H. Rossi, TRW, B1-45, 372-2466

These changes are required to maintain consistency with the revised System Specification for the SST System, HNF-3912, Rev. 1.

See attached Distribution Sheet, 1 copy each except as noted.
ENGINEERING CHANGE NOTICE

16. Design Verification Required
- Yes
- No

17. Cost Impact
- Engineering
  - Additional
    - $0
  - Savings
    - $0
- Construction
  - Additional
    - $0
  - Savings
    - $0

18. Schedule Impact (days)
- Improvement
- Delay

19. Change Impact Review: Indicate the related documents (other than the engineering documents identified on Side 1) that will be affected by the change described in Block 13. Enter the affected document number in Block 22.

- SDD/DD
- Functional Design Criteria
- Operating Specification
- Criticality Specification
- Conceptual Design Report
- Equipment Spec.
- Const. Spec.
- Procurement Spec.
- Vendor Information
- OM Manual
- FSAR/SAR
- Safety Equipment List
- Radiation Work Permit
- Environmental Impact Statement
- Environmental Report
- Environmental Permit
- Seismic/Stress Analysis
- Stress/Design Report
- Interface Control Drawing
- Calibration Procedure
- Installation Procedure
- Maintenance Procedure
- Engineering Procedure
- Operating Instruction
- Operating Procedure
- Operational Safety Requirement
- IEFD Drawing
- Cell Arrangement Drawing
- Essential Material Specification
- Fac. Proc. Samp. Schedule
- Inspection Plan
- Inventory Adjustment Request
- Tank Calibration Manual
- Health Physics Procedure
- Spares Multiple Unit Listing
- Test Procedures/Specification
- Component Index
- ASME Coded Item
- Human Factor Consideration
- Computer Software
- Electric Circuit Schedule
- ICRS Procedure
- Process Control Manual/Plan
- Process Flow Chart
- Purchase Requisition
- Tickler File

20. Other Affected Documents: (NOTE: Documents listed below will not be revised by this ECN.) Signatures below indicate that the signing organization has been notified of other affected documents listed below.

Document Number/Revision

21. Approvals

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DEPARTMENT OF ENERGY

Signature or a Control Number that tracks the Approval Signature

ADDITIONAL


A-7900-013-3 (10/97)
Performance Requirements for the Single-Shell Tank

C. E. Grenard (Numatec), and M. W. Leonard and H. Rossi (TRW)
Cogema Engineering Corporation, Richland, WA 99352
U.S. Department of Energy Contract DE-AC06-96RL13200

EDT/ECN: 650583 UC: 721
Org Code: 82400 Charge Code: CACN 106464
B&R Code: Total Pages: 61

Key Words: single-shell tank, SST, waste feed delivery, WFD, performance requirements

Abstract: This document provides performance requirements for the waste storage and waste feed delivery functions of the Single-Shell Tank (SST) System. The requirements presented here in will be used as a basis for evaluating the ability of the system to complete the single-shell tank waste feed delivery mission. They will also be used to select the technology or technologies for retrieving waste from the tanks selected for the single-shell tank waste feed delivery mission, assumed to be 241-C-102 and 241-C-104. This revision of the Performance Requirements for the SST is based on the findings of the SST Functional Analysis, and are reflected in the current System Specification for the SST System.

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PERFORMANCE REQUIREMENTS FOR THE
SINGLE SHELL TANK SYSTEM

September 1999

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Richland, Washington
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CONTENTS

1.0 INTRODUCTION ........................................................................................................................................ 1

2.0 PURPOSE AND SCOPE ................................................................................................................................. 2

3.0 PERFORMANCE REQUIREMENTS .................................................................................................................. 4

3.1 MAINTAIN SAFE WASTE WITHIN THE SINGLE SHELL TANK SYSTEM ...................................................... 6
   3.1.a Single Shell Tank System Capacity, Phase 1 .......................................................................................... 6
   3.1.1 Store Waste in the Single Shell Tank System ................................................................................. 7
   3.1.2 Distribute Utilities in the Single Shell Tank System ....................................................................... 7
   3.1.3 Support Single Shell Tank System .................................................................................................. 10

3.2 REMOVE WASTE FROM SINGLE SHELL TANKS FOR PHASE 1 WASTE FEED DELIVERY ....................... 10
   3.2.a Single Shell Tank Waste Removal Volume, Phase 1 Waste Feed Delivery ...................................... 10
   3.2.b C-104 WFD Duration ....................................................................................................................... 10
   3.2.c SST WFD Cleanliness Goal ............................................................................................................. 11
   3.2.d Tanks C-104/C-102 Unretrieved Waste Characteristics .................................................................. 11
   3.2.e Single-Shell Tank Retrieved Waste Characteristics ....................................................................... 11
   3.2.f Double-Shell Tank Dangerous Waste Restrictions ......................................................................... 12
   3.2.g Single Shell Tank Retrieved Waste Properties .............................................................................. 12

3.3 RETRIEVE SINGLE SHELL TANK WASTE CONCURRENT WITH PHASE 1 (PHMC) ......................................... 13
   3.3.a Single Shell Tank Phase 1 PHMC Waste Removal ........................................................................ 13
   3.3.b Single-Shell Tank Retrieval Cleanliness ......................................................................................... 13
   3.3.c Single-Shell Tank Unretrieved Waste Properties .......................................................................... 13
   3.3.d Single Shell Tank Retrieved Waste Characteristics ................................................................... 14
   3.3.e Double-Shell Tank Dangerous Waste Restrictions ...................................................................... 15

3.4 RETRIEVE WASTE FROM SINGLE SHELL TANKS, PHASE 2 (PRIV.) .......................................................... 15
   3.4.a Single Shell Tank Waste Removal Volume, Phase 2 ...................................................................... 15
   3.4.b Single-Shell Tank Retrieval Cleanliness ......................................................................................... 15
   3.4.c Single-Shell Tank Unretrieved Waste Properties .......................................................................... 16
   3.4.d Single Shell Tank Retrieved Waste Characteristics ................................................................... 16
   3.4.e Double-Shell Tank Dangerous Waste Restrictions ...................................................................... 17

3.5 DOUBLE-SHELL TANK SYSTEM INTERFACE REQUIREMENTS .................................................................. 17
   3.5.a DST Supernatant Volume Available For Phase 1 SST Waste Feed Delivery ................................... 17
   3.5.b DST Supernatant Volume For SST Retrieval Concurrent With Phase 1 ........................................ 17
   3.5.c DST Supernatant Volume For Phase 2 SST Retrieval .................................................................. 18
   3.5.d DST Supernatant Properties for All Single Shell Tank Retrieval Missions .................................. 18
3.6 CENTRAL PLATEAU ELECTRICAL DISTRIBUTION SYSTEM .................................. 18
  3.6.a Single-Shell Tank System Electrical Power for Safe Storage .................. 18
  3.6.b Single-Shell Tank System Electrical Power for Phase 1 ......................... 19
  3.6.c Single-Shell Tank System Electrical Power for Phase 2 ......................... 19

3.7 CENTRAL PLATEAU WATER SYSTEM ................................................................ 19
  3.7.a Single-Shell Tank System Raw Water ....................................................... 19
  3.7.b Single-Shell Tank System Raw Water ....................................................... 20

3.8 MASTER MONITOR AND CONTROL SYSTEM ......................................................... 20

4.0 REFERENCES ........................................................................................................... 21

APPENDIXES

A - ASSESSMENT OF SINGLE SHELL TANK
    SAFE STORAGE ELECTRICAL POWER REQUIREMENTS

B - QUANTITY OF HIGH-LEVEL WASTE FEED
    REQUIRED FROM 241-C-104 AND 241-C-102

C - DOUBLE-SHELL TANK SUPERNATANT VOLUME AVAILABLE
    FOR PHASE 1 SINGLE SHELL TANK WASTE FEED DELIVERY
## LIST OF TERMS

<table>
<thead>
<tr>
<th>Abbreviation</th>
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<tr>
<td>AGA</td>
<td>Alternative Generation Analysis</td>
</tr>
<tr>
<td>DQO</td>
<td>Data Quality Objective</td>
</tr>
<tr>
<td>DST</td>
<td>Double-Shell Tank</td>
</tr>
<tr>
<td>HLW</td>
<td>High-Level Waste</td>
</tr>
<tr>
<td>LDR</td>
<td>Land Disposal Restrictions</td>
</tr>
<tr>
<td>MAR</td>
<td>Mission Analysis Report</td>
</tr>
<tr>
<td>MS</td>
<td>Maintain Safe</td>
</tr>
<tr>
<td>MSC</td>
<td>Maintain Safe &amp; Compliant</td>
</tr>
<tr>
<td>MUST</td>
<td>Miscellaneous Underground Storage Tank</td>
</tr>
<tr>
<td>RPP</td>
<td>River Protection Project</td>
</tr>
<tr>
<td>PHMC</td>
<td>Project Hanford Management Contract</td>
</tr>
<tr>
<td>SE</td>
<td>Systems Engineering</td>
</tr>
<tr>
<td>SSC</td>
<td>Systems, Structures, and Components</td>
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<tr>
<td>SST</td>
<td>Single Shell Tank</td>
</tr>
<tr>
<td>SWL</td>
<td>Salt Well Liquid</td>
</tr>
<tr>
<td>TBD</td>
<td>To be Defined</td>
</tr>
<tr>
<td>TBR</td>
<td>To be Refined</td>
</tr>
<tr>
<td>TFS</td>
<td>Tank Farm System</td>
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<td><em>Hanford Federal Facility Agreement and Consent Order</em></td>
</tr>
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<td>Tank Waste Remediation System</td>
</tr>
<tr>
<td>WFD</td>
<td>Waste Feed Delivery</td>
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PERFORMANCE REQUIREMENTS FOR THE
SINGLE SHELL TANK SYSTEM

1.0 INTRODUCTION

The Tank Farm System (TFS) contains waste received from various radioactive, chemical waste processing facilities at Hanford. The mission of the River Protection Project (RPP), (Acree 1998) is to remove, treat and dispose of this waste. The primary segments within the TFS are the double-shell tank (DST) and the Single Shell tank (SST) systems. The DST System contains 28 DSTs in six tank farms. This system receives waste from various waste generators on the Hanford Site. The SST System contains 149 SSTs in 12 tank farms. Both systems include associated miscellaneous underground storage tanks (MUSTs), transfer lines, and other systems, structures, and components (SSCs) that have or will support the SST mission. This document provides performance requirements for the retrieval and transfer of waste from the SSTs to the DST System, where it will be blended with other waste, characterized, and chemically adjusted before being sent to a treatment facility.

The SST System has a storage capacity of 355,000 m$^3$ (94 Mgal) and contains 136,000 m$^3$ (36 Mgal) waste (Hanlon 1998). This waste volume does not include waste contained in the MUSTs that have been assigned to the SST System. By the time Waste Feed Delivery and/or SST Retrieval phases begin, drainable liquids will have been removed from the SSTs to the extent possible, leaving only precipitated salts (i.e., salt cake) and sludges.

Waste will be retrieved from the SSTs during three distinct periods (Stokes 1998). The first period (Remove Waste from Single Shell Tanks for Phase 1 Waste Feed Delivery) will remove waste from the 241-C-104 and 241-C-102 single shell tanks for processing as high-level waste (HLW) feed in the Phase 1 waste vitrification facility. Closure criteria will not be available until approximately 2005, and are therefore not included as design criteria for Phase 1 SST Waste Feed Delivery systems.

During the second period (Retrieve Single Shell Tank Waste Concurrent with Phase 1 (Project Hanford Management Contract (PHMC)), the RPP contractor will be responsible for retrieving waste from selected SSTs to develop or demonstrate SST retrieval technologies for use during Phase 2 SST waste retrieval. This waste will be used to support either the extended operation of the Phase 1 treatment facility, or as the initial feed for the Phase 2 waste treatment facility. The quantity of waste that can be retrieved will be limited by DST space availability. During this stage, sufficient waste will be removed from each SST (i.e., the 100 series and or the small diameter, 200 series tanks) to allow tank closure. Waste may be retrieved from some MUSTs during this phase.

The plan for the third and final period (Retrieve Waste from Single Shell Tanks, Phase 2, (Private Contractors (Priv.)) is to use private contractors to retrieve the remaining waste from the SST System. Waste will be removed from both 100 and 200 series tanks and associated MUSTs and piping. Sufficient waste must be removed to permit tank farm closure. Per the Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement) (Ecology et al. 1996), SST waste retrieval must be completed by the end of September 2018.
2.0 PURPOSE AND SCOPE

A functional analysis (Leonard et al. 1999) of the SST System was performed which resulted in the SST System function hierarchy shown in Figure 2.0-1. As shown, the analysis identified four top-level functions (shaded boxes) to be performed by the SST System. The waste storage (Maintain Safe (MS) Waste w/in the SST System) and waste feed delivery (Remove Waste from SSTs for Phase 1 WFD) functions were further decomposed to an additional level. Note that lower level waste feed delivery functions are based on assumptions made in the functional analysis, and require further architectural decisions that will be based on future alternative generation analysis (AGA). Similarly, the remaining functions shown under Retrieve SST Waste require further study, and will be decomposed when Phase 1 and Phase 2 SST Retrieval baselines are established.

The SST System functional analysis also included a function for salt well liquid (SWL) pumping. However this document does not discuss SWL pumping requirements, because the basis has already been established for the SWL program and SWL pumping equipment will be completed before SST waste feed delivery begins.

This document provides the basis/rationale for the performance requirements for the above-described waste storage and waste feed delivery functions, which are well defined at this time. It will be further revised to include requirements for Phase 1 and Phase 2, SST Waste Retrieval as the scope of each period is established.
Figure 2.0-1. Single Shell Tank System Function Tree.

Legend:
- Site SE Handshake Function
- Top-Level SST Function
- SST System Sub-Function

AGA = Alternative Generation Analysis
DST = Double Shell Tank
MS = Maintain Safe
MSC = Maintain Safe & Compliant
SE = Systems Engineering
SST = Single Shell Tank
SWL = Salt-well Liquid
TFS = Tank Farm System
tsd = RDD-100 Database Hierarchial Numbering System Prefix
PHMC = Project Hanford Management Contractor
Priv. = Private Contractor, non-PHMC
WFD = Waste Feed Delivery

Note: The tsd. number in each box is the function’s hierarchial number assigned in the RDD-100 database.

*Requirements not included in this document.
**Not included in the System Specification for the SST System; pending future AGAs. Requirements therefore cannot be included in this document.
3.0 PERFORMANCE REQUIREMENTS

This document provides performance requirements for the SST waste storage and waste feed delivery functions. It will be updated with performance requirements for the remaining two waste retrieval functions when plans for processing waste during these periods are further defined.

The requirements identified below are at various levels of maturity. Requirements that require additional analysis for validation are marked as follows:

- A TBR (to be refined) identifies requirements based on technical and programmatic assumptions that cannot be validated at this time. TBR requirements are considered to be sufficiently mature for preliminary design.

- A TBD (to be defined) identifies requirements that either cannot be quantified or the quantification that can be done would be inadequate for design.

Factors that prevent validation or quantification of TBR and TBD requirements include uncertainties in the Phase 1 LAW/HLW plant contract, the undefined scope of SST Retrieval concurrent with both Phase 1 and for Phase2, and the incompleteness of characterization data to define waste properties. Engineering studies are required to resolve the TBR and TBD requirements. Issues describing the problems are provided for TBR and TBD requirements.

This document defines the applicable performance requirements for the functions listed and described in Section 2.2 of the SST System functional analysis report (Leonard et al. 1999). A rationale and a description of germane issues are also provided for each requirement. It should be noted that functional requirements are not included in this document, but are included in the functional analysis document referenced above.

The SST System functional analysis also defined the major interfaces between the SST System and other major facilities/systems as shown in Figure 3.0-1. The most complex SST System interface is with the DST System. During waste removal, supernatant or inhibited water from the DST System will be used to dissolve or break up SST waste, and/or transfer it to a receiver DST. During all modes of operation, SST waste samples will be obtained by the waste characterization system for analysis of its chemical and physical properties. Likewise, electrical power and raw water from site utilities will be distributed within the SST system during all modes of operation, as required to support the SST mission. The quantifiable performance requirements associated with these external interface requirements are discussed in this document.
Figure 3.0-1. Single Shell Tank System Interface Diagram.

- Master Monitor and Control System
- Tank Waste Sampling System
- Central Plateau Electrical System
- Single-Shell Tank System
- Central Plateau Water System
- Double-Shell Tank System

Legend:
- RPP Facility
- Non-RPP Facility
- Non-RPP Facility Accepting Secondary Waste Stream

hsem = Hanford Site Environmental Management System
RPP = River Protection Project
3.1 MAINTAIN SAFE WASTE WITHIN THE SINGLE SHELL TANK SYSTEM

3.1.a Single Shell Tank System Capacity, Phase 1

The SST system shall continue to store up to 134 ML (35.3 Mgal) of waste.

Rationale: Table 1 shows both the capacity of each SST and the volume of waste in each tank farm. Data for this table was obtained from the Waste Tank Summary Report (Hanlon 1998). The Wyden Bill (Public Law 101-510) forbids adding waste to the tanks. Therefore, only the 134 ML (35.3 Mgal) of waste currently in the system can be stored in the SST System.

Table 1. Tank Farm Capacity and Waste Volume.

<table>
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<tr>
<th>Tank Farm</th>
<th>Tank Capacity (gallons)</th>
<th>No. of Tanks</th>
<th>Total Capacity (gallons)</th>
<th>Waste Volume (gallons)</th>
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<td>4,000,000</td>
<td>906,000</td>
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<tr>
<td>C</td>
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<td>12</td>
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<tr>
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<td>12</td>
<td>6,360,000</td>
<td>2,057,000</td>
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<tr>
<td></td>
<td>55,000</td>
<td>4</td>
<td>220,000</td>
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<td>6,360,000</td>
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Issue: It is not known whether the use of fluids for retrieving waste in SSTs will be allowed by WA State regulators. There is currently a prohibition to liquid addition to SSTs. However, most retrieval methods available for retrieving waste from SSTs require the use of a liquid (e.g. water or DST supernatants).
3.1.1 Store Waste in the Single Shell Tank System

3.1.1.a Single Shell Tank Capacity.

The quantity of waste stored in each SST shall not exceed the values identified in Table E-6 of HNF-EP-0182-127 Waste Tank Summary Report for Month Ending October 31, 1998.

**Rationale:** The best estimates of the volume of waste in each SST are provided in Table E-6 of HNF-EP-0182-127 (Hanlon 1998). No waste may be added to SSTs for storage.

**Issue:** It is not known whether the use of fluids for retrieving waste in SSTs will be allowed by WA State regulators. There is currently a prohibition to liquid addition to SSTs. However, most retrieval methods available for retrieving waste from SSTs require the use of a liquid (e.g. water or DST supernatants).

3.1.2 Distribute Utilities in the Single Shell Tank System

3.1.2.a Single Shell Tank Safe Storage Electrical Power.

The system shall be capable of distributing the minimum electrical power specified below to each tank farm through the year 2028. This power is received as 480V, 3 phase electrical power and transformed and distributed as needed.

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<td>AX Farm</td>
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<td>341 kVA</td>
<td>B Farm</td>
<td>84 kVA</td>
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<td>50 kVA</td>
<td>BY Farm</td>
<td>497 kVA</td>
</tr>
<tr>
<td>S Farm</td>
<td>235 kVA</td>
<td>SX Farm</td>
<td>223 kVA</td>
</tr>
<tr>
<td>U Farm</td>
<td>193 kVA</td>
<td>T Farm</td>
<td>61 kVA</td>
</tr>
<tr>
<td>TX Farm</td>
<td>33 kVA</td>
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<td>79 kVA</td>
</tr>
</tbody>
</table>

Note: The power requirements specified above are sufficient for the safe storage portion of the SST System mission. Power for waste retrieval will be in addition to safe storage power requirements.

**Rationale:** A study was performed to evaluate SST, safe storage power requirements (Appendix A). These are listed above. Safe storage electrical power is currently required and will continue to be required for until waste retrieval is complete for each tank farm. Power for waste feed delivery, and Phase 1 and Phase 2 SST Retrieval is needed for a shorter duration and is identified separately.

**Issue:** The specified power requirement is based on an estimate and is believed to be conservative. A more detailed study is needed to verify safe storage power requirements.
3.1.2.b Single Shell Tank Waste Feed Delivery Retrieval Electrical Power.
The system shall be capable of distributing an additional TBD kW of TBD V, 3 phase electrical power to the C Farm during Phase 1 WFD. This power is added to that specified in 3.1.2.a.

Rationale: Electric power requirements in support of waste feed delivery are process dependant and will be established subsequent to process selection. Current schedules show retrieval from C Tank Farm starting in March 2005 and completing in 2009. Electric power will need to be available 1 year earlier to support startup testing.

Issue: The power requirements for SST WFD have not been established. These requirements are process and technology dependent. Subsequent to the Project W-523 AGA, which will evaluate alternative retrieval processes/technologies, this electrical power requirement can be bounded.

An analysis is required to define the power need for the SST System C Tank Farm for the period of Phase 1 WFD.

3.1.2.c Single Shell Tank Retrieval Electrical Power (Concurrent with Phase 1).
The system shall be capable of distributing additional electrical power at TBD V to TBD Tank Farms concurrent with Phase 1 as specified below:

TBD

This power is in addition to that specified in 3.1.2.a.

Rationale: SST retrieval electrical power requirements cannot be assessed until the requirements for SST retrieval concurrent with Phase 1 are established.

Issue: The power requirements for supplying 3 phase electrical power to selected Tank Farms for the period concurrent with Phase 1 have not been established.

An analysis is required to define the power needs for the selected Tank Farms for the period specified above.

3.1.2.d Single Shell Tank Phase 2 Retrieval Electrical Power.
The system shall be capable of distributing additional electrical power at TBD V to the TBD Tank Farms during Phase 2 as specified below:

TBD

This power is in addition to that specified in 3.1.2.a.

Rationale: SST retrieval electrical power requirements cannot be assessed until the requirements for Phase 2 SST retrieval are established.
Issue: Electrical power needs for SST Retrieval for Phase 2 have not yet been determined. A requirements analysis must be performed to quantify SST Retrieval power needs once a Phase 2 retrieval strategy and system concept have been identified.

3.1.2.e Single Shell Tank Raw Water Phase 1 WFD.
The system shall be capable of distributing TBD gpm of water in C farm at TBD pressure during Phase 1 WFD.

Rationale: Raw water is needed for flushing the transfer lines when the waste retrieval system is shut down. The volume of water required has not been defined.

Issue: The quantity of water required to flush the transfer lines in C Farm when WFD waste removal equipment is shutdown has not been established. This requirement is process/technology dependent and can be bounded subsequent to the Project W-523 AGA.

3.1.2.f SST Raw Water, Concurrent with Phase 1.
The system shall be capable of distributing raw water to support SST retrieval in TBD farms, concurrent with Phase 1, as specified below:

TBD L/min (gal/min)

Rationale: Raw water will be needed during SST retrieval concurrent with Phase 1 for flushing the transfer lines when waste retrieval systems are shut down. The volume of water required has not been established.

Issue: Raw water needs for SST retrieval--Concurrent with Phase 1 and Phase 2--have not yet been determined. The quantities of water to flush transfer lines at unknown SST Farm locations have not yet been determined.

3.1.2.g Single Shell Tank Raw Water, Phase 2.
The system shall be capable of distributing raw water to support SST retrieval during Phase 2, as specified below:

TBD L/min (gal/min)

Rationale: Raw water is needed for flushing transfer lines when the Phase 2 waste retrieval systems are shut down. The volume of water required and the rate at which it needs to be delivered have not been established.

Issue: Raw water needs for SST retrieval--Concurrent with Phase 1 and Phase 2--have not yet been determined. The quantities of water to flush transfer lines at unknown SST Farm locations have not yet been determined.
3.1.3 Support Single Shell Tank System

Reserved

3.2 REMOVE WASTE FROM SINGLE SHELL TANKS FOR PHASE 1 WASTE FEED DELIVERY

3.2.a Single Shell Tank Waste Removal Volume, Phase 1 Waste Feed Delivery

The system shall be capable of removing the quantities of existing waste inventory specified below from the designated SSTs and delivering them to either Tank AZ-101 or Tank AY-102, at the discretion of the system operator.

<table>
<thead>
<tr>
<th>Single Shell Tank</th>
<th>Minimum Volume</th>
<th>Maximum Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-104</td>
<td>0.81 ML (212 kgal)</td>
<td>Sec 3. 2.b</td>
</tr>
<tr>
<td>C-102</td>
<td>1.29 ML (339 kgal)</td>
<td>12 Months</td>
</tr>
</tbody>
</table>

**Rationale:** The specified volume is the minimum from each tank required to support Phase 1 waste feed delivery (Appendix B). The system must be capable of delivering at least this quantity of waste to the receipt tanks to support blending with waste that will be in them.

**Issue:** The volumes of waste to be retrieved from 241-C-104 and 241-C-102 are based on the assumption that soluble and insoluble waste will be retrieved at the same rate. A wet retrieval process, if selected, may retrieve soluble waste at a higher rate than insoluble waste. As a result a higher percentage of waste would need to be retrieved to obtain the same quantity of insoluble solids.

3.2.b C-104 WFD Duration

The system shall be capable of removing the first 0.40 ML (106 Kgal) of waste from C-104 in 6 months (maximum) with the balance of the waste removed in an additional 8 months (maximum).

**Rationale:** The receipt tank is the first tank to be sent for HLW processing and will not be available to support earlier retrieval of 241-C-104. The 6-month delivery is the expected time available to support blending with waste in time to support HLW processing. The 8-month (TBR) delivery is the expected time available to support blending with waste in another tank in time to support HLW processing.

**Issue:** The 8-month delivery needs to be reviewed and verified.
3.2.c SST WFD Cleanliness Goal

In addition to meeting the above waste removal requirements, the goal of the system is to leave no more than 10.2 kL (360 cu. ft.) of waste in C-104 and C-102 (TBR).

**Rationale:** Retrieval to achieve this volume of residual waste in each tank has been specified in the Tri-Party Agreement as necessary for closure. Although retrieval to this extent is not necessary for waste feed delivery, achievement of this level could significantly reduce program costs by eliminating a need to re-enter the tank with another system for terminal clean out.

**Issue:** Cleanliness requirements for closure have not been established through the RCRA process. This process must be completed to confirm that the specified cleanliness level is necessary and sufficient for tank farm closure.

3.2.d Tanks C-104/C-102 Unretrieved Waste Characteristics.

The system shall be capable of removing waste from Tanks C-104/102 with the following properties:

<table>
<thead>
<tr>
<th>Property</th>
<th>C-104</th>
<th>C-102</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density</td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td>Viscosity</td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td>Shear Strength</td>
<td>TBD</td>
<td>TBD</td>
</tr>
</tbody>
</table>

**Rationale:** The waste properties are necessary to support design of the waste retrieval system.

**Issue:** Waste characteristics are important factors in estimating retrieval effectiveness of particular technologies. However, the characteristics of C-104/102 waste have not yet been specified in the SST System Spec.

Determine the characteristics of the waste in C-104 and C-102 and include in the SST System Spec. The best basis estimate may have some information. C-104/102 core samples are available in the characterization lab. Document analysis results as part of the waste Analysis Plan.

3.2.e Single-Shell Tank Retrieved Waste Characteristics

The system shall be capable of adjusting the waste properties to satisfy the requirements of HNF-SD-WM-DQO-001 Rev.2 (Fowler 1998), and HNF-SD-WM-TSR-006, Administrative Control (AC), Rev. O-S, (Noorani 1999), 5.7, 5.8, and 5.12 (AB). In case of conflicting requirements, the requirements in HNF-SD-WM-TSR-006, Rev. O-S will take precedence.

**Rationale:** The system DQO and TSRs identified above contain the full set of waste compatibility requirements for accepting waste into the DST System from the SST
System except for the Land Disposal Restriction (LDR) numbers that are identified below. A new requirement has been written to reflect the land disposal number restrictions in WHC-SD-WM-EV-053 (Mulkey 1998) (See 3.2.f). Requirements in the TSRs are in addition to the normal compatibility requirements.

**Issue:** Properties for waste retrieved from SSTs have not been specified by the current revision of the DQO or by the TSR. The current revision of the DQO treats only those transfers that are:

1. Liquid with <5 percent solids by volume
2. Saltwell liquids
3. Evaporator slurry with a specific gravity of <1.41

An analysis must be performed to establish the appropriate safety limits/criteria for transferring retrieved SST waste that may not meet the above criteria into the DST System. Revise HNF-SD-WM-DQO-001 and HNF-SD-WM-TSR-006.

### 3.2.f Double-Shell Tank Dangerous Waste Restrictions

The SST System shall be capable of adjusting, as necessary, waste sent to the DST System to comply with DOE/RL-88-21, *Hanford Facility Dangerous Waste Permit* (DOE-RL 1998).

**Rationale:** The LDR numbers identifying the dangerous wastes that may be stored in the DST system are identified in the referenced permit. The DST System cannot accept waste with LDR numbers other than those identified in the permit.

**Issue:** The SST system may contain wastes with LDR numbers other than those identified in the DST System permit. The DST System cannot accept these wastes until the permit is revised for the dangerous waste treated.

### 3.2.g Single Shell Tank Retrieved Waste Properties.

The SST System shall be capable of adjusting the waste properties to the values specified below:

- **Specific Gravity** less than or equal to 1.2
- **Solids Content** less than or equal to 30 percent (vol.)
- **Viscosity** less than or equal to 93.45 cP
- **Particle Size** TBD

**Rationale:** The waste properties are necessary to support design of the waste retrieval system.

**Issue:** Allowable particle size and particle size distribution for retrieved SST waste is unknown at this time. This information is needed to fully specify the capabilities of the
SST waste feed delivery system so that it will perform within the constraints of existing system elements.

Perform an analysis to establish the appropriate particle size limits for waste transferred to the DST System via existing DST System piping and/or the above ground piping installed for C-106 sluicing.

3.3 RETRIEVE SINGLE SHELL TANK WASTE CONCURRENT WITH PHASE 1 (PHMC)

3.3.a Single Shell Tank Phase 1 PHMC Waste Removal

The system shall be capable of removing at least TBD ML (TBD kgal) of waste from TBD SSTs and delivering it to TBD DSTs.

**Rationale:** The scope of the *Remove SST Waste Concurrent with Phase 1 (PHMC)* has not been established. A study is needed to define the scope of this function. This study shall evaluate DST System storage space and Phase 2 processing needs to determine the quantity and type of waste to be retrieved from the SSTs to support the start of Phase 2 waste processing, and will evaluate the need for technology demonstrations. Based on this information it will define the types and volumes of waste to be retrieved by the PHMC.

**Issue:** A strategy for SST waste retrieval concurrent with Phase 1 has not yet been established. Once this strategy has been established a requirements analysis must be performed to quantify the required retrieval rate, total volume and the locations from which the waste will be retrieved.

3.3.b Single-Shell Tank Retrieval Cleanliness

The system shall be capable of leaving no more than 10.2 kL (360 cu. ft.) of waste in the 100 series SSTs and no more than 0.85 kL (30 cu. ft.) of waste in the 200 series SSTs (TBR).

**Rationale:** Retrieval to achieve this volume of residual waste in each tank has been specified in the Tri-Party Agreement as necessary for closure.

**Issue:** Cleanliness requirements for closure have not been established through the RCRA process. This process must be completed to confirm that the specified cleanliness level is necessary and sufficient for tank farm closure.

3.3.c Single-Shell Tank Unretrieved Waste Properties

The system shall be capable of retrieving waste from selected SSTs with the following properties:
Density: TBD
Viscosity: TBD
Shear Strength: TBD

**Rationale:** The waste properties are necessary to support design of the waste retrieval system.

**Issue:** Selection of SSTs for retrieval by the PHMC concurrent with Phase 1 processing and those retrieved during Phase 2 by the Private vendor has not yet been finalized. Once these tanks have been selected, waste characterization data will need to be evaluated to define the waste properties in these tanks. If available data is insufficient, additional sampling and analysis will be required. The waste properties are necessary to ensure the retrieval system designed will be capable of retrieving the waste within the time specified.

### 3.3.d Single Shell Tank Retrieved Waste Characteristics

The system shall be capable of adjusting the waste properties to satisfy the requirements of HNF-SD-WM-DQO-001 Rev.2 (Fowler 1998), and HNF-SD-WM-TSR-006, Administrative Control (AC), Rev. O-S, (Noorani 1999), 5.7, 5.8, and 5.12 (AB). In case of conflicting requirements, the requirements in HNF-SD-WM-TSR-006, Rev. O-S will take precedence.

**Rationale:** The system DQO and TSRs identified above contain the full set of waste compatibility requirements for accepting waste into the DST System from the SST System. The letters in HNF-2288 (Conrads 1998), Section E, apply only to waste transferred into the DST System from outside the RPP. WHC-SD-WM-EV-053 (Mulkey 1998) repeatedly references HNF-SD-WM-DQO-001 (Fowler 1998) as the source of the compatibility requirements. A new requirement has been written to reflect the land disposal number restrictions in WHC-SD-WM-EV-053 (Mulkey 1998) (See 3.2.f). Requirements in the TSRs are in addition to the normal compatibility requirements.

**Issue:** Properties for waste retrieved from SSTs have not been specified by the current revision of the DQO or by the TSR. The current revision of the DQO treats only those transfers that are:

1. Liquid with <5 percent solids by volume
2. Saltwell liquids
3. Evaporator slurry with a specific gravity of <1.41

An analysis must be performed to establish the appropriate safety limits/criteria for transferring retrieved SST waste that may not meet the above criteria into the DST System. Revise HNF-SD-WM-DQO-001 and HNF-SD-WM-TSR-006.
3.3.e Double-Shell Tank Dangerous Waste Restrictions

The SST System shall be capable of adjusting, as necessary, waste sent to the DST System to comply with DOE/RL-88-21, *Hanford Facility Dangerous Waste Permit* (DOE-RL 1998).

**Rationale:** The LDR numbers identifying the dangerous wastes that may be stored in the DST system are identified in the referenced permit. The DST System cannot accept waste with LDR numbers other than those identified in the permit.

**Issue:** The SST system may contain wastes with LDR numbers other than those identified in the DST System permit. The DST System cannot accept these wastes until the permit is revised for the dangerous waste treated.

3.4 RETRIEVE WASTE FROM SINGLE SHELL TANKS, PHASE 2 (PRIV.)

3.4.a Single Shell Tank Waste Removal Volume, Phase 2

The system shall be capable of retrieving at least TBD ML (TBD kgal) of waste out of TBD tanks and delivering it to TBD DSTs.

**Rationale:** The scope of the *Remove Waste from Remaining SSTs, Phase 2 (Priv.*) has not been established. A study is needed to define the scope of this function. This study shall evaluate Phase 2 processing needs to determine how much waste and the type of waste to be retrieved from the SSTs to support Phase 2 waste processing.

**Issue:** The Phase 2 SST System Retrieval Performance and Interface Requirements are currently listed as TBD and still need to be defined.

Requirements analysis is needed to define all the Phase 2 SST System Performance and Interface Requirements after the SST Retrieval Strategy is defined.

3.4.b Single-Shell Tank Retrieval Cleanliness

The system shall be capable of leaving no more than 10.2 kL (360 cu. ft.) of waste in the 100 series SSTs and no more than 0.85 kL (30 cu. ft.) of waste in the 200 series SSTs (TBR).

**Rationale:** Retrieval to achieve this volume of residual waste in each tank is specified in the Tri-Party Agreement as necessary for closure.

**Issue:** Cleanliness requirements for closure have not been established through the RCRA process. This process must be completed to confirm that the specified cleanliness level is necessary and sufficient for tank farm closure.
3.4.c Single-Shell Tank Unretrieved Waste Properties

The system shall be capable of retrieving waste from selected SSTs with the following properties:

- Density: TBD
- Viscosity: TBD
- Shear Strength: TBD

**Rationale:** The waste properties are necessary to support design of the waste retrieval system.

**Issue:** Selection of SSTs for retrieval by the PHMC concurrent with Phase 1 processing and those retrieved during Phase 2 by the Private vendor has not yet been finalized. Once these tanks have been selected, waste characterization data will need to be evaluated to define the waste properties in these tanks. If available data is insufficient, additional sampling and analysis will be required. The waste properties are necessary to ensure the retrieval system designed will be capable of retrieving the waste within the time specified.

3.4.d Single-Shell Tank Retrieved Waste Characteristics

The system shall be capable of adjusting the waste properties to satisfy the requirements of HNF-SD-WM-DQO-001 Rev.2 (Fowler 1998), and HNF-SD-WM-TSR-006, Administrative Control (AC), Rev. 0-S, (Noorani 1999), 5.7, 5.8, and 5.12 (AB). In case of conflicting requirements, the requirements in HNF-SD-WM-TSR-006, Rev. 0-S will take precedence.

**Rationale:** The system DQO and TSRs identified above contain the full set of waste compatibility requirements for accepting waste into the DST System from the SST System. The letters in HNF-2288 (Conrads 1998), Section E, apply only to waste transferred into the DST System from outside the RPP. WHC-SD-WM-EV-053 (Mulkey 1998) repeatedly references HNF-SD-WM-DQO-001 (Fowler 1998) as the source of the compatibility requirements. A new requirement has been written to reflect the land disposal number restrictions in WHC-SD-WM-EV-053 (Mulkey 1998) (See 3.2.f). Requirements in the TSRs are in addition to the normal compatibility requirements.

**Issue:** Properties for waste retrieved from SSTs have not been specified by the current revision of the DQO or by the TSR. The current revision of the DQO treats only those transfers that are:

1. Liquid with <5 percent solids by volume
2. Saltwell liquids
3. Evaporator slurry with a specific gravity of <1.41
HNF-3829
Revision 1

An analysis must be performed to establish the appropriate safety limits/criteria for transferring retrieved SST waste that may not meet the above criteria into the DST System. Revise HNF-SD-WM-DQO-001 and HNF-SD-WM-TSR-006.

3.4.e Double-Shell Tank Dangerous Waste Restrictions

The SST System shall be capable of adjusting, as necessary, waste sent to the DST System to comply with DOE/RL-88-21, Hanford Facility Dangerous Waste Permit (DOE-RL 1998)

**Rationale:** The LDR numbers identifying the dangerous wastes that may be stored in the DST system are identified in the referenced permit. The DST System cannot accept waste with LDR numbers other than those identified in the permit.

**Issue:** The SST system may contain wastes with LDR numbers other than those identified in the DST System permit. The DST System cannot accept these wastes until the permit is revised for the dangerous waste treated.

3.5 DOUBLE-SHELL TANK SYSTEM INTERFACE REQUIREMENTS

3.5.a DST Supernatant Volume Available For Phase 1 SST Waste Feed Delivery

The following table defines the maximum supernatant volumes available from the DST System at the supernatant source tank specified:

<table>
<thead>
<tr>
<th>SST Requiring Supernatant</th>
<th>Available Volume</th>
<th>Supernatant Source Tank</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-104</td>
<td>1.20 ML (318 kgal)</td>
<td>AY-102</td>
</tr>
<tr>
<td>C-102</td>
<td>2.11 ML (558 kgal)</td>
<td>AY-102</td>
</tr>
</tbody>
</table>

**Rationale:** See Appendix C.

**Issue:** It is not known whether the use of fluids for retrieving waste in SSTs will be allowed by WA State regulators. There is currently a prohibition to liquid addition to SSTs. However, most retrieval methods available for retrieving waste from SSTs require the use of a liquid (e.g. water or DST supernatants).

3.5.b DST Supernatant Volume For SST Retrieval Concurrent With Phase 1

The available supernatant volume and DST source tank(s) are TBD. (Requirements for SST Retrieval Concurrent with Phase 1 will be defined when the SST retrieval strategy is defined).
Rationale: TBD

Issue: The DST Supernatant Volume requirement for SST Retrieval Concurrent with Phase 1 is currently listed as TBD and still needs to be defined.

Requirements analysis is needed to define the DST Supernatant Volume requirement for SST Retrieval Concurrent with Phase 1 after the SST Retrieval Strategy is defined.

3.5.c DST Supernatant Volume For Phase 2 SST Retrieval

The available supernatant volume and DST source tank(s) are TBD. (Requirements for Phase 2 will be defined when the SST retrieval strategy is defined).

Rationale: TBD

Issue: The SST System Retrieval Performance and Interface Requirements are currently listed as TBD and still needs to be defined.

Requirements analysis is needed to define all the Phase 2 SST System Performance and Interface Requirements after the SST Retrieval Strategy is defined.

3.5.d DST Supernatant Properties for All Single Shell Tank Retrieval Missions

The following table contains the supernatant properties, as provided by the DST System, for all SST retrieval missions:

TBD

Rationale: TBD

Issue: The DST Supernatant Properties requirement for all SST Retrieval Missions is currently listed as TBD and still needs to be defined.

Requirements analysis is needed to define the DST Supernatant Properties requirement for all SST Retrieval Missions.

3.6 CENTRAL PLATEAU ELECTRICAL DISTRIBUTION SYSTEM

3.6.a Single-Shell Tank System Electrical Power for Safe Storage

The Central Plateau Electrical System shall provide at least 2,100 kVA to the SST System for safe storage through the year 2028.

Rationale: This is the sum total of the power required by each tank farm identified in paragraph 3.1.2.a.
Issue: The specified power requirement is based on an estimate and is believed to be conservative. A more detailed study is needed to verify safe storage power requirements.

3.6.b Single-Shell Tank System Electrical Power for Phase 1

The Central Plateau Electrical System shall provide at least an additional TBD kVA to the SST System for Phase 1. This power is in addition to that specified in Section 3.6.a

Rationale: This is the sum total of the power required by each tank farm identified in paragraphs 3.1.2.b and 3.1.2.c. SST Phase 1 retrieval for WFD and SST retrieval concurrent with Phase 1 may overlap and, thus, sufficient power must be available to support both.

Issue: The power requirements for SST WFD have not been established. These requirement are process and technology dependent. Subsequent to the Project W-523 AGA, which will evaluate alternative retrieval processes/technologies, this electrical power requirement can be bounded.

An analysis is required to define the power need for the SST System C Tank Farm for the period of Phase 1 WFD.

3.6.c Single-Shell Tank System Electrical Power for Phase 2

The Central Plateau Electrical System shall provide at least an additional TBD kVA to the SST System for Phase 2. This power is an addition to that specified in Section 3.6.a

Rationale: This is the sum total of the power required each tank farm identified in paragraph 3.1.2.d.

Issue: Electrical power needs for SST Retrieval for Phase 2 have not yet been determined. A requirements analysis must be performed to quantify SST Retrieval power needs once a Phase 2 retrieval strategy and system concept have been identified.

3.7 CENTRAL PLATEAU WATER SYSTEM

3.7.a Single-Shell Tank System Raw Water

The Central Plateau Raw Water System shall provide at least TBD L/min (gal/min) to the SST System during Phase 1.

Rationale: This is the sum total of the raw water required for each tank farm identified in paragraphs 3.1.2.b and 3.1.2.c. SST Phase 1 retrieval for WFD and SST retrieval
concurrent with Phase 1 may overlap and, thus, sufficient power must be available to support both.

**Issue:** The quantity of water required to flush the transfer lines in C Farm when WFD waste removal equipment is shutdown has not been established. This requirement is process/technology dependent and can be bounded subsequent to the Project W-523 AGA.

Raw water needs for SST retrieval--Concurrent with Phase 1 and Phase 2--have not yet been determined. The quantities of water to flush transfer lines at unknown SST Farm locations have not yet been determined.

### 3.7.b Single-Shell Tank System Raw Water

The Central Plateau Raw Water System shall provide at least TBD L/min (gal/min) to the SST System during Phase 2.

**Rationale:** This is the sum total of the raw water required for each tank farm identified in paragraph 3.1.2.d.

**Issue:** Raw water needs for SST retrieval--Concurrent with Phase 1 and Phase 2--have not yet been determined. The quantities of water to flush transfer lines at unknown SST Farm locations have not yet been determined.

### 3.8 MASTER MONITOR AND CONTROL SYSTEM

TBD
4.0 REFERENCES


APPENDIX A

ASSESSMENT OF SINGLE SHELL TANK
SAFE STORAGE ELECTRICAL POWER REQUIREMENTS
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VIA FAX

February 22, 1999

Mr. Charles E. Grenard
COGEMA Engineering
Post Office Box 840
Richland, Washington 99352

SUBJECT: COGEMA TASK ORDER P-99-032-009 - TRANSMITTAL OF LETTER REPORT - ARES TASK NO. 9904910

Dear Mr. Grenard:


Attached is the Draft Letter Report documenting the results of the review of the Single-Shell Tank Farms loading requirements.

Please provide comments for incorporation after completion of the review.

Thank you for the opportunity to complete this work. If you have any questions, please call me at 946-3300.

Sincerely,

Robert L. Fritz
Vice President and Manager, Richland Operation

RLF/bc

Attachments - as stated

cc: Fred Renz (via fax, w/o attachments)
1.0 INTRODUCTION

ARES Corporation was contracted to perform a review of the normal and emergency electrical power requirements for SST Tank Farms identified in the preliminary unissued “Trade Study TS-W314-1 Electrical Power Requirements” (WHC-SD-W314-ES-003) prepared by ICF Kaiser Hanford Company. The key element of the task was to determine the validity of the calculations in light of the changes in power requirements for the safe storage of waste in the SST farms since preparation of this report. ARES was also tasked with the identification of the tasks and resources to update (if required) and issue new calculations.

2.0 APPROACH TO THE REVIEW

2.1 Drawing Review

Copies of the latest one line drawings for each SST Tank Farm, the electrical utility switching diagrams and distribution maps were obtained from microfilm (minus the latest ECN’s). The drawings were compared to the loads calculated in the Trade Study.

2.2 Interviews

Lockheed Martin Hanford Company electrical engineers for the SST tank farms, saltwell pumping and waste sampling were also contacted to obtain information on the present requirements for safe storage, saltwell pumping, waste sampling and the need for an emergency or an alternate power source.

3.0 REVIEW RESULTS

The results of the review show that the Trade Study calculations do not represent the actual power usage in the tank farms based on the meter readings taken between 1993 through 1995 and the current operations being performed. The additional loads identified in the study for both transfer (saltwell pumping) and characterization (waste sampling) do not represent additional loads to the power requirements for each farm. The characterization loads have been supplied either from a portable diesel generator or from existing receptacles within the tank farms and the characterization loads are usually of such a short duration that the loads on the existing transformer feeding the tank farms would never overload the main transformer. The saltwell pumping loads also have a short duration and normally only one tank in each farm would be pumped at one time.
3.1 Discussion

The existing transformers which feed each tank farm in most cases are larger than the calculated loads in the Trade Study.

Table 1 provides the summary data associated with each SST farm, the data from the Trade Study and the updated/current information regarding transformer loading.

Table 1. Single Shell Tank Farms Power Requirements

<table>
<thead>
<tr>
<th>Tank Farm</th>
<th>Transformer size</th>
<th>Storage</th>
<th>Salinewell Pumping</th>
<th>Total without characterization</th>
<th>1995 Metered Load</th>
<th>1999 Load Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>241-A</td>
<td>1000 kVA</td>
<td>633.7 kVA</td>
<td>91.7 kVA</td>
<td>725.4 kVA</td>
<td>279.4 kVA</td>
<td>174.7 kVA</td>
</tr>
<tr>
<td>241-AX</td>
<td>Fed from A</td>
<td>125.9 kVA</td>
<td>91.7 kVA</td>
<td>217.6 kVA</td>
<td>Unavailable</td>
<td>110 kVA</td>
</tr>
<tr>
<td>241-B</td>
<td>112.5 kVA</td>
<td>70.7 kVA</td>
<td>7.2 kVA</td>
<td>77.9 kVA</td>
<td>Unavailable</td>
<td>84.1 kVA</td>
</tr>
<tr>
<td>241-BX</td>
<td>30 kVA &amp; 75 kVA</td>
<td>260.8 kVA</td>
<td>95.5 kVA</td>
<td>356.3 kVA</td>
<td>Unavailable</td>
<td>49.8 kVA</td>
</tr>
<tr>
<td>241-BY</td>
<td>1000 kVA</td>
<td>413.1 kVA</td>
<td>87.6 kVA</td>
<td>500.7 kVA</td>
<td>Unavailable</td>
<td>497.4 kVA</td>
</tr>
<tr>
<td>241-C</td>
<td>450 kVA</td>
<td>128.5 kVA</td>
<td>13.7 kVA</td>
<td>142.2 kVA</td>
<td>141.8 kVA</td>
<td>341 kVA</td>
</tr>
<tr>
<td>241-S</td>
<td>300 kVA</td>
<td>83 kVA</td>
<td>55.1 kVA</td>
<td>172.1 kVA</td>
<td>Unavailable</td>
<td>235 kVA</td>
</tr>
<tr>
<td>241-SX</td>
<td>300 kVA &amp; 75 kVA</td>
<td>248.3 kVA</td>
<td>89.6 kVA</td>
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The loads in the study for the 241-A Farm also feed loads for 241-A and 241-AX tank farm plus the 241-AY tank farm. The fan loads in the 241-A-702 building were for the 241-AY and 241-AZ tanks and have now been taken out of service since the ventilation for the 241-AY and 241-AZ farms is now on a new transformer installed by Project W-030.

The loads for 241-TX and 241-TY are now lower since the tank farms were put into a Clean Safe and Stable mode after the study was done.

The loads for the 241-C farm are greater than the calculated load since the tank farm lighting upgrade was installed after the study and were not in the calculated load. The drawings show that the lighting load was tapped to the emergency bus section of the MCC. The emergency bus is only fed with a 175 amp breaker and the load breaker to the new lighting panel is 225 amps. The transformers which feed the 241-C farm are in a delta-delta ungrounded configuration which means that potentially there is not a good grounding system. This area requires immediate attention.

The 241-BX Tank Farm loads have been removed from service and abandoned in place.
4.0 SUMMARY

The existing transformers are adequate to supply the loads in each tank farm for safe storage, salt well pumping and characterization. The future loads for retrieval were not considered in this review.

The emergency or backup loads were not looked into during this review except for 241-A farm which has the capability of being feed from a alternate 13.8 Kv source or from existing diesel generators. These loads have been taken out of service since they were for the 241-AY and 241-AZ ventilation system which is now fed from a new system installed on project W-030. The 241-C MCC has a receptacle for a portable generator. The 241-SX compressor building once had the capability for being fed from an alternate source which is now disconnected.

In order to evaluate the emergency or backup power requirements, the Single-Shell Waste Tank Safety Equipment List (SEL) will need to be assessed against the present one-line drawings to determine the impact.

Figure 1 provides an estimate and schedule for updating the Trade Study to reflect current requirements and information.

5.0 RECOMMENDATIONS

A new study should be done based on the one line drawings, the present metered loads and the requirements of the SEL. The panel schedules for the 120/208 volt, 120/240 volt and 480 volt systems need to be reviewed and factored into the study. The new study should use work sheets (see Figure 2) to determine the loads in lieu of the Dapper Calculations used in the Trade Study.

The 241-C farm electrical system needs to be upgraded for the storage and transfer of liquids and should be combined with the new electrical substation installed by Project W-320.
Figure 1. Estimate for Updating Engineering Study

**Data Collection**
- 16 hours - Professional Engineer
- 16 hours - Designer

**Calculation Revisions**
- 80 hours - Professional Engineer
- 10 hours - Electrical Engineer/Manager

**Text Preparation**
- 60 hours - Professional Engineer
- 28 hours - Administration
- 10 hours - Electrical Engineer/Manager

**Final Report Assembly**
- 16 hours - Professional Engineer
- 8 hours - Administration
- 4 hours - Electrical Engineer/Manager

**Comment Incorporation**
- 16 hours - Professional Engineer
- 4 hours - Administration
- 1 hour - Electrical Engineer/Manager

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Figure 2.
DISTRIBUTION CALCULATION WORKSHEET

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Project Description: [Blank]
Inspection Office: [Blank]
QUANTITY OF HIGH-LEVEL WASTE FEED
REQUIRED FROM 241-C-104 AND 241-C-102
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The amount of waste to be retrieved from tanks 241-C-102 and 241-C-104 is described below. Current volumes of tank waste (primarily solids) are from Best Basis Inventories. A retrieval efficiency of 85% was assumed based on the projected retrieval efficiency for C-106 sluicing. Using this enabling assumption, the retrieval efficiency of 85% was applied to tanks C-102 and C-104 to yield projected volumes to be retrieved from these tanks.

C-102: $949 \text{ m}^3 \times 0.85 = 807 \text{ m}^3$

C-104: $1,518 \text{ m}^3 \times 0.85 = 1,290 \text{ m}^3$
DOUBLE-SHELL TANK SUPERNATANT VOLUME AVAILABLE
FOR PHASE 1 SINGLE SHELL TANK WASTE FEED DELIVERY
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APPENDIX C

DOUBLE-SHELL TANK SUPERNATANT VOLUME AVAILABLE FOR PHASE 1 SINGLE SHELL TANK WASTE FEED DELIVERY

This paper documents the 0th-order calculations performed to derive the available double-shell tank (DST) supernatant volume requirements for Phase 1 Single Shell Tank (SST) Waste Feed Delivery (WFD). The SST System will use DST supernatants as a waste mobilization fluid and/or a fluid that will allow for the transfer of SST waste to the DSTs via pipeline. For this calculation, the supernatant volume available in the DST System was constrained only by the amount of tank space available in 241-AY-102 (supernatant source tank) at the beginning of each SST retrieval campaign. This available tank space is allocated to chemically adjusted water additions to 241-AY-102 that can be used immediately as supernatant for SST retrieval. Solids settling and actual waste supernatant availability was not modeled in this calculation. Future calculations should consider constraining the amount of water added to the DST System based on SST WFD System needs and on the waste minimization requirements levied on the DST System. The SST WFD System needs will become more clear at the conclusion of the Project W-523 Alternatives Generation and Analysis (AGA). This AGA will select a retrieval technology and associated system configuration for 241-C-104.

The TWRS Operation and Utilization Plan (TWRSO&UP) (see HNF-SD-WM-SP-012, Rev. 1) documents a high-level waste (HLW) feed staging plan for Phase 1 that includes the following tank retrieval sequences (see Figure 1):

1. The HLW in 241-AY-102 (= 241-AY-102 waste + previously sluiced 241-C-106 waste) is split, with one half of the contents transferred to 241-AZ-101, which has been emptied via providing BNFL the first HLW feed batch for treatment;

2. 241-C-104 is retrieved in two batches. The first batch is retrieved into 241-AZ-101, which blends with the waste there to form batch group #3; the second 241-C-104 batch is retrieved into 241-AY-102, which forms batch group #4. 241-AI-102 is the supernatant source tank for both 241-C-104 and 241-C-102 retrieval; hence, supernatants needed for the C-104 retrieval campaigns can be added to the 241-AY-102 space available in the form of inhibited water;

3. Batch group #3 is sent to BNFL out of 241-AZ-101. Subsequently, batch group #4 is sent to 241-AZ-101 for HLW feed staging;

4. 241-C-102 is retrieved in one batch to the emptied 241-AY-102, which forms the contingency batch—batch group #5. Supernatants needed for the 241-C-102 retrieval campaign can be added to the available space in 241-AY-102 in the form of inhibited water.
Figure 1. High-Level Waste Retrieval Sequence for Batch Group Nos. 3 and 4.

Note that the volume available in 241-AZ-102 for water addition when retrieving 241-C-104 is that volume not used by the batch group #4 mixture (See Figure 1). Note also that there is space available in 241-AZ-101 that could be used for water additions; however, this space will remain unallocated for the purposes of this calculation. Other assumptions made for this calculation are listed below:

- 241-AZ-102 and 241-AZ-101 each have a tank capacity of 3.79 ML (1,000 kgal) [HNF-SD-WM-SP-012, Rev. 1, Appendix A, Section 3.3];

- 241-AZ-102 is full when half its contents are sent to 241-AZ-101. This implies that 1.90 ML (500 kgal) of 241-AZ-102 tank space is available for the second batch of 241-C-104 and inhibited water additions [Worst case assumption];

- 241-AZ-102 can be pumped down to 10 in. above the tank bottom or 0.1 ML (27 kgal) when transferring batch group #4 to 241-AZ-101 [HNF-SD-WM-SP-012, Rev. 1, Appendix A, Section 3.5];

- 85% of the total volume contained in tanks 241-C-104 and 241-C-102 are retrieved into the DSTs [HNF-SD-WM-SP-012, Rev. 1, Section 3.2.1.1].
• Supernatant in the form of added inhibited water is available immediately for SST retrieval [3/4/99 Crawford discussion];

Further, the below calculations leave 0.28 ML (75 kgal) of tank space (about 7.5%) unallocated for contingency.

241-AY-102 Space Available for C-104 Retrieval

The volume of waste in 241-C-104 is taken to be 0.950 ML (251 kgal) (see Attachment 1). If 85 percent of this amount is retrieved and split into two equal batches with one going to 241-AZ-101 and the other going 241-AY-102 (see Figure 1), then the amount of space available in 241-AY-102 available for water additions is:

- 1.89 ML (500 kgal) Space available in 241-AY-102 after 241-AY-102 split
- 0.404 ML (107 kgal) Waste retrieved from 241-C-104 to 241-AY-102
- 0.283 ML (75 kgal) Contingency space

1.20 ML (318 kgal) Space available in 241-AY-102 for water additions

241-AY-102 Space Available for C-102 Retrieval

The volume of waste in 241-C-102 is taken to be 1.52 ML (402 kgal) (see Attachment 2). If 85 percent of this amount is retrieved into 241-02 (see Figure 1), then the amount of space available in 241-AY-102 available for water additions is:

- 3.69 ML (975 kgal) 241-AY-102 capacity less 10” of remaining waste (Batch Group #4)
- 1.29 ML (342 kgal) Waste retrieved from 241-C-102 to 241-AY-102
- 0.283 ML (75 kgal) Contingency space

2.11 ML (558 kgal) Space available in 241-AY-102 for water additions

Discussion

Assuming: (a) the DST System will use the space available for water additions; and (b) water additions to AY-102 are available immediately as supernatants for use in SST retrieval, the following SST System interface requirement can be constructed (Note: SST System Spec. specifies volumes in m³):

DST Supernatant Volume Available for Phase 1 SST WFD. The following table defines the maximum supernatant volumes to be made available by the DST System in the supernatant source tank specified:
Given the above assumptions, this interface requirement represents the most constraining case for the SST System. That is, the available supernatant volume in AY-102 will increase as solids are allowed to settle over time (see Figure 2). A more thorough calculation of the available supernatants that accounts for solids settling and the C-104/102 retrieval process should be performed such that water additions to the DST System are minimized.

Figure 2. Supernatants Available for SST Retrieval vs. Time (Qualitative).

Note that a performance requirement consistent with the above SST System interface requirement must be added to the DST System Specification. This will require the DST System to perform such that this supernatant volume is indeed made available by the DST System.
References


The following report was created with the TWINS Automated Tank Characterization Report utility found on http://ptwins.pnl.gov:9397/twinsproto/reports.htm for the purposes of determining the volume of waste contained in tank C-104.

The Tank Description, HTCE Surface Level and Tank Profile View TWINS reports agree with one another and with the Waste Tank Summary Report for Month Ending October 31, 1998 (HNF-EP-0182-127) on the C-104 waste volume ( = 295 kgal). However, the Tank Surface Level TWINS report shows recent surface level measurements that indicate a waste volume of less than 253 kgal. These measurements agree with the volume estimate arrived at via the Best Basis Inventory (BBI) of the tank waste ( = 251 kgal, 3/15/99 conversation with Tom Crawford, LMHC). Since the C-104/102 waste removal volume requirements for the SST System Spec were calculated using the BBI, the 251 kgal volume, as supported by recent measurements, will be used for the available supernatant calculation as well.

This report prepared especially for Michael Leonard on 3/16/99

Tank: 241-C-104

Sampling Events:
   162
   165

Reports:
   Description of Tank
   HTCE Surface Level
   Tank Profile View
   Tank Surface Level

Constituent Groups:
## Data Dictionary to Reports in this Document

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<td>Provides an executive summary of information about the tank including tank description, tank status, sampling dates, and service status.</td>
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<tr>
<td>Tank Profile View</td>
<td>A cross sectional view of the tank showing basic dimensions, components and riser penetrations. The level of waste in the tank is also represented.</td>
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Description of Tank 241-C-104

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<td>Diameter</td>
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<td>Operating Depth</td>
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<td>Design Capacity</td>
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| TANK STATUS (as of 12/31/98)    |                     |
| Waste Classification           | Complexant concentrate waste |
| Total Waste Volume             | 1116.7 kL (295 kgal)  |
| Supernate Volume               | 0 kL (0 kgal)        |
| Saltcake Volume                | 0 kL (0 kgal)        |
| Sludge Volume                  | 1116.7 kL (295 kgal) |
| Drainable Interstitial Liquid Volume | 41.6 kL (11 kgal) |
| Waste Surface Level            |                     |
| Waste Surface Level (current)  |                     |
| Temperature (1/1/98 - 12/31/98) | 27.8°C - 36.7°C (82°F - 98°F) |
| Temperature (current)          |                     |
| Integrity                      | Sound               |
| Watch List Status              |                     |

| SAMPLING DATES                 |                     |
| Core Samples                   | 7/30/1996 - 7/30/1996 |
|                               | 8/16/1996 - 8/16/1996 |
| Vapor Samples                  | 3/3/1994             |

| SERVICE STATUS                 |                     |
| Declared Inactive              | 1980                |
| Interim Stabilization          | September 1989      |
| Intrusion Prevention           | September 1990      |
241-C-104 Tank Surface Level (after 1/1/96 only)

Volume (gallons)

NOTE: Measured data points are indicated by dots.

Level in Inches
TWINS Automated Tank Characterization Report (C-102)

The following report was created with the TWINS Automated Tank Characterization Report utility found on http://pctwins.pnl.gov:9397/twinsproto/reports.htm for the purposes of determining the volume of waste contained in tank C-102.

The Tank Description, HTCE Surface Level and Tank Profile View TWINS reports agree with one another and with the Waste Tank Summary Report for Month Ending October 31, 1998 (HNF-EP-0182-127) on the C-102 waste volume (= 316 kgal). However, the Tank Surface Level TWINS report shows recent surface level measurements that indicate a waste volume of greater than 415 kgal. These measurements agree with the volume estimate arrived at via the Best Basis Inventory (BBI) of the tank waste (= 402 kgal, 3/15/99 conversation with Tom Crawford, LMHC). Since the C-104/102 waste removal volume requirements for the SST System Spec were calculated using the BBI, the 402 kgal volume, as supported by recent measurements, will be used for the available supernatant calculation as well.

This report prepared especially for Michael Leonard on 3/16/99

Tank: 241-C-102

Sampling Events:

Reports:
   - Description of Tank
   - HTCE Surface Level
   - Tank Profile View
   - Tank Surface Level

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241-C-102 Tank Surface Level (after 1/1/96 only)

Volume (gallons)

NOTE: Measured data points are indicated by dots.
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# Performance Requirements for the Single-Shell Tank System

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