

Sta. 37- 72

AUG 12 1997

ENGINEERING DATA TRANSMITTAL

Page 1 of 2
1. EDT 621692

2. To: (Receiving Organization) Distribution		3. From: (Originating Organization) Hanford Tanks Initiative Project		4. Related EDT No.: N/A	
5. Proj./Prog./Dept./Div.: HTI Project/TWD Division		6. Design Authority/ Design Agent/Cog. Engr.: Steve Schaus		7. Purchase Order No.: TKG-SWV-379954, Task 55	
8. Originator Remarks: None				9. Equip./Component No.: N/A	
				10. System/Bldg./Facility: N/A	
11. Receiver Remarks: 11A. Design Baseline Document? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No				12. Major Assm. Dwg. No.: N/A	
				13. Permit/Permit Application No.: N/A	
				14. Required Response Date: N/A	

15. DATA TRANSMITTED					(F)	(G)	(H)	(I)
(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	Approval Designator	Reason for Transmittal	Originator Disposition	Receiver Disposition
1	HNF-SD-WM-TX-001		0	Hanford Tank Initiative - Test Implementation Plan for Demonstration of In-Tank Retrieval Technology	N/A	2	1	1

16. KEY						
Approval Designator (F)		Reason for Transmittal (G)			Disposition (H) & (I)	
E, S, Q, D or N/A (see WHC-CM-3-5, Sec.12.7)		1. Approval	4. Review	1. Approved	4. Reviewed no/comment	
		2. Release	5. Post-Review	2. Approved w/comment	5. Reviewed w/comment	
		3. Information	6. Dist. (Receipt Acknow. Required)	3. Disapproved w/comment	6. Receipt acknowledged	

17. SIGNATURE/DISTRIBUTION (See Approval Designator for required signatures)											
(G) Reason	(H) Disp.	(J) Name	(K) Signature	(L) Date	(M) MSIN	(G) Reason	(H) Disp.	(J) Name	(K) Signature	(L) Date	(M) MSIN
		Design Authority									
		Design Agent									
2	1	Cog. Eng. P.S. Schaus	<i>P.S. Schaus</i>	7/10/97							
2	1	Cog. Mgr. R.W. Root	<i>R.W. Root</i>	7/10/97							
		QA									
		Safety									
		Env.									

18. P.S. Schaus <i>P.S. Schaus</i> 7/10/97 Signature of EDT Date Originator		19. L. B. McDaniel <i>L. B. McDaniel</i> 7/10/97 Authorized Representative Date for Receiving Organization		20. R. W. Root <i>R. W. Root</i> 7/10/97 Design Authority/ Cognizant Manager Date		21. DOE APPROVAL (if required) Ctrl. No. <input type="checkbox"/> Approved <input type="checkbox"/> Approved w/comments <input type="checkbox"/> Disapproved w/comments	
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Hanford Tanks Initiative - Test Implementation Plan for Demonstration of In-Tank Retrieval Technology

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U.S. Department of Energy Contract DE-AC06-96RL13200

EDT/ECN: 621692

UC: 2030

Org Code: 73400

Charge Code: D26B2

B&R Code: EW3130010

Total Pages: *22 of 24*
pages

Key Words: Tank Retrieval Demonstration

Abstract: This document presents a Systems Engineering approach for performing the series of tests associated with demonstrating in-tank retrieval technologies. The testing ranges from cold testing of individual components at the vendor's facility to the final fully integrated demonstration of the retrieval system's ability to remove hard heel high-level waste from the bottom of a Hanford single-shell tank.

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H. L. Burkland *7/14/97*
Release Approval Date

AUG 12 1997		ID.
DATE:		73
STA:		37

Release Stamp

Approved for Public Release

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ACRONYMS

ALARA	As-Low-As-Reasonably-Achievable
ATP	Acceptance Test Plan
BOP	Balance-of-Plant
CMP	Configuration Management Plan
DOE	U.S. Department of Energy
DOE-RL	U.S. Department of Energy, Richland Operations Office
DQO	Data Quality Objectives
HIT	Hanford Tanks Initiative
HLW	High-Level Waste
HVAC	Heating Ventilating and Air Conditioning
IWRS	Integrated Waste Retrieval System
ORR	Occupational Readiness Review
OTP	Operational Test Plan
PHMC	Project Hanford Management Contractor
PNNL	Pacific Northwest National Laboratory
QA	Quality Assurance
QC	Quality Control
RFP	Request For Proposal
SST	Single-Shell Tank
TPA	Tri-Party Agreement, an informal name for the <u>Hanford Federal Facilities Agreement and Consent Order</u>
TWRS	Tank Waste Retrieval System
WRS	Waste Removal System
WTS	Waste Transfer System

1.0 INTRODUCTION

The Hanford environmental management, or cleanup, mission is to protect the health and safety of the public, workers, and the environment; control hazardous materials; and utilize the land for other missions.

In support of this mission, the Tank Waste Remediation System (TWRS) project has been given the mission of storing, treating, and immobilizing highly radioactive Hanford Site waste (including current and future tank waste and cesium/strontium capsule disposition) in an environmentally sound, safe, and cost-effective manner.

To support the TWRS mission (Knutson 1995), waste must be retrieved from tanks and immobilized, and the nearly empty storage facilities in the tank farm operable units must be closed in a manner that is safe, environmentally sound, and cost effective. The Hanford Federal Facility Agreement and Consent Order (Ecology et al. 1994) (referred to as the Tri-Party Agreement) established milestones for completing specified activities to carry out this mission. Among these is Milestone M-45-00, which requires retrieval of as much waste as technically possible, with tank waste residues not to exceed 10.2 m³ (360 ft³) in each 100-Series tank, 0.85 m³ (30 ft³) in each 200-Series tank, or the limit of waste retrieval technology capability, whichever is less. This milestone also requires closure of all Single-Shell Tanks (SSTs) by the year 2024.

Capability to retrieve some types of waste by hydraulic sluicing is uncertain. Previously, a sluicing process was used that was not effective entirely on hard-packed solids (referred to as a "hard heel"). Also unknown is whether tank farms may be closed with residual waste in compliance with applicable environmental regulations, even if the percentage of waste retrieved complies with Milestone M-45-00.

There is significant program risk unless retrieval performance requirements are defined and retrieval systems are developed and deployed before contractor bids are solicited for the retrieval scope of the TWRS privatization program (termed "Phase II privatization"). The preparation of the Request for Proposal (RFP) for Phase II privatization is planned tentatively to begin in the year 2002. The mission of the Hanford Tanks Initiative (HTI) is to minimize the programmatic uncertainties and risks associated with tank waste retrieval by employing appropriate technologies and methods to achieve the following:

- Retrieve difficult-to-remove hard-heel waste from a SST;
- Retrieve waste from a SST that has been categorized as having leaked;
- Establish retrieval performance criteria, including cost;
- Characterize waste to measure compliance with retrieval performance criteria;

and

- Provide a basis for future National Environmental Policy Act of 1969 (NEPA 1969), safety, and regulatory actions affecting waste retrieval and operable unit closure for tank farms.

The HTI project activities will begin in Fiscal-Year (FY-) 1997 and be completed in four years. It will focus on two tanks, 241-AX-104 and 241-C-106. The project will be staffed with participants from the U.S. Department of Energy (DOE), Project Hanford Management Contractor (PHMC), Pacific Northwest National Laboratory (PNNL), the EM-50 Tank Focus Area, and other national laboratories. Participation by private industry is a main objective of the HTI project. The HTI will provide the DOE with information vital for the establishment of requirements and specifications of the retrieval scope of the TWRS privatization program.

In accomplishing the HTI mission, technologies and services will be acquired through performance-based contracts with private industry. Performance-based specifications will be used to develop technologies and acquire services from the national laboratories. A major goal is to establish teaming relationships with the private sector and the national laboratories to meet the competitive performance requirements for retrieval and characterization technologies.

The HTI project has been divided into three sub-projects as described in the following three paragraphs.

The first sub-project demonstrates a range of retrieval technologies. In this sub-project, industry and other technology developers will be solicited to propose alternate technologies for removing waste from SSTs. The technologies of the participants will be evaluated and proof-of-principle tests of the best technologies will be performed. The results of these tests will be disseminated to prospective bidders to support design refinements for subsequent testing.

The second sub-project demonstrates in-tank retrieval technologies. A performance-based competitive bid process will be used to select two vendors to provide equipment to participate in "cold" testing. It is anticipated that one of the two vendors will be selected to test the equipment in Tank 241-C-106. Hot testing is expected to provide data on waste removal capability. As part of this hot test, the retrieval system will be used to complete retrieval of the hard-heel waste to comply with the requirement of either 10.2 m³ (360 ft³) residue or the limit of waste retrieval technology capability, whichever is less (Milestone M-45-00).

The third sub-project demonstrates a methodology for establishing a closure basis for SSTs. In this sub-project, the amount of waste that may be left behind in the tanks is determined, a basis for determining when waste retrieval is complete is established, the technology and analytical basis for determining when retrieval is complete is demonstrated, and the performance of various retrieval/closure alternatives is evaluated and compared.

The tests associated with the second sub-project, the demonstration of in-tank retrieval technologies, is the subject of this plan. For defining and planning the testing requirements of the subproject, the systems that will be tested individually and in an integrated fashion are the:

- Waste Removal System (WRS);

- Waste Transfer System (WTS); and
- Balance-of-Plant (BOP) Systems.

The combined systems will be designated as the Integrated Waste Retrieval System (IWRS).

1.1 PURPOSE

The plan presents a systematic approach to performing tests associated with demonstrating in-tank retrieval technologies. The testing activities focus on demonstrating the capabilities of vendor-provided technologies to remove radiochemical sludge heels from the SSTs, and on generating information to provide answers to the TWRS project regarding the capability of retrieval technologies to meet TPA requirements and the cost to arrive at various waste-removal levels. The tests will be performed throughout a period of approximately 20 months (9/98 through 5/00). The tests will include, sequentially, the following testing stages:

- Qualification Tests to verify the design requirements for the WRS, WTS, and BOP have been met (Section 3.1);
- Cold Tests to demonstrate that the WRS, WTS, and BOP can dislodge, mobilize, and transfer simulated wastes from a simulated tank to a simulated receiver tank (Section 3.2);
- Functional Tests to demonstrate that the WRS is in working order subsequent to arriving at the Hanford Site, and that the WTS and BOP are ready for use by the vendors (Section 3.3);
- Mockup/Training Tests to demonstrate, in a simulation of an actual tank riser, that the systems can be deployed (installed) in an actual tank for retrieval tests (Section 4.1). These tests focus on training, environment, safety, health, and quality-related requirements and procedures;
- Acceptance/Operational Tests to demonstrate that the IWRS has been deployed correctly in Tank 241-C-106, prior to hot testing (Section 4.2); and
- Retrieval Tests to demonstrate that the IWRS can remove waste from the Tank 241-C-106 environment (Section 4.3).

Characteristics of each type of test for the WRS and the combined WTS and BOP tests are shown in Tables 1 and 2, respectively. The characteristics include:

- Where the tests will be conducted;
- What company will perform the tests;
- The type of test bed to be used; and
- The type of waste involved (if any).

Table 1. Test Information Matrix for Demonstration of Vendor-Constructed WRS.

Test Type	Sub-system Qualification Section 3.1	Cold Section 3.2	Functional Section 3.3	Mockup/Training Section 4.1	Accept/Operate* Section 4.2	Retrieval* Section 4.3
Characteristics						
Location						
Vendor Site						
Hanford Site						
Performer						
Vendor						
PHMC Support						
Integrated Team						
Test Bed						
Out-of-Tank						
Simulated Tank						
241-C-106						
Waste						
None						
Simulated						
241-C-106						

* Note that these two tests are of the entire IWRS.

Table 2. Test Information Matrix for Demonstration of PHMC-Constructed WTS and BOP Systems.

Test Type	Sub-system Qualification Section 3.1	Cold Section 3.2	Functional Section 3.3	Mockup/Training Section 4.1	Accept/Operate* Section 4.2	Retrieval* Section 4.3
Characteristics						
Location			N/A	N/A		
Hanford Site						
Performer			N/A	N/A		
PHMC Support						
Integrated Team						
Test Bed			N/A	N/A		
Out-of-Tank						
241-AX-104 and 241-C-106						
Waste			N/A	N/A		
None						
Simulated						
241-C-106						

* Note that these two tests are of the entire IWRS.

The desired outcome of the Demonstration of In-Tank Retrieval Technologies is to:

- Demonstrate the selected technology's hard-heel waste removal capability can achieve a goal of leaving no more than 10.2 m³ (360 ft³) residual waste remaining after retrieval;
- Collect the necessary data concerning the selected technology's performance so that estimates can be made as to the realistic limits (cost, schedule, and performance) of the waste retrieval technology's capabilities; and
- Remove sufficient waste from the SST test tank to reduce heat generation to < 40,000 BTU/hr (if this goal has not already been met by earlier sluicing performed by Project W-320).

Throughout this demonstration process, vendors will be required to document, implement, and maintain an appropriate and approved Quality Assurance (QA) Program. The QA Program will identify the industry consensus QA standard(s) that have been adopted, such as NQA-1, ISO Q9001, DOE Order 5700.6C, or 10 CFR 830.120. Vendor initiated changes to these QA Programs during the performance of their contracts will be required to be submit to the PHMC for review and approval prior to implementation. When subcontracting any portion of these contracts, the vendors will be required to invoke the applicable quality assurance program requirements on the next level subcontractors.

This plan defines what testing will be performed (scope), why the testing will be performed (rationale), the sequencing of testing (schedule), and where the testing will be performed. Based on this plan, individual test plans and procedures will be developed to provide detailed definition of each operational test and to establish procedures and acceptance criteria for completing each test. Section 5.0 provides additional information regarding the test plans to be developed.

1.2 PLAN CONTENTS

This plan consists of the following sections.

1. Introduction--This section describes the purpose of the testing program and the Test Implementation Plan contents.
2. Background--This section describes the history of the tanks at the Hanford Site, the need for the HTI project, and its goals. It also describes how the Demonstration of In-Tank Demonstration Technologies sub-project relates to the HTI project, and supports its goals.

3. Qualification Tests--This section describes the objectives of the tests conducted to demonstrate that engineering design and development are complete; that design risks have been minimized; that the system will perform as required and specified. This testing includes subsystem qualification tests, cold tests, and functional tests. Subsystem qualification and cold tests is accomplished at the vendor's site for the WRS. All other qualification tests are accomplished at the Hanford site.
4. Operational Tests--This section describes tests conducted in conditions as close as possible to the operational environment. It is used to estimate operational effectiveness and suitability for identification of operational deficiencies and needed modifications. This testing consists of mockup/training tests, acceptance/operational tests, and tests of the integrated WTS. These tests will be conducted at the Hanford site, culminating in testing on/in Tank C-106.
5. Development of Test Plans--This section describes the development of vendor-generated and PHMC-approved test plans and procedures for each testing stage. The PHMC will also generate test plans for WTS and BOP systems testing, as necessary.
6. Test Plan Deviations--This section invokes the TWRS Configuration Management Plan as the procedure for implementing changes to planned tests. This plan will be followed in the event that new tests are identified, planned tests are modified or deleted, or certain tests are not possible to implement.
7. Data Management--This section invokes the TWRS Data Quality Objective (DQO) process and the TWRS Quality Assurance (QA) Plan as the processes for defining and managing test data, including data collection, recording, evaluation, reporting, and archiving.
8. Schedule--This section presents the testing program schedule.
9. Resources--This section presents an overview of resource requirements for implementation of the testing program.
10. References--This section contains a bibliography of all documents referenced in this document.

2.0 BACKGROUND

2.1 TANK HISTORY

From 1943 to 1989, the Hanford Site's principal mission was the production of weapons-grade plutonium. To produce plutonium, uranium metal was irradiated in plutonium-production reactors.

The irradiated uranium metal, known as spent fuel, was cooled and treated in a chemical separations or reprocessing plant, where plutonium was separated from uranium and many other radioactive by-products. The plutonium then was used for nuclear weapons production. Large amounts of spent fuel were produced to generate enough plutonium to make a nuclear weapon. The chemical separations process resulted in large volumes of radioactive waste.

The Hanford Site processed more than 100,000 metric tons (110,000 tons) of uranium and generated several-hundred-thousand metric tons of waste. The waste included high-level, transuranic, low-level, hazardous, and mixed waste.

For the high-level waste (HLW) generated by the chemical reprocessing plants, waste management initially involved adding sodium hydroxide or calcium carbonate to make the acidic waste alkaline; and storing the waste in large underground tanks until a long-term disposal solution could be determined. During the 1940s through the early 1960s, 149 SSTs with a capacity of 210,000 L (55,000 gal) to 3,800,000 L (1,000,000 gal) were built to store HLW near the center of the Hanford Site in an area named the 200 East and West Areas.

Subsequent processing of these wastes, including the recovery of uranium, cesium, and strontium, and the evaporation and resulting concentration of wastes, have created mixtures of highly radioactive materials, comprised of liquids, saltcake, soft sludges, and hardpan. Removal of liquids, saltcake, and sludges have been demonstrated previously, and no technology issues exist. However, the removal of hardpan materials is yet to be demonstrated; thus, the need for the HTI.

2.2 PROJECT HISTORY

The HTI was established in response to issues raised within the SST Retrieval sub-project of the TWRS project. These issues were:

- Clean-out requirements for SSTs;
- Leakage limits for SSTs;
- Retrieval methods; and
- Operable unit closure methods.

The HTI sub-projects were established to provide resolution to these issues with the Demonstration of In-Tank Retrieval Technologies resolving the issues of clean-out requirements and retrieval methods.

3.0 QUALIFICATION TESTS

Qualification Tests are tests conducted to demonstrate that engineering design and development are complete; that design risks have been minimized; that the system will perform as required and specified. This testing includes subsystem qualification tests, cold tests, and functional tests.

3.1 SUBSYSTEM QUALIFICATION TESTS

Qualification testing of the IWRS developed in response to a performance-based specification will be required to ensure that the system meets the requirements contained in the specification before conducting other tests and demonstrations. Its subsystems are:

- The WRS being constructed by vendors;
- The WTS being constructed by the PHMC; and
- The BOP systems being constructed by the PHMC.

Data acquired during Qualification tests will be used to:

- Verify that the design requirements have been met;
- Verify that design of the components support the subsystem and the integrated system; and
- Support development of requirements for on-site, integrated testing and training.

These Qualification tests may be performed in several ways to show compliance with performance requirements, such as:

- Observations;
- Analyses (calculations);
- Inspections (limited tools); and
- Actual tests and measurements.

Qualification tests of the WRS will be conducted at the vendor's site by the vendor and qualification tests of the WTS and BOP components and subsystems will be conducted on-site by the PHMC. As noted in subsequent tests, the vendor supplied subsystems will be tested on-site with the other subsystems by a trained, integrated team of vendor and PHMC staff. Tests conducted by the vendor at the vendor's site or at the Hanford Site will be observed by and/or verified by PHMC staff. The DOE-RL staff will be notified of, and invited to observe all tests conducted by the vendor or PHMC. Tests will not be delayed or rescheduled pending DOE-RL participation.

3.1.1 QUALIFICATION TESTS OF THE WASTE REMOVAL SYSTEM AT THE VENDOR'S SITE

These tests will be conducted in accordance with detailed test plans developed by the vendor and approved by the PHMC. The tests and their objectives will include items as shown in Table 3.

Table 3. Qualification Test Objectives for the WRS at the Vendor's Site.

Tests	Objectives
Deploy WRS	Qualify the ability to insert the WRS into and remove it from a tank.
Remove Waste	Qualify the ability of the WRS to dislodge, mobilize, and convey simulated waste.
Condition Waste	Qualify the ability of the WRS to condition simulated waste to allow pumping through the WTS.
Operate WRS	Qualify the ability of the WRS to operate and maneuver under simulated conditions.
Control and Monitor WRS	Qualify the ability to control and monitor the operations of the WRS.

3.1.2 QUALIFICATION TESTS OF THE WASTE TRANSFER SYSTEM ON SITE

These tests will be conducted in accordance with detailed test plans developed and approved by the PHMC. The tests and their objectives will include items as shown in Table 4.

Table 4. Qualification Test Objectives for the WTS on Site.

Tests	Objectives
Verify WTS	Qualify WTS. Verify existing WTS and modifications.
Control and Monitor WTS	Qualify the ability to control and monitor the operations of the WTS.

3.1.3 QUALIFICATION OF BALANCE-OF-PLANT SYSTEMS

These tests will be conducted by the PHMC on site, in accordance with detailed test plans developed by the constructor and approved by the PHMC. The BOP Systems potentially needing qualification testing could include:

- New risers;
- Modifications to the heating, ventilating, and air conditioning (HVAC) system;
- Utility upgrades;
- Instrumentation and controls.

Tests and objectives for these modified systems and their interfaces with other systems will be determined as the project identifies needs.

3.2 COLD TESTS

Cold testing of the WRS, WTS, and BOP systems will be required to demonstrate that the systems meet requirements prior to integrated, on-site acceptance, and hot testing.

Data acquired during Cold Tests will be used to;

- Demonstrate that each component and system operates as required under simulated conditions;
- Qualify that components and systems could operate as an integrated system; and
- Support development of requirements for integrated, on-site hot testing, and training.

Cold tests of the WRS will be conducted at the vendor's site by the vendor, and cold tests of the WTS will be conducted on-site by the PHMC. In subsequent tests, the two vendor supplied systems, WRS, will be integrated with the PHMC supplied WTS and BOP systems and tested on-site by a trained, integrated team of vendor and PHMC staff. Tests conducted by the vendor at the vendor's site or at the Hanford Site will be observed by and/or verified by PHMC staff. The DOE-RL staff will be notified of, and invited to observe all tests conducted by the vendor or PHMC. Tests will not be delayed or rescheduled pending DOE-RL participation.

3.2.1 COLD TESTS OF THE WASTE REMOVAL SYSTEM AT THE VENDOR'S SITE

These tests will be conducted by the vendor at the vendor's site in accordance with detailed test plans developed by the vendor and approved by the PHMC. The tests and their objectives will include items as shown in Table 5.

Table 5. Cold Test Objectives for the WRS at the Vendor's Site.

Tests	Objectives
Deploy WRS	Demonstrate the ability to insert the WRS into and remove it from a simulated tank.
Remove Waste	Demonstrate the ability of the WRS to dislodge, mobilize, and convey simulated waste.
Condition Waste	Demonstrate the ability of the WRS to condition simulated waste to allow pumping through the WTS.
Operate WRS	Demonstrate the ability of the WRS to operate and maneuver under simulated conditions.
Control and Monitor WRS	Demonstrate the ability to control and monitor the operations of the WRS.

3.2.2 COLD TESTS OF THE WASTE TRANSFER SYSTEM ON SITE

These tests will be conducted by the PHMC on site in accordance with detailed test plans developed and approved by the PHMC. The tests and their objectives will include items as shown in Table 6.

Table 6. Cold Test Objectives for the WTS on Site.

Tests	Objectives
Verify WTS	Demonstrate that the existing transfer system and modifications can transfer wastes.
Control and Monitor WTS	Demonstrate the ability to control and monitor the operations of the WTS.

3.2.3 COLD TESTS OF BALANCE-OF-PLANT SYSTEMS

These tests will be conducted by the PHMC on site in accordance with detailed test plans developed by the constructors and approved by the PHMC. The BOP Systems potentially needing cold testing could include:

- New risers;
- Modifications to the HVAC system;
- Utility upgrades; and
- Instrumentation and controls.

Tests and objectives for these modified systems and their interfaces with other systems will be determined as the project identifies needs.

3.3 FUNCTIONAL TESTS

Functional testing of off-site vendor-constructed systems of the IWRS will be required of the vendors at the Hanford Site to demonstrate that the systems are in working order subsequent to being shipped to the Site and prior to being subjected to operational tests. These tests will be conducted in a non-radioactive environment. Tests conducted by the vendor at the vendor's site or at the Hanford Site will be observed by and/or verified by PHMC staff. The DOE-RL staff will be notified of, and invited to observe all tests conducted by the vendor or PHMC. Tests will not be delayed or rescheduled pending DOE-RL participation.

Data acquired during Functional Tests will be used to:

- Verify that the components or subsystems operate at the Hanford Site as demonstrated at the vendor's site.

3.3.1 FUNCTIONAL TESTS OF THE WASTE REMOVAL SYSTEM ON SITE

Functional tests will be conducted on site on the WRS, in accordance with vendor-developed and PHMC-approved test plans to verify that the systems are as functional (i.e., operate) as they did at the vendor's sites. These tests and objectives will include items as shown in Table 7.

Table 7. Functional Test Objectives for the WRS on Site.

Tests	Objectives
Remove Waste	Demonstrate that the WRS functions of waste dislodging, mobilization, and conveyance are met.
Condition Waste	Demonstrate that the WRS functions to condition waste are operable.
Operate WRS	Demonstrate that the WRS functions of operability and maneuverability are operable.
Control and Monitor WRS	Demonstrate that the WRS functions to control and monitor operations of the WRS are operable.

3.3.2 FUNCTIONAL TESTING OF BALANCE-OF-PLANT SYSTEMS ON SITE

These tests will be conducted by vendors on site in accordance with detailed test plans developed by the vendor and approved by the PHMC. The BOP systems potentially requiring functional testing could include:

- New risers;
- Modifications to the HVAC system;

- Utility upgrades; and
- Instrumentation and controls.

Tests and objectives for these systems and their interfaces with other systems will be determined as the project identifies needs.

4.0 OPERATIONAL TESTS

Operational Tests are conducted in conditions as close as possible to the operational environment. It is used to estimate operational effectiveness and suitability for identification of operational deficiencies and needed modifications. This testing consists of mockup/training tests, acceptance/operational tests, and tests of the integrated WTS.

4.1 MOCKUP/TRAINING TESTS

Mockup/Training testing of vendor- and PHMC-constructed systems will be required on site to demonstrate, in a simulation of an actual tank riser, that the systems can be deployed safely (installed) in an actual tank for retrieval tests. These tests will be focused on environment, safety, health, and quality-related requirements and procedures. This will be the first time that vendor and PHMC operators will work together. Tests conducted by the vendor at the vendor's site or at the Hanford Site will be observed by and/or verified by PHMC staff. The DOE-RL staff will be notified of, and invited to observe all tests conducted by the vendor or PHMC. Tests will not be delayed or rescheduled pending DOE-RL participation.

Data acquired during Mockup/Training tests will be used to:

- Demonstrate that each component and the overall system can be assembled and installed safely;
- Demonstrate that the integrated system can be installed in a manner that protects facilities, equipment, workers, and the environment; and
- Support installation and removal and training.

4.1.1 MOCKUP/TRAINING TESTS OF THE WASTE REMOVAL SYSTEM ON SITE

These tests will be conducted by the vendor on site in accordance with detailed test plans developed by the vendor and approved by the PHMC. The tests and their objectives will include items as shown in Table 8.

Table 8. Mockup/Training Test Objectives for the WRS on Site.

Test	Objectives
Deploy WRS	Demonstrate the ability to safely insert the WRS into and remove it from a simulated tank.

4.1.2 MOCKUP/TRAINING TESTS OF BALANCE-OF-PLANT SYSTEMS

These tests will be conducted by vendors or the PHMC on site in accordance with detailed test plans developed by the vendor and approved by the PHMC. The BOP Systems potentially needing Mockup/Training testing could include:

- Modifications to pits; and
- The BOP equipment removal.

Tests and objectives for these systems and their interfaces with other subsystems will be determined as the project identifies needs.

4.2 ACCEPTANCE/OPERATIONAL TESTS

Acceptance/Operational cold tests will be conducted on site in Tank 241-C-106 by the vendor in cooperation and coordination with PHMC staff to demonstrate that the each system (both vendor- and PHMC-constructed) and the IWRS is ready to be operated. No actual waste materials will be involved in the tests, though the tests will be conducted in the actual tank. System tests will be conducted by vendors and the integrated system will be tested by an integrated team of vendor and PHMC staff. Tests conducted by the vendor at the vendor's site or at the Hanford Site, will be observed by and/or verified by PHMC staff. The DOE-RL staff will be notified of, and invited to observe all tests conducted by the vendor or PHMC. Tests will not be delayed or rescheduled pending DOE-RL participation. These tests will support the ORR of the system to be performed by an independent organization of PHMC and DOE.

Data acquired during Acceptance/Operational testing of the WRS will be used to:

- Demonstrate that each system operates as required under actual tank conditions;
- Demonstrate that the integrated systems operates as required under actual tank conditions;
- Demonstrate that the integrated system operates in a safe, healthful, quality, and environmentally acceptable manner; and

Support the independent (PHMC and DOE) ORR process.

4.2.1 ACCEPTANCE/OPERATIONAL TESTS OF THE WASTE REMOVAL SYSTEM BY THE VENDOR ON SITE

These tests will be conducted in accordance vendor developed plans approved by PHMC. During these tests, there will be:

- No supernate flow from the support tank; and
- No waste pumped to the surface.

The tests and their objectives will include items as shown in Table 9.

Table 9. Acceptance/Operational Test Objectives for the WRS on Site.

Tests	Objectives
Deploy WRS	Demonstrate the ability to safely insert the WRS into the Tank 241-C-106.
Operate WRS	Demonstrate the ability of the WRS to safely operate and maneuver within Tank 241-C-106.
Control and Monitor WRS	Demonstrate the ability to safely control and monitor the operations of the WRS in Tank 241-C-106.

4.2.2 ACCEPTANCE/OPERATIONAL TESTS OF THE WASTE TRANSFER SYSTEM ON SITE

These tests will be conducted by PHMC on site in accordance with detailed plans developed and approved by the PHMC. The tests and their objectives will include items as shown in Table 10.

Table 10. Acceptance/Operational Test Objectives for the WTS on Site.

Tests	Objectives
Operate WTS	Demonstrate that the existing WTS and modifications can operate within Tank 241-C-106.
Control and Monitor WTS	Demonstrate the ability to control and monitor the operations of the WTS in Tank 241-C-106.

4.2.3 ACCEPTANCE/OPERATIONAL TESTS OF BALANCE-OF-PLANT SYSTEMS

These tests will be conducted by vendors or the PHMC on site in accordance with detailed test plans approved by the PHMC. The BOP systems potentially needing Acceptance/Operational testing could include:

- Modifications to the HVAC system;
- Utility upgrades; and
- Instrumentation and controls.

The tests and their objectives will include items as shown in Table 11.

Table 11. Acceptance/Operational Test Objectives for the BOP Systems.

Tests	Objectives
Operate BOP Systems	Demonstrate that the BOP systems can operate within Tank 241-C-106.
Control and Monitor BOP	Demonstrate the ability to control and monitor the operations and maintenance of the BOP Systems in Tank 241-C-106.

4.2.4 INTEGRATED WASTE RETRIEVAL SYSTEM ACCEPTANCE AND OPERATIONAL TEST

The Acceptance and Operational Test Plans and Procedures (ATP/OTP) will be reviewed and approved by the independent ORR Group of the PHMC. The test results will be reviewed and approved by the independent ORR Group and by a DOE, Richland Operations Office (RL) ORR Group prior to initiation of the Retrieval tests described below.

4.3 INTEGRATED WASTE RETRIEVAL SYSTEM TESTS

Retrieval hot testing of the IWRS will be required to demonstrate that the system can operate as designed. These tests will be conducted by an integrated vendor team and the PHMC. Tests conducted by the vendor at the vendor's site or at the Hanford Site will be observed by and/or verified by PHMC staff. The DOE-RL staff will be notified of, and invited to observe all tests conducted by the vendor or PHMC. Tests will not be delayed or rescheduled pending DOE-RL participation.

Data acquired during IWRS tests will be used to:

- Demonstrate system performance;
- Demonstrate that each system, and the integrated system operates as required in the operational environment; and
- Determine acceptability of operating parameters to include, but not limited to--
 - Flow rates,
 - Tank heat generation (< 40,000 BTU/h),
 - Amount of heel remaining (< 360 ft³ or the limit of waste retrieval technology capability),
 - Operating cost, schedule, and technology capabilities,

- Operating cycles, and
- Safety and As-Low-As-Reasonably-Achievable (ALARA) opportunities.

The tests and their objectives will include items as shown in Table 12.

Table 12. Test Objectives for the IWRS.

Tests	Objectives
Remove Waste	Demonstrate the ability of the IWRS to safely and effectively dislodge, mobilize, and convey Tank 241-C-106 waste.
Condition Waste	Demonstrate the ability of the IWRS to safely and effectively condition Tank 241-C-106 waste.
Operate the IWRS	Demonstrate the ability of the IWRS to safely and effectively operate and maneuver within Tank 241-C-106.
Control and Monitor the IWRS	Demonstrate the ability to safely and effectively control and monitor the operations of the IWRS in Tank 241-C-106.

5.0 DEVELOPMENT OF TEST PLANS

Test plans and procedures will be developed for each of the tests listed in Sections 3 and 4 of this plan. The test plans and procedures will establish the necessary formality of operation for testing, testing objectives, specific test results required (qualitative and quantitative), test criteria, data quality objectives, health and safety requirements, schedules and costs.

In generating the test plans, the data requirements listed in Appendix A of the HTI Plan should be referenced to ensure that all required data are collected. This will also focus the test plan so that additional data, which are not necessary, will not be collected.

Test plans and procedures will be developed in accordance with the requirements of the Tank Waste Remediation System, Systems Engineering Manual (Orsag 1996).

Following the completion of testing, a test report will be developed in accordance with the requirements of the Tank Waste Remediation System, Systems Engineering Manual (Orsag 1996).

6.0 TEST PLAN DEVIATIONS

Throughout the duration of the Demonstration of In-Tank Retrieval Technologies test program, deviations to the sub-project's technical, schedule, and cost baselines are likely to occur. Specifically, program changes may occur because of technical challenges, design delays, procurement delays, equipment failures, etc. Procedures are required to address the impacts of each change on the program's scope, cost, and schedule. These procedures are included in the TWRS Configuration Management Plan (CMP). The CMP shall be the governing document that is used to control all project changes.

7.0 DATA MANAGEMENT

The Demonstration of In-Tank Retrieval Technologies testing program data items include, but are not limited to the following:

- Test Plans (Draft and Final);
- Test Procedures (Draft and Final); and
- Test Reports (Draft and Final).

Other types of program data include raw and reduced test data. All test data shall be recorded, reduced, analyzed, and reported in accordance with the program's test plans, test procedures, approved test report format, Data Quality Objective (DQO) process, and Quality Assurance (QA) Plan. Relevant test data typically will be included in the appendices of the test reports. Quality control (QC) requirements and procedures for collection and analysis of the data will be in accordance with the DQO process and QA Plan, and will be detailed in each test plan.

8.0 SCHEDULE

The testing activities associated with this Test Implementation Plan will be conducted in accordance with the schedule contained in the Hanford Tanks Initiative Plan (Murkowski 1996). The schedule is updated on a regular basis to accurately depict ongoing project activities.

9.0 RESOURCES

Multi-disciplined labor resources will be required for all phases of the Demonstration of In-Tank Retrieval Technologies project. Resources required for the test described in Sections 3 through 4 are documented in the Multi-Year Work Plan (MYWP). Updates to resource requirements are documented in approved Change Requests and annual MYWP updates.

10.0 REFERENCES

Ecology, et al., 1994, Hanford Federal Facility Agreement and Consent Order, also known as the Tri-Party Agreement or TPA, Washington State Department of Ecology, Olympia, Washington.

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Orsag, 1996, Tank Waste Remediation System, Systems Engineering Manual, Westinghouse Hanford Company, Richland, Washington.

WHC, 1996a, Tank Waste Remediation System, Configuration Management Plan, Westinghouse Hanford Company, Richland, Washington.

WHC, 1996b, Multi-Year Work Plan, Westinghouse Hanford Company, Richland, Washington.

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