicate that the document serves its intended purpose.

3. Standards

There are no relevant standards in this area.

4. Quality Assurance

The review groups will establish their own quality assurance.

5. Schedule

The task will start August 1, 1999, with comments received on the final performance assessment by September 30, 1999.

6. Cost (FY 1999)

1.2 man-months of professional time costing \$15,000 will be required.

3.7 RL/PRP Review

I. SUMMARY

The Peer Review Panel and DOE-Headquarters are to review and approve the final performance assessment.

II. GENERALA. Background

The final performance assessment is the regulatory document allowing the disposal of radioactive waste in a disposal facility. By DOE Order, both the Peer Review Panel and DOE Headquarters must review and approve the final performance assessment before disposal occurs.

B. Organization

The responsible organization will be the Environmental Risk and Performance Assessment Section of the Westinghouse Hanford Company, John Rawlins, Manager. The cognizant scientist will be Fred Mann.

C. Vision

The final performance assessment should withstand any attacks on its methods, data, or interpretations.

D. Objectives

This activity will perform the review and approval for the final performance assessment.

E. Deliverables

- 1) Communications from review bodies on the adequacy of the final performance assessment (September 30, 2000)

III. TASK DESCRIPTIONSA. Summary list of tasks

- 1) PRP/DOE Review/Approval of the final performance assessment.

B. PRP/DOE Review/Approval of the final performance assessment

1. Detailed Description

The Peer Review Panel and DOE will review and approve the final performance assessment. If changes to the document, they will be made by the performance assessment team.

The main interface to the reviewers will be Fred Mann.

2. Interfaces

The input for this task is the preliminary performance assessment generated in activity 3.5 (and possibly modified because of the review occurring in 3.6).

The output of this task will approval to disposed of radioactive waste in the disposal facility.

3. Standards

There are no relevant standards in this area.

4. Quality Assurance

The review groups will establish their own quality assurance.

5. Schedule

The task will start October 1, 1999, with final approval/comments by September 30, 2000.

6. Cost

2.4 man-months of professional time costing \$31,000 will be required. Also \$80,000 for external costs in FY 1998 and FY 1999.

APPENDIX A
PA ACTIVITIES

- 1.0 Guidance Using Performance Assessment Activities
 - 1.1 Provide Guidance for Early Activities [1/94 - 7/94]
 - 1.1.1 Advise site selection
 - 1.1.2 Advise system functions and requirements
 - 1.1.3 Advise glass development
 - 1.1.4 Advise characterization and process engineering
 - 1.1.5 Advise on sensitivity of answers to uncertainties
 - 1.1.6 Management
 - 1.2 Provide Guidance for Interim Activities [8/94 - 9/95]
 - 1.3 Provide Guidance for Long-term Activities [10/95 - 9/99]
- 2.0 Interim PA
 - 2.1 Obtain data [12/93 - 10/95]
 - 2.1.1 Performance objectives [1/94 - 1/95]
 - 2.1.2 Scenarios and pathways (including land use) [3/94 - 3/95]
 - 2.1.3 Tool selection and verification [5/94 - 6/95]
 - 2.1.4 Inventory [12/93 - 12/95]
 - 2.1.5 Disposal Facility [12/93 - 10/95]
 - 2.1.6 Release Rates [12/93 - 10/95]
 - 2.1.7 Far field transport data [12/93 - 7/94]
 - 2.2 Calculate responses and document [10/95 - 12/96]
 - 2.3 Define contingencies [1/97 - 9/97]
 - 2.4 Have internal review [1/97 - 3/97]
 - 2.5 External Review with public input [4/97 - 9/97]
- 3.0 Performance Assessment
 - 3.1 Obtain data for preliminary PA [1/94 - 12/97]
 - 3.1.1 update performance objectives (including review) [1/96 - 6/96]
 - 3.1.2 update scenarios and pathways (including review) [1/96 - 6/96]
 - 3.1.3 Tool selection, verification, and certification [1/95 - 12/97]

3.1.4	Inventory	[1/95 - 12/97]
3.1.5	Disposal Facility	[1/95 - 12/97]
3.1.6	Release Rates	[1/94 - 12/97]
3.1.7	Geologic/hydrologic Data	[10/94 - 12/97]
3.1.8	Recharge Data	[1/94 - 12/97]
3.1.9	Chemical Retardation Data (Kd)	[10/94 - 12/97]
3.1.A	Saturated Flow Data	[10/94 - 12/97]
3.1.B	Dosimetry and air transport data	[10/94 - 12/97]
3.1.C	Integrated Testing	[10/94 - 12/97]
3.2	Calculate Response and document for Preliminary PA	[10/97 - 6/98]
3.3	PRP review of Preliminary PA	[7/98 - 12/98]
3.4	Obtain data for final PA	[1/96 - 6/99]
3.4.1	update performance objectives	[1/99 - 3/99]
3.4.2	update scenarios and pathways	[1/99 - 3/99]
3.4.3	update tools	[1/99 - 3/99]
3.4.4	Inventory	[1/98 - 3/99]
3.4.5	Disposal Facility	[4/98 - 6/99]
3.4.6	Release Rates	[1/97 - 6/99]
3.4.7	Geologic/hydrologic data	[1/96 - 6/99]
3.4.8	Recharge Data	[1/97 - 6/99]
3.4.9	Chemical retardation data (Kd)	[1/97 - 6/97]
3.4.A	Saturated Flow Data	[1/97 - 6/97]
3.4.B	Dosimetry and Air Transport data	[1/97 - 6/97]
3.4.C	Integrated Testing	[1/97 - 6/99]
3.5	Calculate responses and document for final PA	[4/99 - 7/99]
3.6	Internal Review	[8/99 - 9/99]
3.7	PRP/HQ review and approval	[10/99 - 9/00]

APPENDIX B
FORMAT and CONTENTSI. SUMMARY

Include a one paragraph statement which summarizes the effort for which the statement of work is to become the management plan document.

II. GENERALA. Background

- 1) Identify need for this activity; and
- 2) Describe previous work including studies, functions and requirements, design criteria, etc. The criteria to be met by the end product must either be referenced or contained in the statement of work. If the criteria is not available, specify that end product criteria must be generated as one of the tasks.

B. Organization

Define the cognizant organization and all supporting organizations responsible for completing the work. Identify the responsible manager and the cognizant scientist / engineer. Identify the responsible manager or contributor from each support group.

C. Vision

Provide an overview of how the proposed activity relates to long-range objectives of the low-level waste performance assessment activity.

D. Objectives

Provide a detailed listing of the objectives of the activity.

E. Deliverables

Provide a listing of the deliverable products and when they will be completed. These products typically include documents, analyses, workshops, major reviews, and presentation/attendance at major meetings.

III. TASK DESCRIPTIONSA. Summary List of TasksB -> N. Task by Task Description

I.1 Detailed Description of Task

- a) Prepare a description of each task to be performed;
- b) Define the scope of the task;
- c) Provide the reason for performing the task;

- d) For computer software development, identify computer software life-cycles to be used;
- e) List special requirements to be observed in the performance of the task, such as reporting requirements, documentation requirements; and
- f) List all major contributors to the task including organization and the extent of their contributions as well as the limit of their responsibilities.

I.2 Interfaces

Describe needed data, information, documents, or other inputs for this task that will be derived from other tasks in this activity, from other activities in the performance assessment effort, or from other efforts. The dates on which these inputs are needed should also be specified.

The users of the output information, data, documents, analyses, etc. should also be identified and the need dates for these items identified.

I.3 Standards

State any applicable codes and standards which must be used in the task and define the limits of their applicability. Included should be references to WHC Standard Engineering Practices.

I.4 Quality Assurance

- a) Define the planned points in the task at which critical reviews will be conducted. Define the selected method of verification to be applied at each review point and also the documentation to be included in each review stage.
- b) For computer software application, identify how the computer software was or will be verified; and
- c) Identify the Impact Level for the task and the basis for the determination.

I.5 Schedule

- a) Provide a schedule showing a detailed breakout of major sub-tier tasks, intermediate and final milestones and deliverables, start and completion dates, as well as review and approval cycles. All prerequisite conditions and inputs for proceeding with any phase of the task should be identified and appropriately labelled with "HOLD" or "DECISION" point flags; and
- b) Describe any special assumptions upon which the plan is predicated; identify a fall-back position in the event the precursor work does not materialize.

I.6 Costs

- a) Provide the total cost estimate for the task AND THE ELEMENTS, broken out by man-months and dollars (totally burdened, please) for each responsible person and/or supporting group;
- b) Identify the major assumptions used in compiling the estimate, particularly those driving significant portions of the cost or schedule; and
- c) Identify the potential need for contingency funding, if applicable, and the recommended percentage to be allowed. Identify any recommended project hold points for criteria and cost estimate review or reconciliation.

IV. OTHER CONSIDERATIONS

Provide other items important for the activity, including strategic considerations, staffing and facility considerations, technology needs and development considerations, as well as strengths and weaknesses of the proposal.

APPENDIX C
DELIVERABLES

FY 1995

November 1994

- 1) Letter report providing performance objectives for the interim performance assessment
- 2) Letter report providing performance objectives for the interim performance assessment

December 1994

- 1) Letter reports justifying selection of tools in each analysis area
- 2) Letter report justifying selection of a computational tool for LLW glass source-term calculations for the interim performance assessment

January 1995

- 1) Letter report documenting comments from review boards on the performance objectives as well as responses to comments .
- 2) Letter report documenting comments from review boards on the scenarios as well as responses to those comments .

February 1995

- 1) Letter report reviewing and modifying (if necessary) code selection used for preliminary performance assessment for applicability to the preliminary performance assessment.

March 1995

- 1) Letter report defining geometry and volume of waste form.
- 2) Letter report defining important barriers used in design.
- 3) The DQO methodology will be employed to develop an integrated characterization plan for site geology and hydrology. The plan will address the needs of the Performance Assessment as well as the needs to the site licensing activities.

June 1995

- 1) Letter reports documenting verification efforts on the selected codes.
- 2) Letter report documenting the total inventory expected to be the glass waste form

- 3) Letter report documenting the highest level of important materials to be in a single vault.
- 4) Letter report documenting methods for verification and certification of the computational tool selected for LLW glass source-term calculations.
- 5) Letter reports justifying selection of tools in each analysis area.
- 6) Letter reports documenting strategy for certifying codes.
- 7) A report on conceptual model of hydraulic properties from literature and description of evaluation and output of flow field for preliminary performance assessment.
- 8) A plan for testing the integrated performance of the disposal system will be developed following the selection of a reference and backup disposal system design.

July 1995

- 1) Letter report determining parameters for transport through important barriers.

September 1995

- 1) Letter report documenting advice concerning important parameters [groundwater flow, prior contamination, and quality of existing hydrologic parameters] in site selection .
- 2) Letter report documenting advice concerning important parameters [release rate, recharge, vault barriers] in the engineered system.
- 3) Letter report documenting advice concerning important parameters [size, shape, temporal release rate] in glass specifications .
- 4) Letter report documenting advice concerning important parameters [K_d , hydrologic parameters] in matrix specifications .
- 5) Letter report documenting advice concerning important parameters [critical isotopes and their maximum amounts] in inventory and chemical/physical processing.
- 6) Letter report discussing status of the sensitivity of uncertainties to results coming from calculations
- 7) Letter report describing preliminary model for hydrolysis and contaminant release from LLW glass
- 8) Letter report documenting LLW glass release source-term for interim performance assessment

- 9) Letter report documenting compilation and interpretation of vadose zone flow and transport properties for soils in the 200 Areas plateau
- 10) A letter report describing the methodology of the field experiment and the results of the hydraulic property measurements
- 11) Letter report describing the entire process, from data collection to model prediction of the Injection Site (Sisson and Lu, 1984),
- 12) A letter report describing increased capabilities at the Geotechnical Engineering Laboratory
- 13) Proceedings from the recharge workshop
- 14) WHC report (or letter report) on geochemical software needs and availability
- 15) A letter report will be prepared describing the ground water modelling task, the information currently available, and the data collection necessary for the low level waste performance assessment.
- 16) A letter report will be prepared describing the ground water modelling task, the information currently available, and the data collection necessary for the low level waste performance assessment.

FY 1996

October 1995

- 1) Letter report acknowledging review of transport parameters.
- 2) Contracts will be placed and the necessary paperwork completed to allow initiation of site characterization

December 1995

- 1) WHC report on geochemical workshop

March 1996

- 1) Letter report providing performance objectives for the preliminary performance assessment
- 2) Letter report providing scenarios for the preliminary performance assessment

June 1996

- 1) Letter report documenting comments from review boards on the performance objectives as well as responses to comments.
- 2) Letter report documenting comments from review boards on the scenarios as well as responses to comments .
- 3) Letter report defining geometry and volume of waste form.
- 4) Letter report justifying selection of a computational tool for LLW glass source-term calculations for the preliminary performance assessment.
- 5) WHC report on geochemical issues and their resolutions.
- 6) A topical paper of "Influences of Moisture Content on Measured Kd Values".

September 1996

- 1) Topical Report: Laboratory Confirmation Tests in Support of LLW Glass Source-Term Release Modeling.
- 2) A report on hydraulic property measurement results.
- 3) Progress letter reports on geochemical data measurements.
- 4) A topical paper of "Proper Treatment of Reactive Contaminant Diffusion in Partially Saturated Sediments".

FY 1997

December 1996

- 1) Interim Performance Assessment as a letter report ready for internal review.

March 1997

- 1) Communications from review bodies on the adequacy of the interim performance assessment .
- 2) A topical paper of "Technical Rationale for Chemical Retardation Values Used in the preliminary performance assessment.

June 1997

- 1) Letter reports documenting experiments conducted for certification.
- 2) Letter report documenting the total inventory expected to be the glass waste form.
- 3) Letter report documenting the highest level of important materials to be in a single vault.
- 4) A topical paper of "Importance of Colloid-facilitated Transport of Contaminants for Hanford LLW Performance Assessment" .

July 1997

- 1) Letter report defining important barriers used in design.
- 2) A letter report describing the present status of the lysimetry experiments.
- 3) A letter report describing the present status of the understanding of evapotranspiration at Hanford.
- 4) A letter report describing the present status of tracer measurements.
- 5) A topical paper of "Technical Rationale for Chemical Retardation Values Used in the preliminary performance assessment".

September 1997

- 1) Communications from the external review groups on the quality of the interim performance assessment.
- 2) Letter report providing suggested changes in approach and design to overcome possible problems revealed in the interim performance assessment.
- 3) Letter report documenting review of inventory data for the preliminary performance assessment.
- 4) Letter report determining parameters for transport through important barriers.
- 5) An interim report summarizing the field data and analysis of the controlled experiment at the adjacent to the Glass disposal facility.
- 6) A report on conceptual model of hydraulic properties from literature and description of evaluation and output of flow field for preliminary performance assessment.
- 7) A letter report documenting and justifying hydraulic properties of matrix materials to be used in preliminary performance assessment.
- 8) Progress letter reports on geochemical data measurements.
- 9) PNL letter report of updated pedigreed data set of effective diffusion coefficient values will be issued for the preliminary performance assessment.
- 10) Site characterization data will be collected and evaluated. A summary report describing the findings of these evaluations. This report will be the principal source of site characterization data to support both licensing and Performance Assessment activities.

FY 1998

November 1997

- 1) A topical paper of "Use of Natural Analogues and Thermodynamics to Defend Long-term Extrapolation of Laboratory Chemical Retardation Data".

December 1997

- 1) Letter reports documenting certification of codes.
- 2) Letter report acknowledging review of transport parameters.
- 3) Topical Report: Laboratory Confirmation Tests in Support of Integrated Source-Term Modeling.
- 4) A letter report describing the present status of the understanding of recharge at Hanford.
- 5) Topical Report: Laboratory Confirmation Tests in Support of Integrated Source-Term Modeling.

March 1998

- 1) Topical Report: An Integrated Source-Term Model for the Hanford LLW Engineered Disposal System.
- 2) Topical Report: Source-Term Calculations for Radionuclide Release from the Hanford LLW Engineered Disposal System.
- 3) Topical Report: An Integrated Source-Term Model for the Hanford LLW Engineered Disposal System.
- 4) Topical Report: Source-Term Calculations for Radionuclide Release from the Hanford LLW Engineered Disposal System.

June 1998

- 1) Preliminary Performance Assessment as a letter report ready for review.

July 1998

- 1) PNL Letter report of the site specific Kd values of studied contaminants and of the results of expert opinion on lesser contaminants.

September 1998

- 1) A final report summarizing the field data and analysis of the controlled experiment. A conclusion will be drawn whether we

- have the appropriate and necessary model for flow and transport in the vadose zone.
- 2) Letter report documenting the comparison of the model predictions with the observed contaminant distributions for selected disposal sites. A conclusion will be drawn for the issue of scale and the model prediction accuracy for the performance assessment.
 - 3) Progress letter reports on geochemical data measurements.
 - 4) A topical paper of "Applicability of Mechanistic Adsorption Models for Key Contaminants in Hanford LLW Glass Disposal".

FY 1999

December 1998

- 1) Communications from review bodies on the adequacy of the preliminary performance assessment.
- 2) Letter report defining geometry and volume of waste form.
- 3) Letter report defining important barriers used in design.
- 4) A letter report describing the present status of the lysimetry experiments.
- 5) A letter report describing the present status of the understanding of evapotranspiration at Hanford.
- 6) A letter report describing the present status of tracer measurements.

January 1999

- 1) A topical paper of "Technical Rationale for Chemical Retardation Values Used in Final Performance Assessment".

March 1999

- 1) Letter reports justifying selection of performance objectives for the final performance assessment.
- 2) Letter report justifying selection of scenarios for the final performance assessment.
- 3) Letter report documenting the total inventory expected to be the glass waste form.
- 4) Letter report documenting the highest level of important materials to be in a single vault .
- 5) Letter report determining parameters for transport through important barriers.
- 6) A letter report describing the present status of the understanding of recharge at Hanford.
- 7) A letter report detailing all data collection activity performed in support of the ground water flow and transport portion of the low level waste performance assessment.

June 1999

- 1) Letter report documenting review of inventory data for the preliminary performance assessment.

- 2) Letter report acknowledging review of transport parameters.

July 1999

- 1) Final Performance Assessment as a letter report ready for internal review.

September 1999

- 1) Progress letter reports on geochemical data measurements.
- 2) Communications from review bodies on the adequacy of the final performance assessment.

FY 2000

September 2000

- 1) Communications from review bodies on the adequacy of the final performance assessment.

APPENDIX D
Manpower Estimates and Costs (\$1000s)

FY 1995

Activity	WHC	WHC	PNL	Other	Total	
1.2A-F	1.27	196	22		218	Advise
1.2G	1.37	211	0	0	211	Manage
1.2	2.64	407	22	0	429	Interim Guidance
2.1.1-.3	0.91	140	0	0	140	PO, Scen, Tool
2.1.4	1.26	194	0	0	194	Inventory
2.1.5	0.47	73	0	0	73	Facility
2.1.6	0.27	42	in 3.1.6	0	42	Release
2.1.7	0.82	127	0	0	127	Transport
2.	3.74	576	0	0	576	IPA
3.1.3	0.93	144	16	0	160	Tool
3.1.6		0	466	0	466	Release
3.1.7	0.53	81	420	216	717	Hydraulic
3.1.8	0.11	17	339	83	439	Recharge
3.1.9	0.84	130	316	99	545	Chemical
3.1.A	1.10	169	0	0	169	Ground Water
3.1.B	0.55	84	0	0	84	Dosimetry
3.1.C	1.65	253	0	0	253	Integrated
3.1	5.70	878	1558	398	2834	Preliminary PA
Total	12.09	1861	1579	398	3839	Total
					3839	Budget

WHC labor given in man-years, costed at \$154,000 per man-year.
Costs are given in \$1000s

FY 1996

Activity	WHC	WHC	PNL	Other	Total	
1.3A-E	1.30	199	22	0	222	Advise
1.3F	1.48	229	0	0	229	Manage
1.3	2.78	428	22	0	450	Final Guidance
2.1.3	0.36	55	0	0	55	Tool
2.2	1.12	172	0	0	172	Write IPA
2.4	0.00	0	0	22	22	Review
2.	1.47	227	0	22	249	IPA
3.1.1-3	0.64	98	0	0	98	PO, Scen, Tool
3.1.4	1.56	241	0	0	241	Inventory
3.1.5	0.25	38	0	0	38	Facility
3.1.6	0.28	43	555	0	598	Release
3.1.7	0.54	83	500	212	795	Hydraulic
3.1.8	0.22	34	597	0	632	Recharge
3.1.9	0.37	57	715	112	883	Chemical
3.1.A	1.67	258	0	84	342	Ground Water
3.1.B	0.56	86	0	0	86	Dosimetry
3.1.C	1.67	258	0	1340	1598	Integrated
3.1	7.76	1195	2367	1747	5309	PPA
Total	12.01	1850	2389	1770	6009	Total
					6029	Budget

WHC labor given in man-years, costed at \$154,000 per man-year.
Costs are given in \$1000s

FY 1997

Activity	WHC	WHC	PNL	Other	Total	
'1.3A-E	1.16	179	20	0	199	Advise
'1.3F	1.33	205	0	0	205	Manage
'1.3	2.49	383	20	0	403	Final Guidance
'2.2	0.36	55	0	0	55	Write IPA
'2.3	0.33	51	0	0	51	Define Contin.
'2.4	0.27	42	0	0	42	Review
'2.	0.96	148	0	0	148	IPA
'3.1.3	0.63	97	0	200	297	Tool
'3.1.4	1.53	236	0	0	236	Inventory
'3.1.5	1.09	168	0	0	168	Facility
'3.1.6	0.25	39	460	0	499	Release
'3.1.7	0.63	97	1000	456	1553	Hydraulic
'3.1.8	0.20	31	375	0	406	Recharge
'3.1.9	0.33	51	745	100	896	Chemical
'3.1.A	1.00	154	0	0	154	Ground Water
'3.1.B	0.50	77	0	0	77	Dosimetry
'3.1.C	1.50	231	0	300	531	Integrated
'3.2	4.12	634	0	0	634	Write PPA
'3.3	0	0	0	60	60	Review
'3.	7.66	1180	2580	1056	4816	PPA
Total	11.11	1711	2600	1056	5367	Total
					5373	Budget

WHC labor given in man-years, costed at \$154,000 per man-year.
Costs are given in \$1000s.

FY 1998

Activity	WHC	WHC	PNL	Other	Total	
'1.3A-E	1.16	179	20	0	199	Advise
'1.3F	1.33	205	0	0	205	Manage
'1.3	2.49	383	20	0	403	Final Guidance
'3.1.3	0.28	43	0	1100	1143	Tool
'3.1.4	1.40	216	0	0	216	Inventory
'3.1.5	0.03	5	0	0	5	Facility
'3.1.6	0.25	39	410	0	449	Release
'3.1.7	0.24	37	315	300	652	Hydraulic
'3.1.8	0.20	31	285	0	316	Recharge
'3.1.9	0.40	62	467	0	529	Chemical
'3.1.A	1.00	154	0	0	154	Ground Water
'3.1.B	0.50	77	0	0	77	Dosimetry
'3.1.C	1.50	231	0	300	531	Integrated
'3.2	1.69	260	0	0	260	Write PPA
'3.3	0.63	97	0	80	177	Review
'3.	8.12	1250	1477	1780	4507	PPA
Total	10.61	1634	1497	1780	4911	Total
					4959	Budget

Activities 3.1.X include costs for 3.4.X as well.

WHC labor given in man-years, costed at \$154,000 per man-year.
Costs are given in \$1000s.

FY 1999

Activity	WHC	WHC	PNL	Other	Total	
'1.3A-E	1.16	179	20	0	199	Advise
'1.3F	1.33	205	0	0	205	Manage
'1.3	2.49	383	20	0	403	Final Guidance
'3.4.1-3	0.40	62	0	300	362	PO, Scen, Tool
'3.4.4	0.83	128	0	0	128	Inventory
'3.4.5	0.45	69	0	0	69	Facility
'3.4.6	0.25	39	410	0	449	Release
'3.4.7	0.24	37	135	0	172	Hydraulic
'3.4.8	0.20	31	285	0	316	Recharge
'3.4.9	0.40	62	450	0	512	Chemical
'3.4.A	1.00	154	0	0	154	Ground Water
'3.4.B	0.50	77	0	0	77	Dosimetry
3.4.C	0.75	116	0	150	266	Integrated
'3.5	0.39	60	0	0	60	Write PPA
'3.6-7	0.30	46	0	80	126	Review
'3.	5.71	879	1280	530	2689	PPA
Total	8.20	1263	1300	530	3093	Total
					4959	Budget

WHC labor given in man-years, costed at \$154,000 per man-year.
Costs are given in \$1000s.

Multi-year Summary

FY 95	FY 96	FY 97	FY 98	FY 99	Total	
218	222	199	199	199	1036	Advise
211	229	205	205	205	1054	Manage
429	450	403	403	403	2090	Guidance
300	153	297	1143	362	2255	PO, Scen, Tool
194	241	236	216	128	1014	Inventory
73	38	168	5	69	352	Facility
508	598	499	449	449	2502	Release
844	795	1553	652	172	4016	Hydraulic
439	632	406	316	316	2108	Recharge
545	883	896	529	512	3364	Chemical
169	342	154	154	154	973	Ground Water
84	86	77	77	77	401	Dosimetry
253	1598	531	531	266	3179	Integrated
0	172	106	260	60	599	Write
0	22	42	177	126	367	Review
3839	6009	5367	4911	3093	23219	Total
3839	6029	5373	4959	4959	25159	Budget
3839	6029	5373	4959	4959	25159	Program Office

Capital Equipment Costs (Computer)

FY 95	FY 96	FY 97	FY 98	FY 99	
100	25	25	100	25	WHC
25	0	0	0	0	PNL
125	25	25	100	25	Total

Non-Performance Assessment Activity

FY 95	FY 96	FY 97	FY 98	FY 99	Total	
231	347	462	462	462	1964	Glass/Matrix T&I

Costs are given in \$1000s.

FY 1995 Detailed Listing

Activity	WHC	WHC	PNL	Other	Total	
1.2A	0.16	25	0	0	25	Site
1.2B	0.36	56	0	0	56	F&R
1.2C	0.20	30	22	0	52	Glass
1.2D	0.27	42	0	0	42	Matrix
1.2E	0.11	17	0	0	17	Charact.
1.2F	0.16	25	0	0	25	Uncertainty
1.2G	1.37	211	0	0	211	Manage
1.2	2.64	407	22	0	429	Interim Guidance
2.1.1	0.15	24	0	0	24	Perf. Objectives
2.1.2	0.15	24	0	0	24	Scenarios
2.1.3.1	0.16	25	0	0	25	Tools - Select)
2.1.3.2	0.44	68	0	0	68	Tools - Verify)
2.1.4.1	0.88	135	0	0	135	Inventory - total
2.1.4.2	0.38	59	0	0	59	Inventory - Ext.
2.1.5.1	0.09	14	0	0	14	Facility - Geo
2.1.5.2	0.09	14	0	0	14	Facility - Barr.
2.1.5.3	0.27	42	0	0	42	Facility - Para.
2.1.5.4	0.02	3	0	0	3	Facility - Review
2.1.6	0.27	42	0	0	42	Glass - WHC

2.1.7	0.82	127	0	0	127	Transport
2	3.74	576	0	0	576	IPA
3.1.3.1	0.22	34	5	0	39	Codes- Criteria
3.1.3.2	0.44	68	11	0	79	Codes-Choose
3.1.3.3	0.00	0	0	0	0	Codes-Verify
3.1.3.4	0.27	42	0	0	42	Codes-Plan Cert.
3.1.6.1	0.00	0	55	0	55	Release - Model
3.1.6.2	0.00	0	274	0	274	Release - Int.Mod
3.1.6.3	0.00	0	137	0	137	Release - Verif.
3.1.7.1	0.19	29	183	46	258	Hyd - IPM
3.1.7.2	0.26	41	202	0	242	Hyd - Field Test
3.1.7.3	0.08	12	35	0	47	Hyd - Disposal
3.1.7.4	0	0	0	88	88	Hyd - Lab Dev.
3.1.7.5	0.00	0	0	82	82	Hyd - Near Field
3.1.8.1	0.11	17	16	33	66	Recharge-Workshop
3.1.8.2	0.00	0	66	0	66	Recharge - Lysim
3.1.8.3	0.00	0	82	0	82	Recharge - evapo
3.1.8.4	0.00	0	104	0	104	Recharge -assess
3.1.8.5	0.00	0	57	32	89	Recharge - tracer
3.1.9.	0.46	71	0	77	148	Chem-Break through
3.1.9.2	0.11	17	16	22	55	Chem - Workshop
3.1.9.4	0.27	42	0	0	42	Chem - Software
3.1.9.5	0.00	0	271	0	271	Chem - Kd
3.1.9.6	0.00	0	29	0	29	Chem - Diffusion
3.1.A.1	0.37	57	0	0	57	GW - develop mod.

3.1.A.2	0.36	56	0	0	56	GW - Literatu
3.1.A.3	0.36	56	0	0	56	GW - plan
3.1.B	0.55	84	0	0	84	Dosimetry
3.1.C.1	1.10	169	0	0	169	Integ - Borehole
3.1.C.2	0.55	84	0	0	84	Ingrated - Tests
3	5.70	878	1558	398	2834	PA
Total	12.09	1861	1579	398	3839	Total
					3839	Budget

WHC labor given in man-years, costed at \$154,000 per man-year.
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