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# Hanford Tanks Initiative Test Facility Functions and Requirements

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Abstract: This document presents the functions and requirements for a test facility for testing single-shell tank waste retrieval equipment and systems for the Hanford Tanks Initiative (HTI) project. This effort includes review of previous test facility functions and requirements and conducting a workshop to develop specific functions and requirements for HTI testing needs. Functions and requirements for testing future retrieval systems that follow HTI are also identified.

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# HANFORD TANKS INITIATIVE TEST FACILITY FUNCTIONS AND REQUIREMENTS

March 1997

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U.S. Department of Energy
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## *EXECUTIVE SUMMARY*

*The Hanford Tanks Initiative is a four-year project that accelerates the waste retrieval activities related to two Hanford underground waste storage tanks. One of the tasks the Hanford Tanks Initiative will undertake is the demonstration of hard-heel waste retrieval in single-shell tank 241-C-106 by acquiring technology and services of the private sector. The Hanford Tanks Initiative will evaluate retrieval systems from at least two private vendors and deploy one of the systems into tank 241-C-106 to retrieve the hard-heel waste.*

*Before installing the waste retrieval system in "hot" operation in a single-shell tank, it must be installed in a "test facility" to test and verify the system setup, operation, deployment, and dismantling in a physical environment approximating that of the single-shell tank.*

*This document develops the functions and requirements for a Hanford Tanks Initiative test facility. The test facility functions and requirements have been prepared around the Hanford Tanks Initiative testing needs (vehicle-based and arm-based retrieval systems). The functions and requirements also reflect the future testing needs of the privatization contractors, as understood at this time. The functions and requirements were developed following a workshop conducted at Hanford in January 1997 and from previous test facility studies and reports.*

*The functions and requirements result in a test facility of approximately 12.8 m (42 ft) x 12.8 m (42 ft) x 12.2 m (40 ft) deep with an overhead crane clearance of 22.9 m (75 ft). The facility must support a weight of 50 tons imposed by the retrieval equipment and allow the "top" to be configured to simulate the top of a single-shell tank. The facility design should allow manned access into the test area for test setup, troubleshooting, and observation. Additional functions and features that fall into the "want" or "nice to have" category are included for consideration as funding allows.*

*The single function identified for future waste retrieval system testing is a depth of approximately 16.8 m (55 ft) to reflect the depth of the 3,785-$m^3$ (1-Mgal) single-shell tanks (241-C-106 is a 1,892-$m^3$ [0.5-Mgal] tank). A separate study evaluating various sites for locating the test facility is underway and will look at locations both on and off the Hanford Site.*

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## LIST OF TERMS

| | |
|---|---|
| ALARA | As low as reasonably achievable |
| CCTV | Closed-circuit television |
| DOE | U.S. Department of Energy |
| FMEF | Fuels and Materials Examination Facility |
| HTI | Hanford Tanks Initiative |
| ORR | Operational Readiness Review |
| PHMC | Project Hanford Management Contractor |
| SST | Single-shell tank |
| TWRS | Tank Waste Remediation System |

# HANFORD TANKS INITIATIVE TEST FACILITY FUNCTIONS AND REQUIREMENTS

## 1.0 INTRODUCTION

The Hanford Tanks Initiative (HTI) is a four-year project resulting from the technical and financial partnership of the U.S. Department of Energy, Office of Waste Management (EM-30) and Office of Science and Technology Development (EM-50). The HTI accelerates activities related to two high-level waste tanks (241-C-106 and 241-AX-104) to resolve technical, cost performance, and regulatory issues. The HTI will provide a basis for design and regulatory decisions affecting the remainder of the tank waste retrieval program. The HTI project will accomplish the following:

- Retrieve the hard-heel waste in single-shell tank (SST) 241-241-C-106 at the Hanford Site.
- Demonstrate alternative retrieval technologies to remove waste forms.
- Define the process, criteria, and technology for reaching closure agreement for an SST (241-AX-104).
- Provide a basis, through technology applications, performance assessments and risk analysis, for establishing an acceptable approach and defining an end-state condition for tank farm closure.
- Conduct residual waste characterization to the extent needed to support the basis for waste retrieval and tank closure.
- Obtain the acceptance of regulatory agencies and stakeholders for methods and processes to define completion of tank waste retrieval.
- Establish new or improved methods to achieve safe and efficient environmental remediation at the Hanford Site.
- Develop reliable cost information for various levels of retrieval to support program and regulatory decisions.

HTI will acquire technologies and services through performance-based contracts with private industry. 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.

HTI will evaluate waste retrieval systems from at least two vendors and deploy one system into tank 241-C-106 to retrieve the hard-heel waste. The system chosen for deployment in tank 241-C-106 must undergo testing to demonstrate system operability and verify processes and procedures. HTI therefore "needs" a facility for testing the waste retrieval system setup, operation, deployment, and dismantling before installation of the system in the tank farm. The test facility should demonstrate the functionality and operability of the integrated HTI waste retrieval systems in a physical environment approximating that of the SST and allow testing of the retrieval system under both normal and off-normal conditions before hot operation in an SST.

The test facility will be operated by the Project Hanford Management Contractor (PHMC). The initial user of the facility will be HTI; however, the facility is also expected to be useful for testing future SST retrieval systems and concepts including the Privatization Contractors systems that are expected to brought aboard beginning in 2011.

## 1.1 SCOPE

The scope of this document is to define the functions and requirements (F&R) for a test facility to provide for predeployment, checkout, testing, and training for the Underground Storage Tank retrieval equipment and systems that will be developed as part of the HTI. Additionally, the F&R for a future Tank Waste Remediation System (TWRS) retrieval test facility, that extend beyond the needs of HTI, are identified.

## 1.2 ASSUMPTIONS

There are a number of assumptions that were adopted in order to prepare the F&R for the test facility. The primary assumptions are listed below:

- The test facility will be used to conduct preoperational testing activities in a non-contaminated environment. These preoperational testing activities include deployment and setup of the system(s), insertion of the equipment into the simulated SST through the appropriate "risers," limited operational demonstration, training, and removal of the system/equipment from the test facility.

- The test facility will be configured to meet the HTI testing needs (vehicle-based and arm-based retrieval systems) although the F&R will reflect the additional testing needs of the privatization contractors, as available.

- Equipment performance and acceptance testing will be performed at the vendor sites and need not be repeated at the HTI test facility.

- Radioactive or contaminated materials will not be used in the facility.

- Some waste simulants, preferably non-hazardous materials, will be used in the test facility and will be provided by the organization performing the test.

- Current HTI testing needs are based on retrieving the residual waste heel from tank 241-C-106.

- The test facility physical environment will not duplicate the SST environmental conditions including air flow (heating, ventilating, and air conditioning), radiation, corrosive vapors, mists, fog, steam, humidity, chemicals, etc.

- The test facility is needed by November of 1998 to accommodate testing of the HTI retrieval systems provided by the HTI commercial vendors.

- Testing of low pressure, high volume sluicing equipment can be accomplished at a vendor's facility or at any of a number of existing Hanford facilities, i.e., the cold test facility in the 600 Area. Deployment, installation, and operation of this type of equipment in the SSTs is a low risk activity that has been done numerous times in the past. Therefore, sluicing equipment will not be tested in the HTI test facility except as a component of a retrieval system, i.e., confined sluicers with a vehicle or arm-based system.

- The HTI required operational life for the facility is two years beginning in November of 1998. Future operational life extends to 2018 when all of the SSTs will be retrieved.

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## 2.0 TESTING REQUIREMENTS

HTI "needs" for testing of tank waste retrieval equipment are for a facility where the HTI retrieval system setup, deployment, operation, and dismantling can be demonstrated before installation in the field. Verification of procedures and demonstration of operator proficiency are also needs. There are longer term needs associated with testing the retrieval equipment for the remainder of the SSTs that are addressed later in this report.

Currently Tank 241-C-106 has been selected as the retrieval demonstration tank. The two most prominent concepts under consideration for a HTI retrieval system are vehicle-based and arm-based systems (Figures 1 and 2). A test facility that can accommodate these two waste retrieval systems should "bound" the testing requirements for other systems.

There are six categories of testing defined in the *Standard Engineering Practices* (WHC 1996).

- Development Testing

  Development testing is performed to provide or develop design information, concepts, or criteria. It may also be preformed to develop performance characteristics.

- Acceptance Testing

  Acceptance testing is performed to demonstrate that fabrication, assembly, installation, and construction requirements have been met as required in the design documents.

- Qualification Testing

  Qualification testing is performed to verify adequacy of design and verify adequacy of performance under conditions that simulate the most adverse design conditions.

- Preoperational Testing

  Preoperational testing is performed in preparation for operational testing. During preoperational testing, systems and components are operated at defined parameters to ensure that they are ready for full operational testing. Preoperational testing may be performed at the test facility, at the tank farm, or both.

Figure 1. Vehicle-Based Waste Retrieval System.

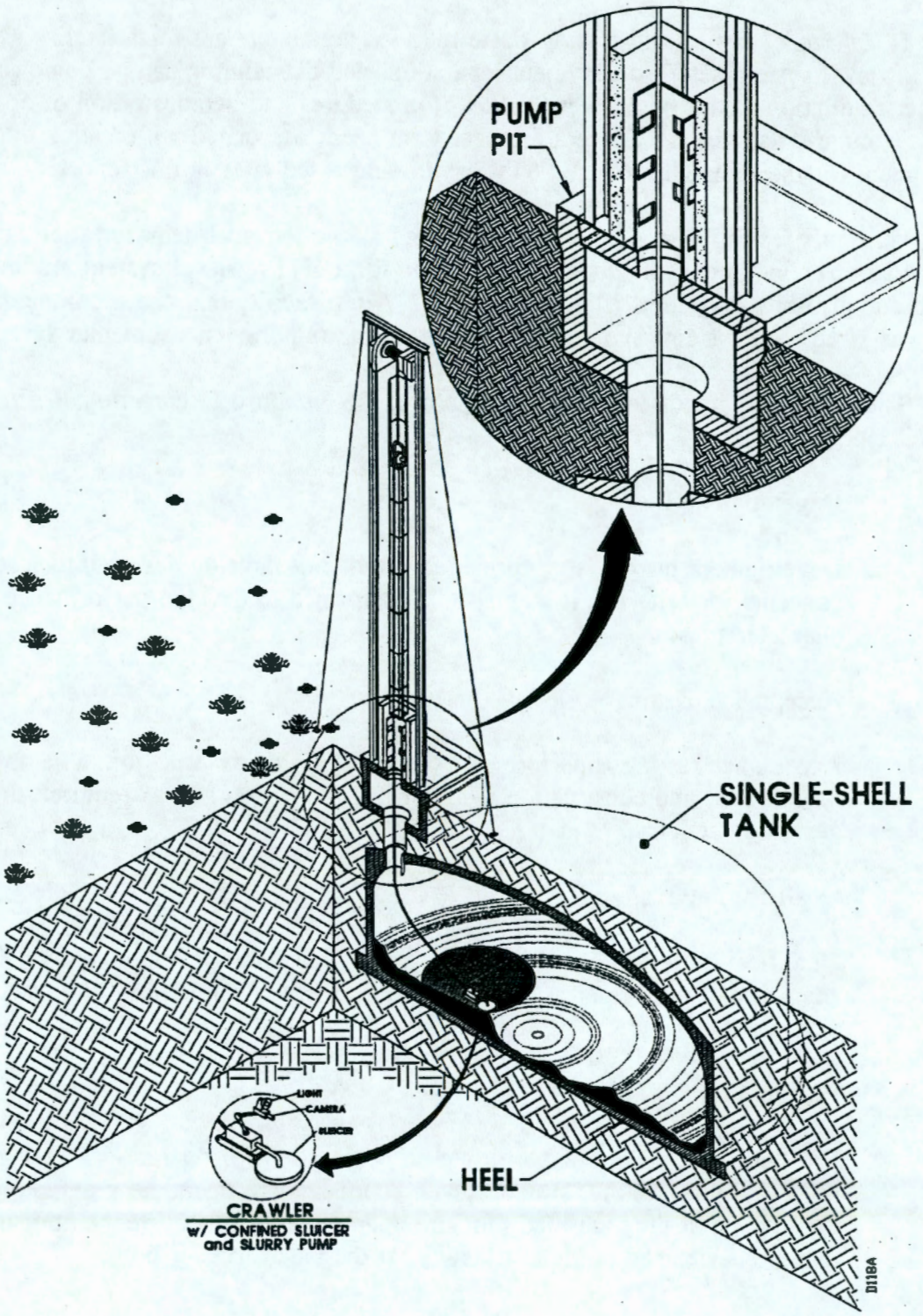
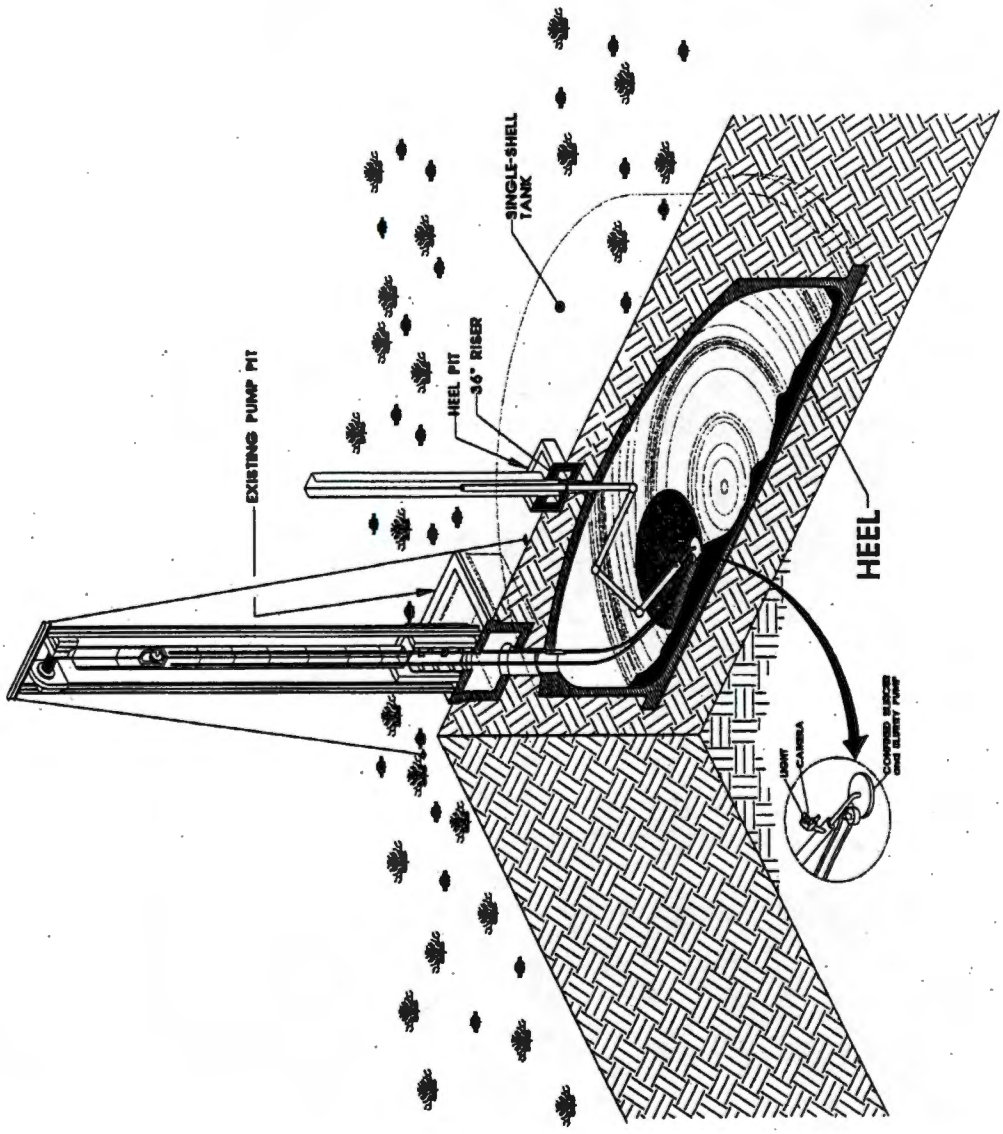


Figure 2. Arm-Based Waste Retrieval System.



- Operational Testing

  Operational testing is performed by the operator with items in their final in-service configuration (including interfaces) to verify that functional, operational, and design requirements have been met.

- Production/Process Testing

  Production/process testing is performed at operating facilities to evaluate potential improvements, develop optimum process parameters, or establish new criteria.

HTI development testing, acceptance testing, and qualification testing will be conducted at the vendors plant. The retrieval system tests that will be conducted at the HTI Test Facility will be performed subsequent to the qualification testing at the vendors plant. The HTI testing is considered "cold" preoperational testing and will be conducted before additional "hot" preoperational testing on tank 241-C-106.

The HTI testing will consist primarily of a demonstration of the functionality and operability of the integrated waste retrieval system in a physical environment approximating that of a SST. Typical tests that will be performed at the test facility are summarized below and shown in Table 1.

- Performance, functional, F&R compliance
- Operational sequences and responses
- Integrated systems operation
- Interfaces (excluding site interfaces)
- Off-normal recovery operations
- Operational readiness demonstrations.

Table 1. Potential Hanford Tanks Initiative Testing Activities.

| Types of testing | Testing locations | | |
|---|---|---|---|
| | Vendor facility | HTI Test Facility | Tank Farm |
| Factory acceptance tests | | | |
| - Fit, form, function, and performance to performance specifications | YES | N/A | N/A |
| Construction acceptance testing | | | |
| - Work site construction testing | N/A | N/A | YES |
| Preoperational testing | | | |
| - Performance, functional, design spec, and F&R compliance | N/A | YES | NO |
| - Operational response and sequence | N/A | YES | YES |
| - Integrated systems performance | N/A | YES | YES |
| - Subsystem performance | N/A | YES | NO |
| - Interfaces | N/A | YES | YES |
| - Off-normal recovery | N/A | YES | YES |
| - Operational readiness demonstrations | N/A | YES | YES |
| Operational testing (at tank farms) | | | |
| - Performance, functional, design spec, and F&R compliance | N/A | NO | NO |
| - Operational response and sequence | N/A | NO | YES |
| - Integrated systems performance | N/A | NO | YES |
| - Subsystem performance | N/A | NO | YES |
| - Interfaces | N/A | NO | YES |
| - Off-normal recovery | N/A | NO | YES |
| - Operational readiness demonstrations | N/A | NO | YES |
| Maintenance testing and troubleshooting | N/A | YES | YES |

F&R = Functions and requirements
HTI = Hanford Tanks Initiative.

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# 3.0 HANFORD TANKS INITIATIVE FUNCTIONS AND REQUIREMENTS IDENTIFICATION

The F&R were developed from two sources. First, from a review of previous test facility F&R (see Section 10.0) and second, from those identified in a HTI Test Facility F&R workshop conducted on January 23, 1997. Workshop results are included in Appendix A. The F&R from both the previous studies and the workshop were revised and updated to reflect the testing needs of HTI and future retrieval projects as currently understood.

There are fundamental functions that must be accommodated in the test facility design in order for the facility to provide the minimum testing capability to attract a user/customer, initially HTI. Unless these fundamental functions are satisfied, the facility would not be viable and should not be constructed.

1. The first fundamental function is to provide a test space of adequate size. The facility must accommodate testing of the HTI arm-based waste retrieval system. The facility must accommodate testing at the maximum arm extension of 11.4 m (37.5 ft) (assuming center riser installation) resulting in a facility minimum length of about 12.8 m (42 ft). Testing of arm radial movement through 90° also results in a facility width of about 12.8 m (42 ft). HTI system testing requires a facility 12.2 m (40 ft) deep to simulate tank 241-C-106. Adequate space for retrieval equipment support bridges or other structures also must be provided. These dimensions allow testing of systems in a "quarter tank" volume. Details of the evaluation and determination of the required size and configuration of the test facility are presented in Appendix B.

2. The second fundamental function is to provide for vehicle access to the "ground" surface adjacent to the top of tank. Cold setup, assembly, checkout, operation, disassembly and removal of the waste retrieval system in a manner similar to that to be used in the tank farms is essential to demonstrate system readiness. This dictates the use of cranes and other handling equipment to assemble, insert, and remove the retrieval systems from the simulated tank risers. The operating clearance for the crane needs to be a minimum of 22.9 m (75 ft) to allow insertion and removal of the equipment into/out of the risers.

3. The third fundamental function is to permit the top of the test facility to be "mocked up" to simulate the physical conditions in the tank farm. This mock-up includes pits, risers, and other features in the tank farms. Since every tank is different in this aspect, the facility needs to provide the versatility for the user to be able to install simulated pits, risers, and other features he feels is necessary for his test. For HTI, a simulation of a portion of the risers/pits above 241-C-106 is the currently envisioned need. Included in this function is providing a 4.6-m (15-ft) working envelope around the rise that the arm/vehicle is installed into.

4. The fourth fundamental function is to validate and demonstrate the assembly, setup, insertion into a riser, deployment into the tank, and subsequent removal of the waste retrieval systems being tested. In some instances, this will be the first time the total system is set up, installed, and operated as a fully integrated unit.

These are the four fundamental functions for the test facility. There are additional functions that customers will consider highly desirable in order to accomplish the complete range of test activities that they envision, but without providing these four fundamental functions the facility would not be useable.

Secondary F&R require evaluation against available funding and other constraints to determine if they should be included or accommodated in the test facility design. The secondary F&R are discussed below. The majority of these were identified in the HTI F&R Workshop conducted January 23, 1997 (Appendix A).

1. Demonstrate Waste Retrieval System Operability

   The ability of the Waste Retrieval System to operate as an integrated unit and retrieve simulated waste in a geometry approximating that of the tank(s) needs to be verified before installing the system on a SST.

2. Validate Operating Procedures

   Validation and confirmation of the adequacy of operating procedures is needed before operation of the system in the tank farms. As-low-as-reasonably-achievable (ALARA) considerations and (radiation) dose reduction are key considerations in validating these procedures.

3. Craft Training

   The craft personnel that will be responsible for installing the system in the tank farms require practice/training on the installation and removal procedures including safety precautions. The test facility will provide the location for this installation practice/training with the total integrated waste retrieval system.

4. Operator Proficiency Demonstration

   The ability of the system operator to safely and efficiently control and operate the equipment is the key to waste retrieval productivity. This demonstration of proficiency is required before operation of the system in the tank farms and is a key step in the Operational Readiness Review (ORR) process.

5. Test Facility Access

Manned access inside the test facility is needed for set-up of test equipment/simulants, visual evaluation of test progress, and trouble shooting of the retrieval equipment. The access could include a manhole to lower a man-basket through and a hatch for lowering equipment. Confined space conditions such as the potential for oxygen deficient atmosphere should be avoided from both the safety and productivity standpoints. This requires provisions for adequate ventilation.

6. Provide Utility Interface

The HTI Waste Retrieval System will use the utilities currently available at 241-C-106 as provided by project W-320. The test facility needs to provide comparable water, electrical power, telephone service, etc., necessary to operate the waste retrieval system and accommodate Vendor Control Systems.

7. Facilitate Maintenance activities

The test facility design needs to accommodate maintenance, trouble-shooting, de-bugging, or diagnosis activities that may be performed on the waste retrieval system by providing a protected/heated maintenance work area and storage space near the test area.

8. Provide Staff Office Space

The Facility needs to provide adequate conditioned office/conference room space to allow for test team pre-test briefing and post-test de-briefing.

9. Provide Equipment/System Security

The test facility should provide physical security for the waste retrieval system and test equipment. Security should include means to preclude un-authorized removal or operation of the waste retrieval system or components.

10. Accommodate Simulant Use

Fully integrated testing of the retrieval systems requires the use of waste simulants. Simulants must be prepared and placed in the test facility in various locations to demonstrate retrieval capability during the tests. Minimum accommodation of simulant use requires a facility that does not preclude the user from importing and using simulants in the tests. Maximum accommodation of simulant use includes providing means to prepare, mix, store, and dispose of the simulants and ingredients before and after use in the test activities. From the HTI standpoint, the minimum accommodation is satisfactory since the performance of

the waste removal tools will be validated at the vendors plant.

11. Provide Observation Facilities

Visitors and guests will want to observe the test activities. These observations will include the "in-tank" portions of the equipment being tested. Windows/observation galleries should include sufficient space for at least 10 visitors to simultaneously view the test activities.

12. Facilitate In-Tank Viewing

The waste retrieval systems include closed-circuit television (CCTV) systems for control and evaluation of the retrieval process. The test facility should simulate the lighting conditions found in the tank including the exclusion of ambient light.

13. Provide Adequate Test Facility Site Space Requirements

The minimum site size required for the test site includes space for vehicle parking, equipment staging, crane maneuvering, and above ground facilities. The minimum requirements based on HTI minimum needs is for a test site of approximately 1.2 hectares (3 acres).

14. Provide Lighting for Conducting Tests During Darkness

During periods of intensive test activity, it may be desirable to conduct test activities during hours of darkness. Sufficient lighting needs to be provided to support testing activities during these periods.

15. Facilitate De-Commissioning/Disposition

The test facility needs to be designed to facilitate de-commissioning and disposal at end-of-life.

16. Structural Configuration/Features

The design of the test facility should provide the space and entry features that will allow mock-up of in-tank hardware and equipment. This includes the air lift circulator mockups.

## 4.0 ADDITIONAL DESIGN REQUIREMENTS

The following are additional design requirements.

- Permanent top/removable panels

  Removable panels on the top of the facility allow maximum adaptability for mocking up various riser and pit configurations. The facility should be constructed with removable panels on the top that are designed to accommodate the 50-ton loading imposed by the HTI retrieval equipment.

- Structural loads

  The facility should be designed to withstand a 50-ton load imposed by the retrieval system. The cranes do not require rolling access to the top of the test facility and will not impose additional loads. The cranes will impose loads of 100 tons (crane plus pick weight) on the surface adjacent to the test facility.

- Top/cover configuration

  The existing 22.9-m (75-ft) diameter SSTs have dome shape tops. There is insufficient justification to duplicate this feature in a test facility. Design and construction costs would be greater for a domed/arched structure than a flat top structure. Varying the length of the risers to simulate a domed top is sufficient for retrieval equipment testing.

- Test facility floor configuration

  The SST designs include both a flat bottom and a sloped bottom concept. From a retrieval equipment testing standpoint, either would be satisfactory. However, having the bottom of the test facility sloped to a sump is desirable to allow removal of water that may intrude into the facility or may be used for cleanup.

- Wall liner

  The SSTs have a steel liner installed on the walls and bottom of the tanks. From a retrieval system testing standpoint, there is no advantage to bare concrete or a steel liner. The least cost option would be the preferred option.

- Electrical

  The test facility needs to provide 300 KW of electrical power to operate the retrieval systems. This is the amount of power provided at tank 241-C-106 by project W-320 and is considered sufficient for operating retrieval systems.

- Utilities

  Utilities such as potable water, steam, compressed air, sanitary sewer, and process sewer are not required to be provided for HTI testing.

- Ambient design conditions (wind, temperature, ash fall, etc.)

  The design requirements for wind loading, snow loads, temperature extremes, earthquakes, ash falls, etc., for this facility are included in the applicable state and local building codes. Additional requirements or restrictions are not required by HTI.

- Equipment storage area

  Not required for HTI testing.

- Tanks for storage of simulated waste

  If required, will be provided by test performer.

- Bulk dry material handling and storage area

  If required, will be provided by test performer.

- Simulated waste mixing and preparation area

  If required, will be provided by test performer.

## 5.0 FUTURE/PRIVATIZATION FUNCTIONS AND REQUIREMENTS

There is an additional future/privatization requirement related to the fundamental function that the test facility "provide a test space of adequate size." Future/privatization tank retrieval activities include tanks with capacities of 1,892 $m^3$ (0.5 Mgal), 2,838 $m^3$ (0.75 Mgal), and 3,785 $m^3$ (1 Mgal). This requires a depth of approximately 16.8 m (55 ft) to reflect the depth of the 3,785-$m^3$ (1-Mgal) tanks. HTI currently plans to retrieve the waste heel from tank 241-C-106, a 1,892-$m^3$ (0.5-Mgal) tank. If the HTI retrieval tank is changed to a 3,785-$m^3$ (1-Mgal) tank, this requirement would be included in the HTI requirements.

Future/privatization secondary F&R fall into two general areas: training and engineering development. The training activities include the following:

- Operator certification/recertification
- Procedure validation
- Practice/develop off-normal event recovery procedures
- Training in maintenance activities.

The engineering development activities involve using the facility as an engineering testbed. Typical retrieval testbed activities that would be considered for this facility include the following.

- Develop in-tank obstacle work around techniques
- Hose management technique development
- Optimization and evaluation of in-tank viewing systems
- Control system response evaluation
- Advanced control system development.

These future/privatization training and engineering development needs impose the additional requirement for the facility to include sufficient space for future expansion to include training and engineering development facilities. Allowing for vehicle parking, equipment staging, crane maneuvering, training facility, and an engineering development facility, the potential space required for a future test facility is for about 2.8 hectares (7 acres) of ground and the associated utilities required to operate the facilities.

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## 6.0 TANK WASTE REMEDIATION SYSTEM TRAINING AND TEST FACILITY

A week long F&R analysis workshop was conducted in 1993 to develop F&R for a major TWRS Retrieval Training and Test facility. Representatives from Kaiser Engineers Hanford, Westinghouse Hanford Company Technology Development, TWRS Training, TWRS Operations, TWRS Maintenance, TWRS Engineering and Pretreatment, and Engineering Applications participated in the workshop. The workshop analysis is included as an appendix to Yanochko (1993) and is available from document files.

Although the scope of the proposed TWRS test facility was much greater than that visualized for HTI, the "Facility General Requirements" from the TWRS workshop are included below for information and comparison. The scope of a TWRS testing and training facility to satisfy all of these requirements results in a facility costing $30 to 50 million and includes two 22.9-m (75-ft) diameter tanks.

1. Minimum 30-year design life.
2. Capable of testing in all weather.
3. Self contained chemical sewer system.
4. Waste storage/transfer capability.
5. Assemble, lift, move, and insert full scale waste retrieval system, space and capability (receiver, decon, packaging).
6. Emulate riser conditions.
7. Top of tank needs to be from 1.8 m (6 ft) to 3.0 m (10 ft) below operating deck.
8. Need two way traffic flow to the site.
9. Need large equipment transfer capability.
10. Need decontamination and disassembly capability.
11. Need access for personnel inside test tank.
12. Top-of-tank needs to be accessible.
13. Need to support full scale retrieval system weight over the top of the tank.
14. Need viewing capability of inside tank at multiple locations.

15. Need gravity feed for removal of simulants.

16. Simulants must be recoverable.

17. Need to simulate the tank farm above grade.

18. Accommodate facility expansion/flexibility.

19. Safety showers and related personnel support.

20. Design to accommodate decontamination and decommissioning, including equipment decon.

21. Emulate various tank sizes (for testing envelope, wet and dry) tank size to range from 6.1 m (20 ft) to 22.9 m (75 ft) in diameter, and 10.7 m (35 ft) to 16.8 m (55 ft) in height.

22. Process and sanitary water is needed including sluicing water.

23. Electricity to support I&C needs.

24. Equipment handling crane (similar to that used in the field) and related "support" equipment.

25. Accommodate existing tank maintenance conditions (mockup).

26. Internal to tank temperature control and pressure.

27. Test equipment storage and setup area (storage unloading and laydown).

28. Simulant storage and transfer.

29. Need a performance-based training facility.

30. Expendables (for training) plus storage area.

31. Listing of performance criteria used to evaluate alternatives.

32. I&C for operating (manual, local, and remote).

33. Simulant preparation area and chemical handling system.

34. Monitoring capability (visual and electronic).

35. Utilities (air, steam, power, etc.).

36. Temporary confinement barrier.

37. Maintain tank environment.

38. Tank protection-liner, shielding, etc.

39. Interim simulant storage area and containers.

40. Accommodate actual waste containers.

41. Accountability systems.

42. Interfaces-carriers, transporters, and conveyors.

43. Waste containers and storage area.

44. Shop/maintenance tools and supplies (lathe, etc.).

45. Any existing facility (or portion) to be considered for use needs to meet non-smearable radiological contamination regulations.

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## 7.0 SCHEDULAR REQUIREMENTS

Current schedules call for HTI installation of the 241-C-106 retrieval equipment in the test facility in October of 1998. This requires the facility to be completed by September 1998. A draft schedule for the design and construction of the test facility is shown in Figure 3.

## 8.0 SITE SELECTION

A separate HTI Test Facility site selection effort has been concluded and the preferred site for the test facility is an abandoned barrow pit located between the 200 East and 200 West areas. The site selection study included investigation of locations both on and off the Hanford Site. The site selection study has been released as a supporting document (Staehr 1997).

| Task Name | Dur | Start | Finish |
|---|---|---|---|
| Define Functions and Requirements | 14w | 1/8/97 | 4/15/97 |
| Site Evaluation and Selection | 6w | 1/22/97 | 3/4/97 |
| Concept Definition | 6w | 3/5/97 | 4/15/97 |
| RFP Preparation and Release | 12w | 4/16/97 | 7/8/97 |
| A&E Firm Selection | 12w | 7/9/97 | 9/30/97 |
| Conceptual Design | 4w | 10/1/97 | 10/28/97 |
| Detail Design | 16w | 10/29/97 | 2/17/98 |
| Procurement | 12w | 2/16/98 | 5/12/98 |
| Fabrication/Construction | 24w | 3/18/98 | 9/1/98 |
| Test Facility Complete | Oct | 9/2/98 | 9/2/98 |
| Ready to Install Equipment | Oct | 10/2/98 | 10/2/98 |

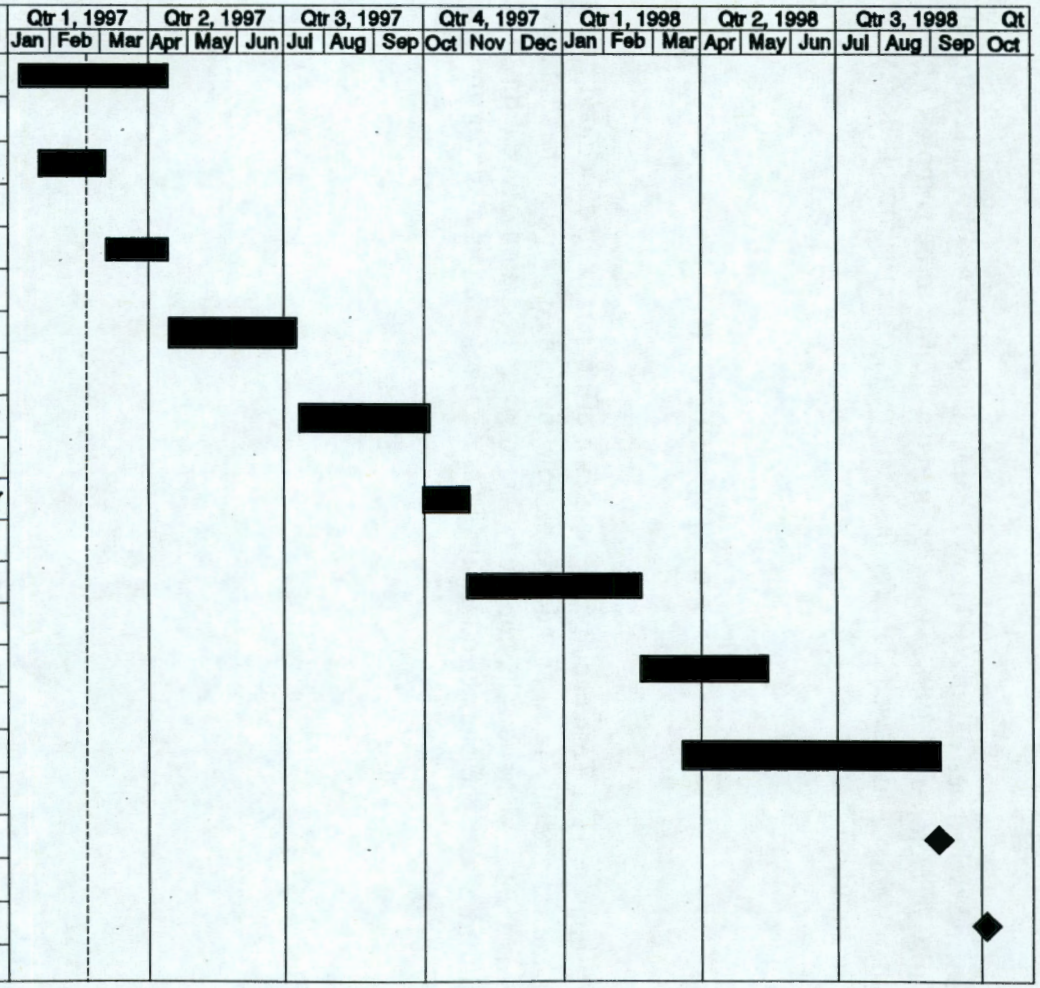


Figure 3. Hanford Tanks Initiative Test Facility Schedule.

## 9.0 REFERENCES

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WHC, 1996, *Standard Engineering Practices*, Release 70, EP-4.2, "Testing Requirements," WHC-CM-6-1, Westinghouse Hanford Company, Richland, Washington.

Yanochko, R. M., 1993, *Requirements for TWRS Training and Test Facilities*, WHC-SD-WM-ER-286, Rev 0., Westinghouse Hanford Company, Richland, Washington.

## 10.0 BIBLIOGRAPHY

The following documents are not referenced in the study, but contain relevant information that was used in the preparation of this document.

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# APPENDIX A

# HANFORD TANKS INITIATIVE TEST FACILITY WORKSHOP FUNCTIONS AND REQUIREMENTS

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# APPENDIX A

## HANFORD TANKS INITIATIVE TEST FACILITY WORKSHOP FUNCTIONS AND REQUIREMENTS

The following functions are requirements (F&R) were developed at the HTI Test Facility Work shop conducted on January 23, 1997. The workshop notes/minutes/roster are included in this appendix. These F&R were not evaluated against constraints, i.e., funding, nor did they have a final prioritization.

1. Mockup (Waste Retrieval System) Installation
   - Verify system egress and ingress
2. Validate Procedures
   - ALARA
   - Dose reduction
3. Train Installation Crafts
4. Demonstrate Operator Proficiency
5. Demonstrate System Operability
   - Verify System is operable in tank
6. Simulate Physical Tank environment (Geometry)
   - 22.9-m (75-ft) diameter minimum
   - 12.2-m (40-ft) depth
   - Long term (privatization) 16.8 m (55-ft) depth
   - Deploy system through risers from 30.5-cm (12-in.) diameter to 91.4-cm (36-in.) diameter
   - Shall not preclude mock-up of in-tank hardware and equipment
   - Withstand 50-ton dead load

7. Simulate Above-Grade Tank Farm Environment
    - Maintain Tank Integrity
    - Facilitate Access Logistics
8. Facilitate In-Tank Vision
    - Simulate Visibility Conditions
    - Exclude light
9. Accommodate Vendor Control System
10. Facilitate Access Inside Tank For Testing Purposes
    - No confined space entry
11. Provide Interface With BOP (i.e., utilities, etc.)
    - Similar to utilities currently available at 241-C-106, provided by W-320
    - Provide Ventilation
12. Facilitate Observers
13. Facilitate Near-Tank Maintenance (Retrieval System Trouble shooting)
    - Conduct de-bugging, diagnosis, etc.
14. House Personnel
15. Protect Equipment/System
    - Preserve life
16. Comply With Regulations
17. Record/Archive Operations Testing
18. Facilitate De-Mobilization/Disposition
    - Facilitate downtime
19. Accommodate Simulant Use.

# FACILITATED TEAM APPROACH

# HTI

## TEST FACILITY FUNCTIONS & REQUIREMENTS WORKSHOP

JANUARY 23, 1997

2440 STEVENS, ROOM 2200

# ACTIONS

| WHAT | WHO/WHEN |
|---|---|
| 1. DETERMINE MINIMUM VOLUME REQMTS. & ADJUST THE FUNCTION #6 REQMTS. ACCORDINGLY. | STU 2/28/97 |
| 2. DETERMINE IF WASTE SIMULANT IS REQ'D FOR THE HTI TEST FACILITY. | STU 2/28/97 |
| 3. COMPLETE DRAFT FER3 & A DRAFT CONCEPT DEFINITION, INCLUDING A TENETIVE SITE SELECTION. | STU • DEAN 2/28/97 |
| 4. | |

# MEMORIES

*✓ CONSIDER TESTING/FACILITY ALTERNATIVES (eg: USE EXISTING FACILITIES, LIKE FMEF, WPPSS ETC.)

✓ CONSIDER MAKING THE TEST FACILITY A "CENTER OF EXCELLENCE" FOR OTHER DOE SITES.

✓ OBTAINING A "DRAFT" CONCEPT DEFINITION & FCRs BY 2/97, WILL SUPPORT FUNDING COMMITMENTS.

*✓ CONSIDER CONDUCTING TESTING & OPERATOR TRAINING @ VENDOR FACILITY.

✓ CONSIDER B. BURKS RECOMMENDATION TO USE OUTSIDE FACILITY.

# ASSUMPTIONS

(2)

- SHORT TERM HTI TEST IS BASED ON C-106 TANK
- LONG TERM HTI TESTS ARE BASED ON ALL OTHER TANK TYPES.
- WILL USE THE LLCE REMOVAL SYS. FOR REMOVAL OF ANY IN-TANK HARDWARE &/OR EQUIPMENT.
- HTI TEST FACILITY PHYSICAL ENVIRONMENT DOES NOT INCLUDE HVAC, WASTE SIMULANTS, RADIATION, CORROSIVE VAPORS/CHEMICALS ETC.

→ A2✓

# ASSUMPTIONS

1

- RFP 8/97, AWARD (?) 1/98, DOWN-SELECT VENDORS TO ONE IN 11/98, ON-SITE TEST/CHECK-OUT IS SCHEDULED FOR 11/98 — 8/99.
- HTI TEST FACILITY WILL BE READY BY 11/98.
- RETRIEVAL SYSTEM ATPs WILL BE @ THE VENDOR SHOP, & OTP WILL BE ON-SITE.
- VENDOR WILL TEST FULL-SCALE RETRIEVAL SYSTEM PER TEST PERFORMANCE CRITERIA IN THE VENDORS FACILITY.
- TECHNOLOGY SYSTEM COULD BE ENHANCED SLUICING, CRAWLER BASED, &/OR ROBOTIC ARM TYPE.
- VENDOR WILL USE WASTE SIMULATE. DURING TESTING @ THEIR SHOP.

A2 HTI TEST FACILITY WILL NOT USE WASTE SIMULATE?

# ISSUES/CONCERNS

- F&Rs WILL DRIVE COST
- IF C-106 IS NOT THE FIRST TANK
- THEN CAPACITY/DEPTH REQMT. COULD CHANGE
- IN-TANK RISERS & HARDWARE

# LDIFD SCOPE/NEEDS (1)

- DURING PROPOSAL PERIOD;
  - WANTED SUPPORT ECONOMIC TRANSITION
  - FOCUS WAS ON TANK PROGRAM
  - THEREFORE, THE IDEA OF A "COLD-TEST FACILITY" WAS IDENTIFIED TO BRIDGE THE GAP.
    - DESIGN ASPECTS, INCLUDING SOME LOCATIONS WERE LOOKED AT.
      NOTE: KEY WAS TO BE COST EFFECTIVE
- ~~WILL SELECT~~ TWO VENDORS WILL BE SELECTED, NEXT FALL, TO DEMONSTRATE RETRIEVAL.
- BIG PICTURE IS PRIVATIZATION TO TREAT WASTE.
- BNFL & LM WILL DESIGN & BUILD THE FACILITY.

# LD/FD SCOPE/NEEDS

(2)

- SCHEDULE:
  - PHASE 1A – PRIVATIZATION: CONCEPTUAL DESIGN, LICENSING, & FUNDING (FINANCE). NOTE: THIS IS FOR A IMMOBILIZATION PLANT (eg: VIT PLANT). DURATION 16 MONTHS OR 10/96 TO 2/98.
  - PHASE 1B – BUILD TWO WASTE DEMONSTRATION FACILITIES. ONE OR BOTH MAY FALL BY THE WASTE-SIDE. (2/98 – 2011)
  - PHASE 2 – PRODUCTION PHASE TO START BY 2011. LOOKING TO RETRIEVE & TREAT WASTE
- PHMC
  - RETRIEVE FROM SSTs (C-106 MAY BE THE 1st TANK) TO DSTs
  - COMMERCIAL VENDORS WILL TEST THEIR RETRIEVAL SYSTEMS ON-SITE 11/98.

## LD/FD SCOPE/NEEDS (3)

- HTI WILL BE THE 1ST CUSTOMER OF THE COLD-TEST FACILITY; THAT IS JOINT FUNDED BY LD/FD.
- FACILITY & LOCATION(S) IS WIDE-OPEN, & WILL WELCOME BEST IDEAS.
- NEEDS-HTI TEST FACILITY F&Rs.
  - BE COST EFFECTIVE (F&Rs WILL DRIVE COST)
  - PLAY ACTIVE ROLE IN HTI ACTIVITIES.
  - LOOKING FOR/AT LONG-TERM RETRIEVAL ISSUES.

# HTI NEEDS/SCHEDULE

- FACILITY NEEDED BY 9/98, & BEING OPERATIONALLY READY BY 11/98
- COMPLETE F&RS MID 4/97.
  COMPLETE CONCEPT DEFINITION 4/97.
  " CONCEPTUAL DESIGN BY 10/97.
  " PROCUREMENT BY 2/98.
  " FACILITY BY 9/98.

* NEEDS: (HTI) MOCK-UP

- LOCATION & FACILITY TO SET-UP, DEPLOY, OPERATE, TRAIN/QUALIFY SYSTEMS & PEOPLE. (ON-SITE)
- SOME OR MINIMUM BOP. (IE: UTILITIES, PUMPS, TANKS ETC.)
- WILL NOT DESIGNATE TECHNOLOGY SYSTEM. THE SELECTED TECHNOLOGY WILL DRIVE SOME FACILITY REQMTS.

* - SELECT SITE LOCATION BY EARLY 3/97

# OPENING REMARKS

BILL

- CAST OUR NET ON F&Rs LONG TERM.
- F&Rs SHOULD CAPTURE THE ESSENCE OF RETRIEVAL; WITH THE SUB-SET BEING FOCUSED ON THE HTI
- IMPLEMENTATION WILL BE ON THE HTI.
- WILL SUPPORT F&Rs LONG-TERM BUT, BUDGET IS ONLY FOR HTI
- LOOKING FOR TWO SETS OF F&Rs: LONG & SHORT TERM
  - FOCUS IS PRIMARILY ON HTI TODAY. HOWEVER, MUST TAKE INTO ACCOUNT THE BROADER/LONG TERM NEEDS

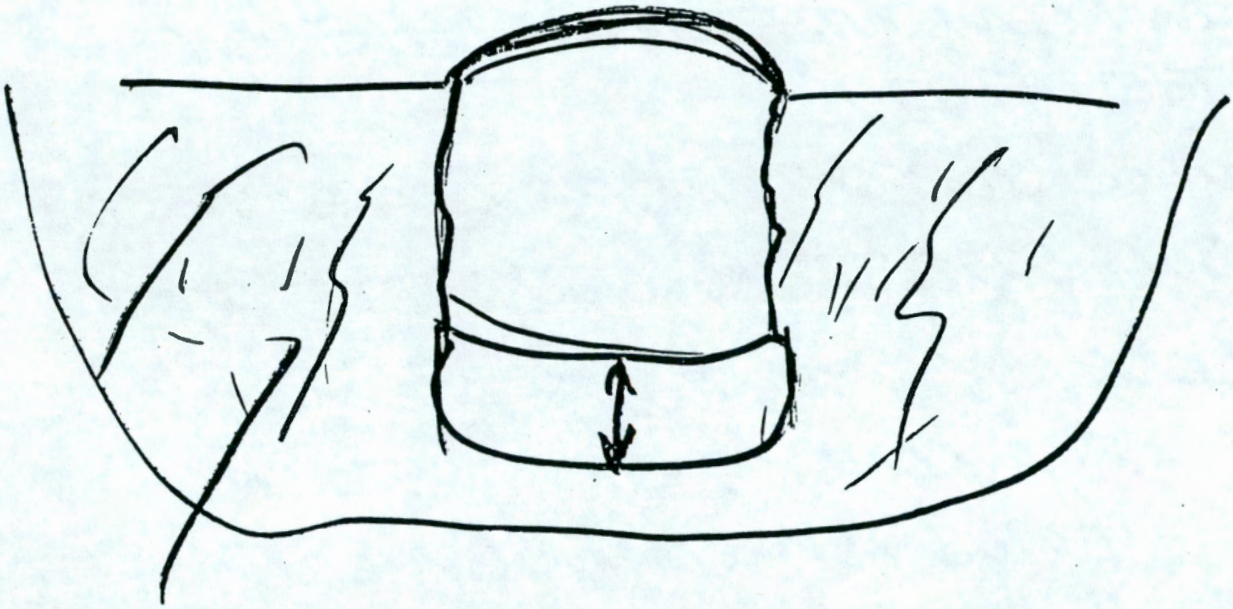
# FUNCTION CATEGORIES

#s = SHORT TERM HTI TEST FACILITY

L = LONG TERM RETRIEVAL

✓ = GOT TO HAVE

* = NICE TO HAVE



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# FUNCTIONS

HTI TEST FACILITY

1

1/L MOCK-UP INSTALLATION ✓
2/L VALIDATE PROCEDURE(S) ✓
3/L TRAIN CRAFTS ✓
INSTALLATION
4/L DEMONSTRATE OPERATOR PROFIENCY ✓
5/L DEMONSTRATE SYSTEM OPERATIBILITY ✓
6/L SIMULATE PHYSICAL TANK ENVIRONMENT (GEOMETRY) *
7/L SIMULATE ABOVE-GRADE TANK FARM ENVIRONMENT ✓
- MAINTAIN TANK INTEGRITY *
- FACILITATE ACCESS LOGISTICS *

8/L FACILITATE IN-TANK VISION *
- SIMULATE ~~LIGHTING~~ VISIBILITY CONDITIONS *

9/L ACCOMODATE VENDOR CONTROL SYSTEM ✓
10/L FACILITATE ACCESS INSIDE TANK FOR TESTING PURPOSES ✓
11/L PROVIDE/INTERFACE BOP (IE: UTILITIES ETC.)
- PROVIDE VENTILATION ✓

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FUNCTIONS

(2)

12/L FACILITATE OBSERVERS *

13/L FACILITATE NEAR-TANK MAINTENANCE *
- CONDUCT DIAGNOSIS, DE-BUGGING, ETC *

14/L HOUSE PERSONNEL *

15/L PROTECT EQUIP/SYSTEM ✓
- PRESERVE LIFE

16/L COMPLY WITH REGULATIONS ✓

17/L RECORD/ARCHIVE OPERATIONS TESTING ✓

18/L FACILITATE DE-MOBILIZATION/DISPOSITION
- FACILITATE DOWNTIME *

L ACCOMODATE SIMULANT USE *

NOTES:

1 - GRADED APPROACH &/OR MINIMAL

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# REQUIREMENTS

FUNCTION NUMBER

HTI TEST FACILITY

- OPERATIONAL LIFE 2 YRS. (PHASE 1).

1 — VERIFY SYSTEM ~~IS OPERABLE~~ EGRESS & INGRESS.

2 — INCLUDES ALARM, DOSE REDUCTION ETC.

5 — VERIFY SYSTEM IS OPERABLE, IN TANK.

6 —
- 75"Φ MINIMUM: SEE ACTION ITEM #1
- ~~SHORT TERM~~ HTI DEPTH 40'
- LONG TERM (PHASE 2) 60' DEPTH
- DEPLOY SYSTEM THROUGH RISERS FROM 12"Φ TO 36"Φ
- SHALL NOT PRECLUDE MOCK-UP OF IN-TANK HARDWARE & EQUIP.
- WITHSTAND 30 TON DEAD LOAD

8 — EXCLUDE LIGHT

10 — NO CONFINED SPACE

11 — SIMILAR TO UTILITIES CURRENTLY AVAILABLE @ C-106, PROVIDED BY W-320.

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DRAFT

8:00 - WELCOME/INTRODUCTIONS
- AGENDA & PURPOSE

8:20 - CLARIFY LM/FD CORPORATE NEEDS/CONSTRAINTS

8:45 - CLARIFY HTI NEEDS/SCHEDULE

9:15 - DEVELOP/IDENTIFY TEST FACILITY FUNCTIONS & REQUIREMENTS
- USE "PARKING-LOTS" AS REQ'D

9:55 - BREAK

10:05 - CONTINUE F&Rs

11:30 - DEVELOP PATH FORWARD
- REVIEW/VALIDATE "PARKING-LOTS"
- DEVELOP ACTIONS TO PROCEED

12:00 - FINISH WITH ROUND-ROBIN
- LAST MINUTE ITEMS
- MEETING UTILITY

# SCOPE STATEMENT SHEET

## SCOPE

- HTI TEST FACILITY NEEDS & F&Rs IN SUPPORT OF C-106 TANK RETRIEVAL OR DESIGNATED ALTERNATIVE.

## OBJECTIVES

- DEVELOP COMMON VISION:
  - CLARIFY LM/FD CORPORATE NEEDS
  - CLARIFY HTI TEST FACILITY NEEDS
  - DEVELOP "DRAFT" SET OF F&Rs
- DEVELOP PATH FORWARD & TEAM APPROACH

## DELIVERABLES

- DRAFT SET/LISTINGS OF HTI TEST FACILITY F&Rs.
- ACTIONS TO PROCEED

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# APPENDIX B

# HANFORD TANKS INITIATIVE TEST FACILITY DIMENSIONS AND CONFIGURATION

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# APPENDIX B

# HANFORD TANKS INITIATIVE TEST FACILITY DIMENSIONS AND CONFIGURATION

## INTRODUCTION

This evaluation is to determine the minimum dimensions required for a test facility for testing the HTI waste retrieval systems.

The HTI test facility will be designed to test two different types of SST waste retrieval systems. Both of the waste retrieval systems that will be tested utilize a "confined sluicer" to break up the waste.

The first type of system is a vehicle-based waste retrieval system that utilizes a vehicle to move a sluicer inside the tank to retrieve the waste. In this concept, the confined sluicer may or may not be installed into the tank using the same riser as the vehicle. However, for the purpose of this study, it will be assumed that the vehicle and confined sluicer will be installed through a single 91.5-cm (36-in.) diameter riser located 1.5-m (5 ft) from the wall of the tank.

The arm-based waste retrieval system utilizes a manipulator arm type device to move the confined sluicer inside the tank. As in the previous concept, the confined sluicer may or may not be installed into the tank using the same riser as the arm. For the purpose of this study, it is assumed that the arm and confined sluicer will not be installed into the tank using the same riser. It is assumed that the confined slicer will be installed through a 91.5-cm (36-in.) diameter riser located 1.5 m (5 ft) from the tank wall and that the arm is installed through a 91.5-cm (36-in.) diameter riser located in the center of the tank.

There are various equipment combinations other than those discussed above. However, the above systems provide bounding requirements that encompass most of the possible waste retrieval equipment configurations currently being considered for waste retrieval. These two concepts are also those being explored in the HTI Project Design Concept Study effort.

## TESTING NEEDS

There are a number of testing needs for the test facility. These needs help define the size and configuration of the facility and are listed below.

1. Need to be able to test the arm and vehicle installation operations. Therefore, we must be able to install the vehicle and arm in the test facility using procedures similar to those that will be used at a real tank.

11.3 m (37 ft) below grade and at least one center and one near wall 91.4-cm (36-in.) risers. The actual test facility would have to be slightly larger (about 12.8 m [42 ft] x 22.9 m [75 ft]) than half a tank to allow demonstration of operations in the center riser.

3. Quarter tank

A quarter tank mockup of 241-C-106 would be the next best configuration and size facility, i.e., a 12.8-m (42-ft) segment of a tank with its bottom 11.3 m (37 ft) below grade and at least one 91.4-cm (36-in.) diameter center riser and one 91.4-cm (36-in.) diameter riser near wall. The actual test facility would have to be slightly larger (about 12.8 m [42 ft] x 12.8 m [42 ft]) than a quarter of a tank to allow demonstration of operations in the center riser.

4. Rectangular shape

A 12.8 m (42 ft) x 22.9 m (75 ft) rectangular shaped facility that mocks up 241-C-106 would be the next best configuration and size facility with its bottom 11.3 m (37 ft) below grade and at least one center and one near wall 91.4-cm (36-in.) risers. The test facility would have to be slightly larger (about 12.8 m (42 ft) x 22.9 m (75 ft) than half of a tank if center riser operations are going to be demonstrated. This shape allows testing of the retrieval systems in a space equivalent to half a tank.

5. Square shape

A 12.8 m (42 ft) x 12.8 m (42 ft) square shaped facility with its bottom 11.3 m (37 ft) below grade with two 91.4-cm (36-in.) diameter risers near a common wall would be the smallest configuration and sized facility that meets all of the HTI requirements. This shape allows testing of the retrieval systems in a space equivalent to a quarter of a tank.

## CONCLUSIONS

All of the Test Facility configurations listed above meet the needs for a test facility. The quarter tank and square shape do not allow vehicle testing at full 22.9 m (75 ft) deployment. However, vehicle testing at full deployment can be accomplished at other locations (i.e., Fuels and Materials Examination Facility [FMEF]) and is not a critical consideration. The square shaped facility is the least costly configurations and with cost as an important consideration, the square shape is the recommended test facility configuration unless a more cost effective existing facility can be located.

2. Need to test the arm operation at full arm extension (11.4 m [37.5 ft]).

3. Need to demonstrate that the arm and confined sluicer can work together as an integrated unit in a physical environment similar to that of a waste tank.

4. Need to demonstrate that the arm and confined sluicer can operate behind in-tank hardware.

5. Need to demonstrate umbilical management of the sluicer hoses and lines.

6. Need to demonstrate that the vehicle and confined sluicer can work together as an integrated unit in a physical environment similar to that of a waste tank.

7. Need to use the test facility for waste retrieval system training and equipment qualification testing.

One need not listed above is for the complete deployment of the vehicle system. This test would demonstrate the capability of the vehicle to drag the umbilical lines completely across the tank floor. This capability can be tested/demonstrated in other facilities and does not have to be performed in the HTI test facility.

The test facility will also require approximately 22.9 m (75 ft) of headroom above the two risers to accommodate the retrieval equipment and the mobile crane(s) used for installation of the arm-based system.

## TEST FACILITY CONFIGURATIONS

There are several facility configurations that would meet the testing needs for HTI. These run from a full 22.9-m (75-ft) diameter facility to 12.8 m (42 ft) by 12.8 m (42 ft) square facility. The depth is determined by the depth of tank 241-C-106 (for HTI). Five of the more logical configurations are (1) full 22.9-m (75-ft) diameter tank, (2) half tank, (3) quarter tank, (4) rectangular shape, and (5) square shape.

1. Full 22.9-m (75-ft) diameter tank

   A full mockup of tank 241-C-106 would be the most desirable (and most costly) configuration and size facility, i.e., a 22.9-m (75-ft) diameter tank with its bottom 11.3 m (37 ft) below grade and at least one 91.4-cm (36-in.) diameter center riser and one 91.4-cm (36-in.) diameter riser near the tank wall.

2. Half tank

   A half tank mockup of 241-C-106 would be the next most desirable configuration and size facility, i.e., half of a 22.9-m (75-ft) diameter tank with its bottom

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