S

ENGINEERING CHANGE NOTICE

Page 1 of 2

1. ECN 660450

Proj. ECN

2. ECN Category (mark one)	3. Originator's Name, Organization, MSIN, and Telephone No.	4. USQ Required?	5. Date
Supplemental ☐ Direct Revision ☒ Change ECN ☐ Temporary ☐ Standby ☐ Supersedure ☐ Cancel/Void ☐	RR Bafus/Proj. Def./R3-73/373-1741	☐ Yes ☒ No	9/27/00
	6. Project Title/No./Work Order No.: Project Definition	7. Bldg./Sys./Fac. No.: Tank Farms	8. Approval Designator: S,Q,E
	9. Document Numbers Changed by this ECN (includes sheet no. and rev.): HNF-4155, Rev. 0	10. Related ECN No(s).	11. Related PO No.: N/A

12a. Modification Work	12b. Work Package No.	12c. Modification Work Completed	12d. Restored to Original Condition (Temp. or Standby ECNs only)
☐ Yes (fill out Blk. 12b) ☒ No (NA Blks. 12b, 12c, 12d)	N/A	N/A Design Authority/Cog. Engineer Signature & Date	N/A Design Authority/Cog. Engineer Signature & Date

13a. Description of Change

13b. Design Baseline Document? ☒ Yes ☐ No

The Monitor and Control Subsystem Level 2 Specification (HNF-4155)was changed to reflect the results of the Baseline Comparison and add supplementary information relating to the previously existing text.

USQ not required per Categorical Exclusion USQ-TF-96-0690, Rev. 2 (changes are prior to the release of field-installation drawings or ECNs and do not alter requirements of an approved facility-installed design or change the Authorizaiton Basis document or Compliance Implementation Plan).

14a. Justification (mark one)	14b. Justification Details
Criteria Change ☒ Design Improvement ☐ Environmental ☐ Facility Deactivation ☐ As-Found ☐ Facilitate Const. ☐ Const. Error/Omission ☐ Design Error/Omission ☐	The results of the Baseline Comparison (RPP-7011, DST Subsystem Specification Project Media Baseline Comparison Summary Report)are incorporated into this revision of HNF-4155. Reformating and minor changes are made to existing text for clarification.

15. Distribution (include name, MSIN, and no. of copies)

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16. Design Verification Required	17. Cost Impact		18. Schedule Impact (days)
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☒ No	Savings ☐ $	Savings ☐ $	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 20.

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

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	Document Number/Revision	Document Number/Revision
N/A		

21. Approvals

	Signature		Date		Signature	Date
Design Authority	C.C. Scaief	R1-56	10/24/00	Design Agent		
Cog. Eng.	R.R. Bafus	R3-73	10/23/00	PE		
Cog. Mgr.	T.J. Collards	R3-73	10/24/00	QA		
QA	W.L.Adams	S5-11	10/23/00	Safety		
Safety	~~RE Debusk~~	~~S7-86~~	10/25/00	Design		
Environ.	K.S. Tollefson	R1-51	10/24/00	Environ.		
Other	R.R. Bevins	R3-25	10/24/00	Other		
W.J. Powell		S5-13	11/3/00			
C.A. Rieck		R3-47	10/24/00			
G.P. Duncan		S6-15	10/25/00	DEPARTMENT OF ENERGY		
C.E. Grenard		R3-73	10/25/00	Signature or a Control Number that tracks the Approval Signature		
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Double-Shell Tank Monitor and Control Subsystem

R. R. Bafus
Numatec Hanford Corporation
Richland, WA 99352
U.S. Department of Energy Contract DE-AC06-99RL-14047

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Key Words: privatization, double-shell tank, waste feed delivery, subsystem, specification, monitor and control

Abstract: This specification revises the performance requirements and provides references to the requisite codes and standards to be applied during design of the Double-Shell Tank (DST) Monitor and Control Subsystem that supports the first phase of Waste Feed Delivery.

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HNF-4155
Revision 1

Double-Shell Tank Monitor and Control Subsystem Specification

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

CH2MHILL
Hanford Group, Inc.
Richland, Washington

Contractor for the U.S. Department of Energy
Office of River Protection under Contract DE-AC06-99RL14047

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HNF-4155
Revision 1

Double-Shell Tank Monitor and Control Subsystem Specification

Prepared by:
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Date Published
October 2000

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Table 2-1. Government Documents. 2-1

Table 2-2. Non-Government Documents. 2-2

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1.0 SCOPE

1.1 DESCRIPTION

This subsystem specification establishes the interface and performance requirements and provides references to the requisite codes and standards to be applied during the design of the Double-Shell Tank (DST) Monitor and Control Subsystem. The DST Monitor and Control Subsystem consists of the new and existing equipment that will be used to provide tank farm operators with integrated local monitoring and control of the DST systems to support Waste Feed Delivery (WFD). New equipment will provide automatic control and safety interlocks where required and provide operators with visibility into the status of DST subsystem operations (e.g., DST mixer pump operation and DST waste transfers) and the ability to manually control specified DST functions as necessary.

This specification is intended to be the basis for new projects/installations (W-521, etc.). This specification is not intended to retroactively affect previously established project design criteria without specific direction by the program.

1.2 CLASSIFICATION

Not applicable.

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2.0 APPLICABLE DOCUMENTS

Design requirements applicable to the DST Monitor and Control Subsystem come from government and non-government source documents and various codes and standards. Each document (of the exact revision identified) in this Section is invoked by one or more requirements of this specification and represents a part of this specification to the extent specified.

2.1 GOVERNMENT DOCUMENTS

U.S. Department of Energy (DOE) orders and regulatory documents, including those promulgated by the Federal Government and Washington State, constitute a part of this specification to the extent specified herein. The regulatory documents that form a part of this specification are listed in Table 2-1.

Table 2-1. Government Documents.

Document Number	Title
10 CFR 835	Occupational Radiation Protection," *Code of Federal Regulations*, as amended.
29 CFR 1910	"Occupational Safety and Health Standards" *Code of Federal Regulations,* as amended.
DOE Order 6430.1A, 1989	*General Design Criteria*, U.S. Department of Energy, Washington, D.C.

2.2 NON-GOVERNMENT DOCUMENTS

National codes, standards, and the Hanford Site documents listed in Table 2-2 constitute a part of this specification to the extent specified herein. Note: The RPP-PRO procedures implement Federal and state regulations and DOE orders. In addition, it should be noted that some requirements are based on the existing authorization basis documents (e.g., *Tank Waste Remediation System Final Safety Analysis Report*, HNF-SD-WM-SAR-067, and *Tank Waste Remediation System Technical Safety Requirements*, HNF-SD-WM-TSR-006). The authorization basis requirements may be changed, if necessary, after the analysis and justification of the resulting risk have been outlined in a final safety analysis report amendment and approval is obtained from the DOE Office of River Protection (ORP).

Table 2-2. Non-Government Documents. (2 sheets)

Document Number	Title
ASME NQA-1, 1994	*Quality Assurance Requirements for Nuclear Facility Applications,* American Society of Mechanical Engineers, New York, New York.
HNF-2004, Rev. 1, 1999	*Estimated Dose to In-Tank Equipment and Ground-Level Transfer Equipment During Privatization*, COGEMA Engineering Corporation for Lockheed Martin Hanford Corporation, Richland, Washington.
HNF-2937, Rev. 0, 1999	*Estimated Maximum Concentration of Radionuclides and Chemical Analytes in Phase 1 and Phase 2 Transfers*, COGEMA Engineering Corporation for Lockheed Martin Hanford Corporation, Richland, Washington.
HNF-2962, Rev. 0, 1998	*A List of EMI/EMC Requirements*, Numatec Hanford Corporation for Fluor Daniel Hanford, Inc., Richland, Washington.
HNF-5183, Rev. 0, 2000	*Tank Farms Radiological Control Manual (TFRCM)*, CH2M HILL Hanford Group, Inc., Richland, Washington.
HNF-IP-0842, Vol. II, Section 6.1, Rev. 0a, 1999	*RPP Administration,* "Tank Farm Operations Equipment Labeling," Lockheed Martin Hanford Corporation, Richland, Washington.
HNF-IP-0842, Vol. IV, Section 6.12, Rev. 0, 2000	*RPP Administration,* "Safety Analysis and Technical Safety Requirements," CH2M HILL Hanford Group, Inc., Richland, Washington.
HNF-IP-0842, Vol. IV, Section 6.11, Rev. 0, 2000	*RPP Administration,* "Safety Analysis Process - Facility Change or Modification," CH2M HILL Hanford Group, Inc., Richland, Washington.
HNF-IP-0842, Vol. IV, Section 6.10, Rev. 0, 2000	*RPP Administration,* "Safety Analysis Process - New Project," CH2M HILL Hanford Group, Inc., Richland, Washington.
HNF-IP-0842, Vol. IV, Section 6.9, Rev. 0, 2000	*RPP Administration,* "Hazard and Accident Analysis Process," CH2M HILL Hanford Group, Inc., Richland, Washington.
HNF-IP-0842, Vol. XI, Section 1.0, Rev. 2a, 1999	*RPP Administration,* "Quality Assurance Program," Lockheed Martin Hanford Corporation, Richland, Washington.
HNF-PRO-309, Rev. 0, 1999	*Computer Software Quality Assurance Requirements,* Fluor Daniel Hanford, Inc., Richland, Washington
HNF-SD-GN-ER-501, Rev. 1, 1998	*Natural Phenomena Hazards, Hanford Site, Washington,* Numatec Hanford Corporation for Fluor Daniel Hanford, Inc., Richland, Washington.

Table 2-2. Non-Government Documents. (2 sheets)

Document Number	Title
HNF-SD-WM-SAR-067, Rev. 1, 1999	*Tank Waste Remediation System Final Safety Analysis Report*, Lockheed Martin Hanford Corporation for Fluor Daniel Hanford, Inc., Richland, Washington.
HNF-SD-WM-TSR-006, Rev. 1, 1999	*Tank Waste Remediation System Technical Safety Requirements*, Fluor Daniel Hanford, Inc., Richland, Washington.
NFPA 70, 1999	*National Electrical Code*, National Fire Protection Association, Quincy, Massachusetts.
RPP-PRO-097, Rev. 0, 1999	*Engineering Design and Evaluation*, CH2M HILL Hanford Group, Inc., Richland, Washington.
RPP-PRO-222, Rev. 0, 1999	*Quality Assurance Records Standards*, CH2M HILL Hanford Group, Inc., Richland, Washington.
RPP-PRO-224, Rev. 0, 1999	*Document Control Program Standards*, CH2M HILL Hanford Group, Inc., Richland, Washington.
RPP-PRO-709, Rev. 0, 1999	*Preparation and Control Standard for Engineering Drawings*, CH2M HILL Hanford Group, Inc., Richland, Washington
RPP-PRO-1621, Rev. 0, 1999	*ALARA Decision-Making Methods*, CH2M HILL Hanford Group, Inc., Richland, Washington.
RPP-PRO-1622, Rev. 0, 1999	*Radiological Design Review Process*, CH2M HILL Hanford Group, Inc., Richland, Washington.
RPP-PRO-1819, Rev. 0, 1999	*Engineering Requirements*, CH2M HILL Hanford Group, Inc., Richland, Washington.
UCRL 15673, 1985	*Human Factors Design Guidelines for Maintainability of DOE Nuclear Facilities*, Lawrence Livermore National Laboratory, Livermore, California.

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3.0 REQUIREMENTS

3.1 SUBSYSTEM/COMPONENT DEFINITION

The DST System provides safe storage of waste products, serves as a waste processing system for waste pretreatment, and provides a staging system for delivery of waste feed to the River Protection Project (RPP) Privatization Contractor facility for waste treatment/immobilization.

The DST System includes six tank farms containing a total of 28 DSTs. Five of the DST farms are located in the 200 East Area (241-AN, 241-AP, 241-AW, 241-AY, and 241-AZ), and one is located in the 200 West Area (241-SY). The four tanks in the 241-AY and 241-AZ tank farms are designed to store high heat or "aging" waste and have a design storage capacity of 3,800 m^3 (1 Mgal) each. Each of the other DSTs has a design capacity of 4,390 m^3 (1.16 Mgal) per tank. Tank 241-AN-107, with a capacity of 4,390 m^3 (1.16 Mgal), could be used as an aging waste storage tank. The planned usage of the DSTs during Phase 1 Waste Feed Delivery is detailed in the *Tank Waste Remediation System Operation and Utilization Plan to Support Waste Feed Delivery*, HNF-SD-WM-SP-012. This specification's requirements are based on the Case 3, Project Planning, DST usage scenario documented therein. Notice that Case 3S6D, 2006 Hot Start, will be documented in Revision 2 of HNF-SD-WM-SP-012 and will serve as the baseline case for the Readiness to Proceed-2 (RTP-2) RPP milestone. Case 3S6D incorporates changes to Case 3 to resolve feed staging tank issues, reflect changes in the assumptions, and include additional programmatic constraints, as directed by DOE ORP. Preliminary quantitative and qualitative assessments were performed to determine the impacts of these changes to the DST subsystem requirements. Generally, the DST subsystem requirements were determined to be insensitive to the aforementioned changes; that is, the fundamental system-level requirements remained constant between Cases 3 and 3S6D (e.g., the need to prepare and transfer AN Farm tank waste to the vitrification facility). In instances where quantitative assessments were performed, the enveloping case was selected to develop the DST subsystem requirements.

The DST System specification (*System Specification for the Double-Shell Tank System*, HNF-SD-WM-TRD-007) identifies several second-tier waste transfer functions (Figure 3-1). The DST Monitor and Control Subsystem function has been further decomposed as shown. These are shown as third- and fourth-tier functions in Figures 3-1. *Functional Analysis for Double-Shell Tank Subsystems*, HNF-5136, allocates the shaded third- and fourth-tier functions of Figures 3-1 to the DST Monitor and Control Subsystem. Section 3.2.1 of this specification is organized to accommodate these shaded functions.

Functions allocated to the DST Monitor and Control Subsystem are as follows:

- "Monitor" the process by measuring, transmitting, receiving, recording, and displaying the data.
- "Compare" the data received to a setpoint or status parameter to facilitate manual control or to maintain the process within normal operating limits by automatic control. This function also provides a signal to initiate a response to an off-normal comparison.

Figure 3-1. Double-Shell Tank Monitor and Control Subsystem Functional Hierarchy for Waste Storage. (4 sheets)

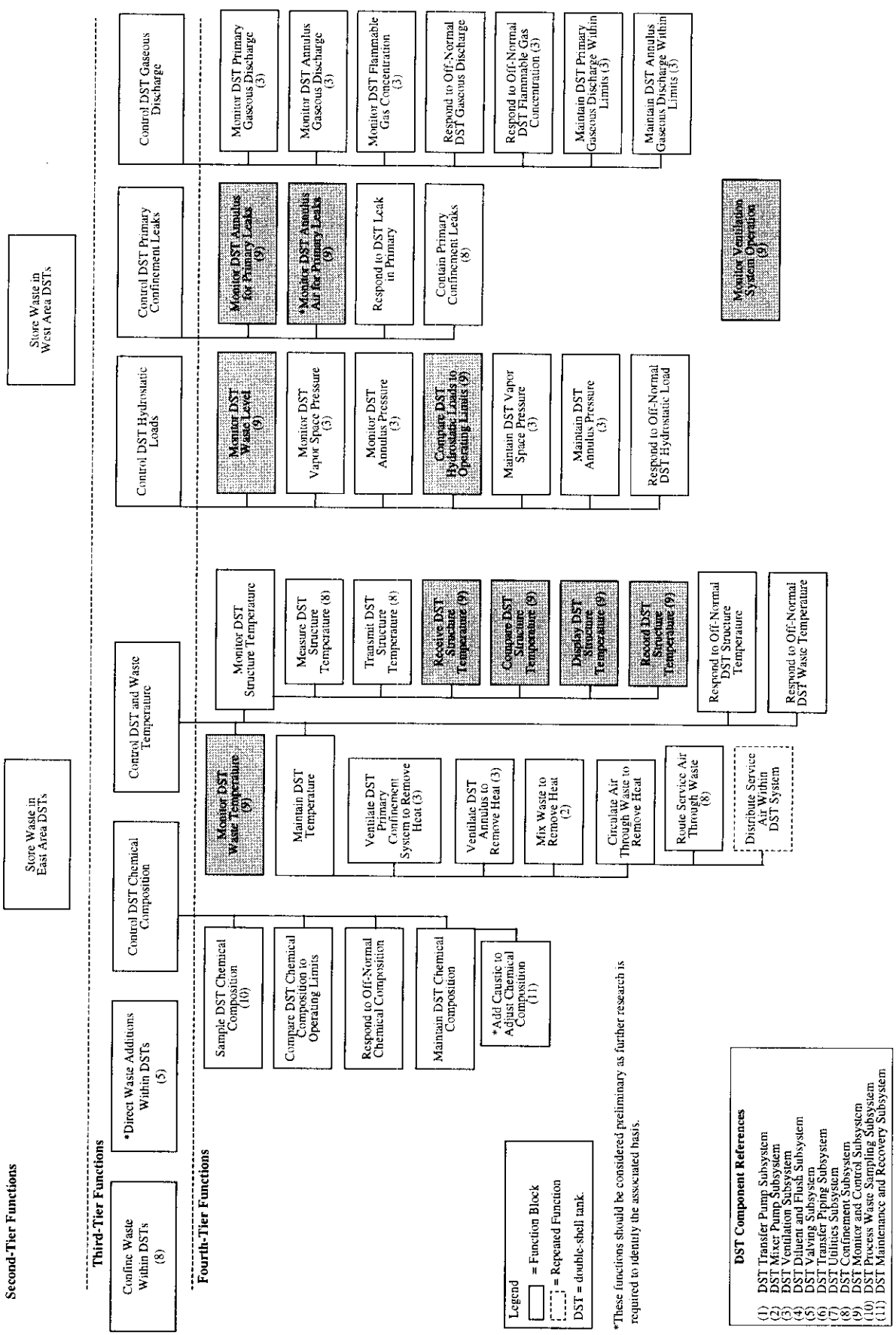


Figure 3-1. Double-Shell Tank Monitor and Control Subsystem Functional Hierarchy for Waste Storage. (4 sheets)

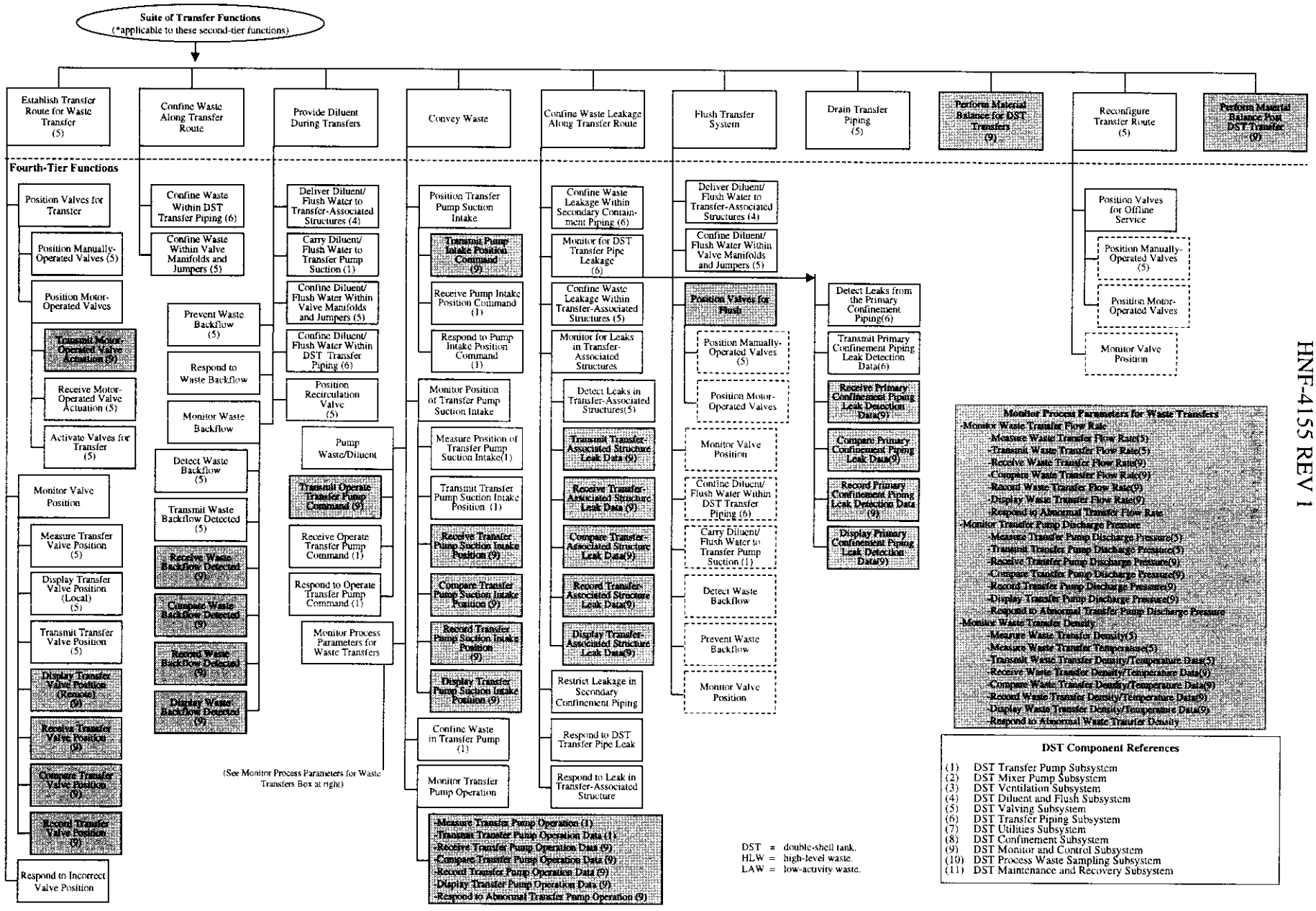
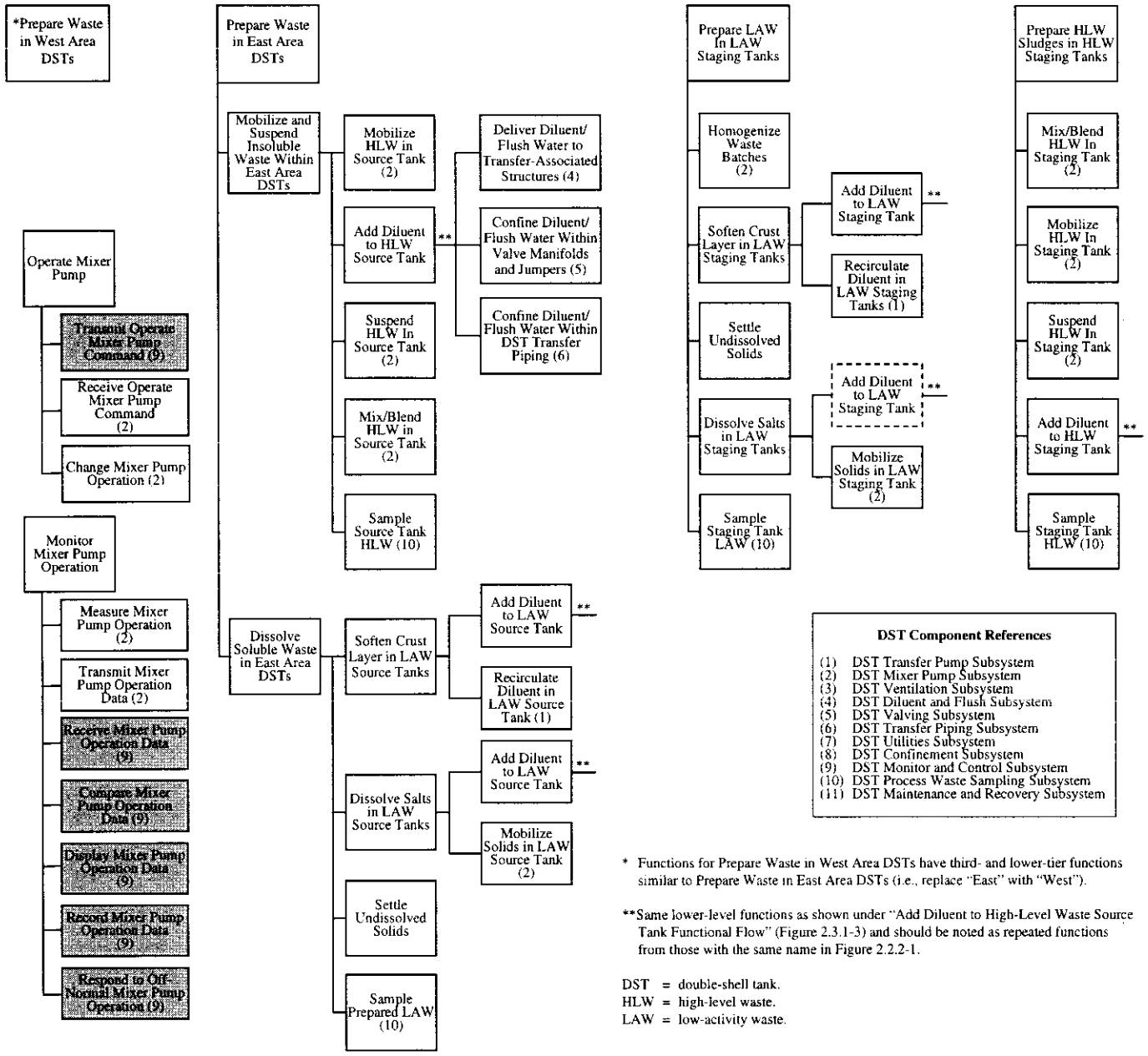


Figure 3-1. Double-Shell Tank Monitor and Control Subsystem Functional Hierarchy for Waste Storage. (4sheets)

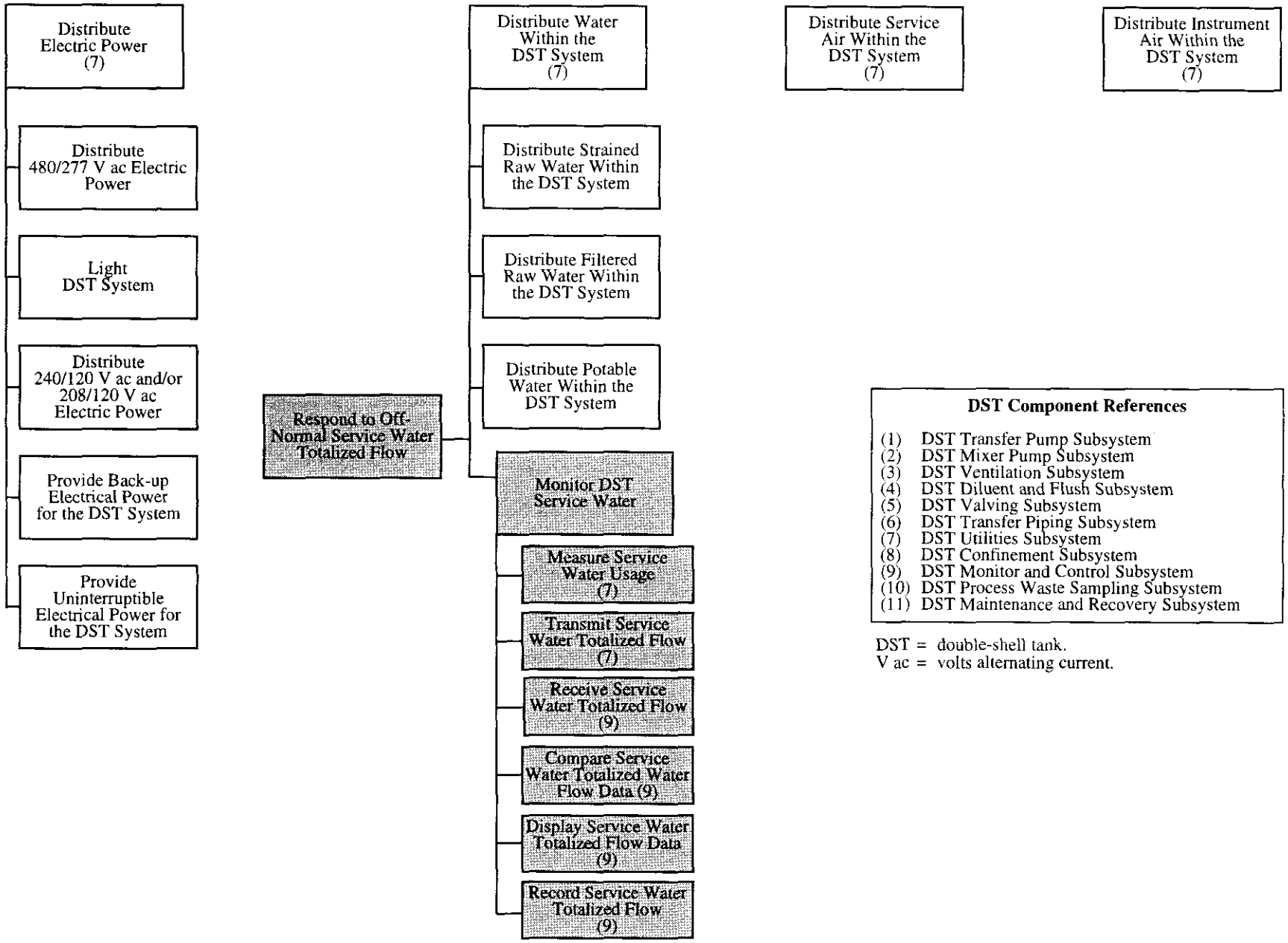


* Functions for Prepare Waste in West Area DSTs have third- and lower-tier functions similar to Prepare Waste in East Area DSTs (i.e., replace "East" with "West").

**Same lower-level functions as shown under "Add Diluent to High-Level Waste Source Tank Functional Flow" (Figure 2.3.1-3) and should be noted as repeated functions from those with the same name in Figure 2.2.2-1.

DST = double-shell tank.
HLW = high-level waste.
LAW = low-activity waste.

Figure 3-1. Double-Shell Tank Monitor and Control Subsystem Functional Hierarchy for Waste Storage. (4 sheets)



DST Component References

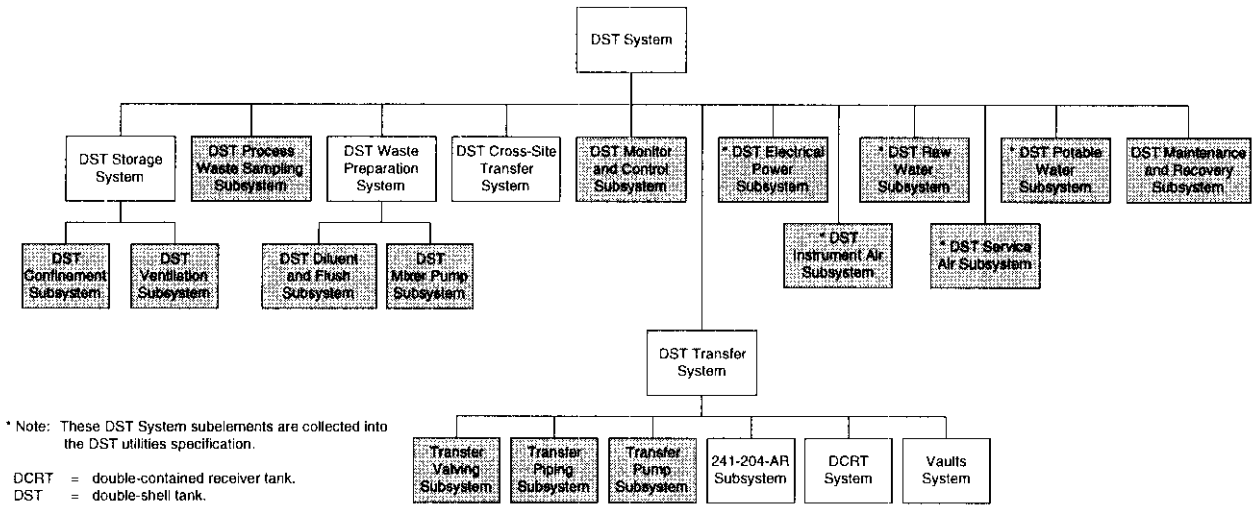
(1) DST Transfer Pump Subsystem
(2) DST Mixer Pump Subsystem
(3) DST Ventilation Subsystem
(4) DST Diluent and Flush Subsystem
(5) DST Valving Subsystem
(6) DST Transfer Piping Subsystem
(7) DST Utilities Subsystem
(8) DST Confinement Subsystem
(9) DST Monitor and Control Subsystem
(10) DST Process Waste Sampling Subsystem
(11) DST Maintenance and Recovery Subsystem

DST = double-shell tank.
V ac = volts alternating current.

- "Respond to Off-Normal" operating conditions (e.g., provide alarm, interlock, or process shutdown) by taking actions to correct situations where a process parameter is not within operating/design limits.

The DST System consists of the 12 subsystems identified in Figure 3-2. Five of these subsystems (electrical, raw water, potable water, service air, and instrument air) will be collected into one specification for the DST Utilities Subsystem. Several of these subsystems have been further subdivided to identify lower level subsystem/components. Subsystem specifications will be prepared for the subsystems/components shaded in Figure 3-2, because they will be constructed or modified in support of Phase 1 Waste Feed Delivery.

Figure 3-2. Double-Shell Tank System Architecture Tree.



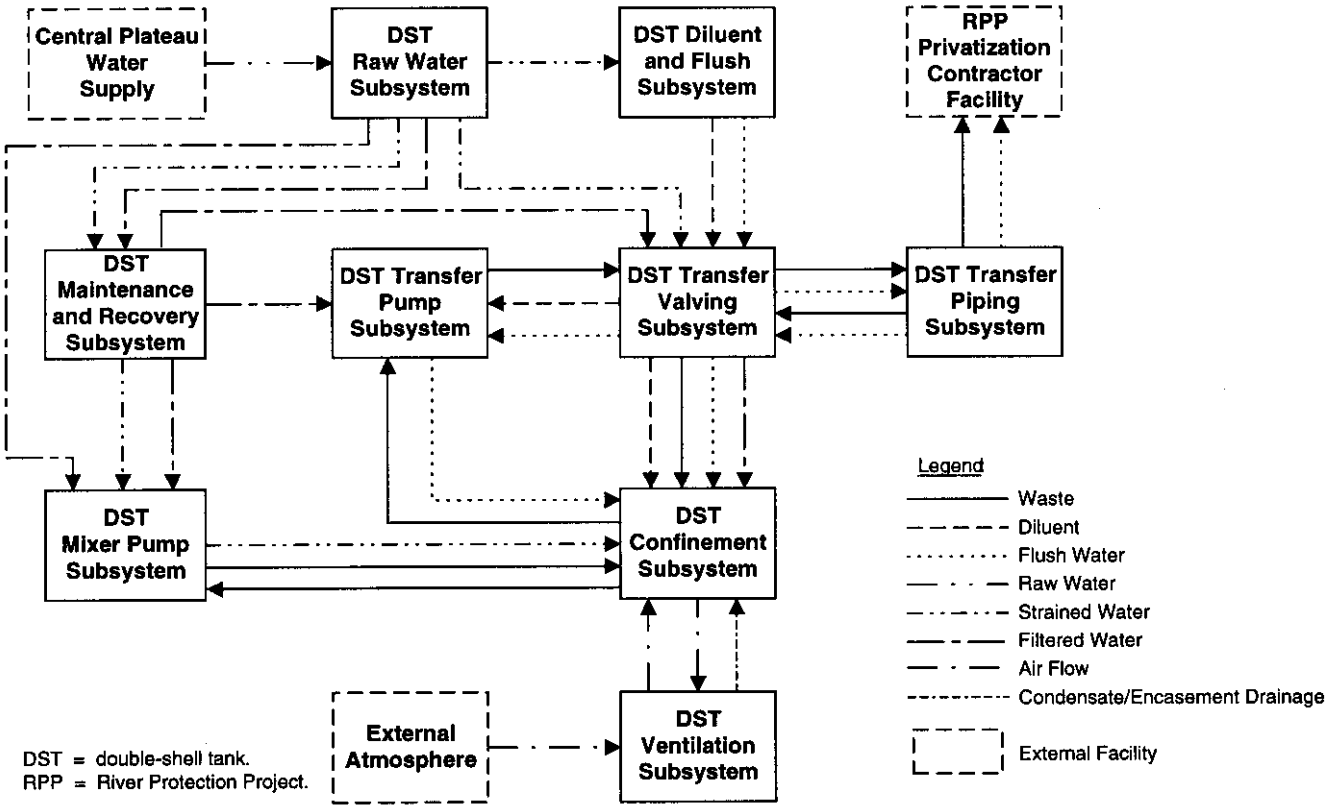
The primary interfaces between DST subsystems/components are shown in Figures 3-3 and 3-4. Figure 3-3 shows the primary DST mechanical system interfaces for eight subsystems. Different materials going between the subsystems are shown as different types of lines. For waste preparation, the mixer pump moves waste within the waste confinement subsystem (i.e., the tanks) at a high velocity to suspend undissolved solids and/or to mix supernatant. Once waste preparation is complete, waste is removed from the DST Confinement Subsystem source tank by the transfer pump and is routed by the valving subsystem through the piping subsystem toward its destination (i.e., another DST or the RPP Privatization Contractor facility). If the destination is another DST, the valving subsystem will direct the waste into the receiving DST. If the destination is the processing plant, the plant's waste receipt piping will route the waste into the plant.

The DST Confinement Subsystem must confine the tank waste during both in-tank waste processing (e.g., mixing, diluent addition) and in static storage. In either case, the DST Ventilation Subsystem draws air in from, and exhausts air out to, the external atmosphere to cool and to maintain confinement of the DST Confinement Subsystem vapors. Before exhausting the air, the DST Ventilation Subsystem removes radioactive particulates and hazardous and toxic gases (primary only) from the confinement subsystem's primary and annulus vapor space.

The DST Raw Water Subsystem receives water from the Site Raw Water Distribution System, where it is strained to remove large particulates before being used by the DST Diluent and Flush Subsystem. The DST Diluent and Flush Subsystem chemically adjusts the water for dilution or for flushing. The degree of chemical adjustment of diluent will depend on the batch of waste being transferred. The raw water is heated to match the waste temperature [see *Waste Feed Delivery Technical Basis*, HNF-1939, Volume II, Revisions 0a (Addendum 1-1), 0b (Addendum 2-1), and 0c (Addendum 3-1)].

Diluent is routed by the valving subsystem either to the transfer pump for in-line dilution of the waste or to the confinement subsystem for in-tank dilution. When a transfer is complete, the transfer pump, valving, and piping subsystems are flushed with water.

Figure 3-3. Subsystem for Double-Shell Tank Mechanical System Interfaces.



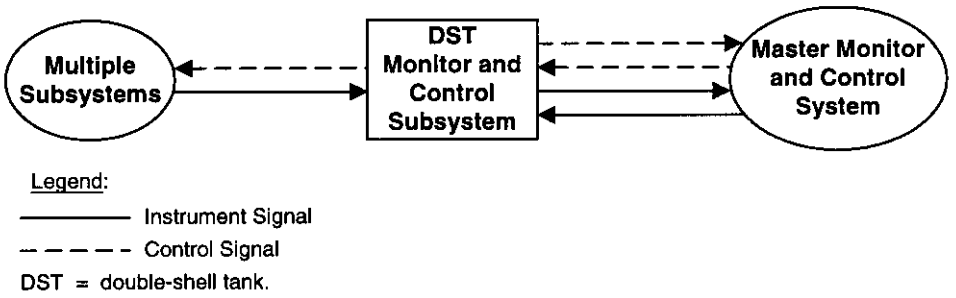
The DST Raw Water Subsystem filters water to remove small particles before the water is piped directly to the mixer pump and transfer valving subsystems. Filtered water is routed to the

confinement subsystem via the transfer valving subsystem. Filtered water also can be routed to the mixer pump, the transfer pump, and the valve pit via the DST Maintenance and Recovery Subsystem for infrequent needs. Infrequent needs may include filling a mixer pump drive shaft and providing water to the pump seals.

The DST Maintenance and Recovery Subsystem will be used for many other infrequent needs that were not shown on the diagram for reasons of clarity. For example, raw water will be used to decontaminate the pumps when they are removed from the tanks. It also will be used in decontaminating the valve and pump pits.

Figure 3-4 generically shows how the DST Monitor and Control Subsystem interfaces with other systems. The subsystems shown in Figure 3-3 provide instrument data signals to the DST Monitor and Control Subsystem. The DST Monitor and Control Subsystem transmits selected data to the Master Monitor and Control System. The DST Monitor and Control Subsystem also receives data and control signals from the Master Monitor and Control System. Based on the data and control signals received, the DST Monitor and Control Subsystem sends control signals to the multiple DST subsystems.

Figure 3-4. Interfaces for Double-Shell Tank Monitor and Control Subsystem.

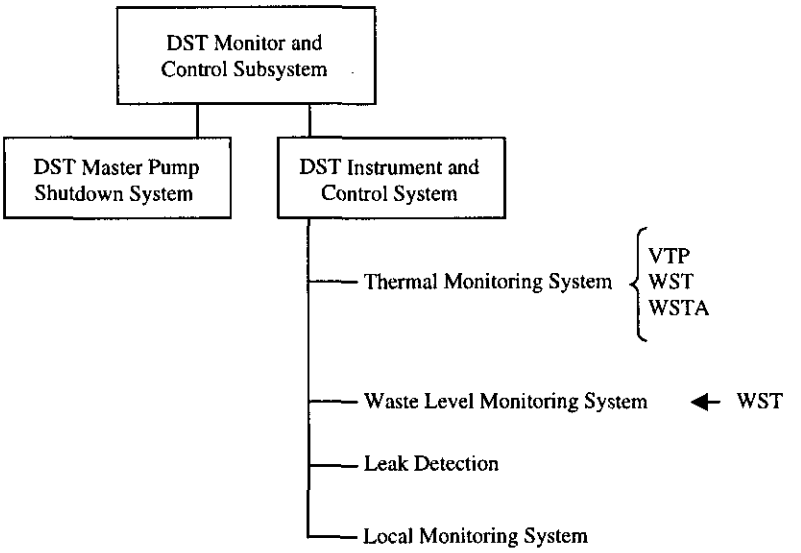


3.1.1 Subsystem/Component Diagrams

Major subsystems for the DST Monitor and Control Subsystem were chosen based on the subsystem's functional requirements and the DST System architecture. Figure 3-5 shows the architectural decomposition of the DST Monitor and Control Subsystem. The major subsystems that have been identified are:

- DST master pump shutdown system
- DST instrument and control system

Figure 3-5. Architectural Decomposition of the Double-Shell Tank Monitor and Control Subsystem.



Note: Information taken from the SDT System Architecture Tree (HNF-4208)

DST = double-shell tank.
VTP = Ventilation Tank Primary.
WST = Waste Storage Tank.
WSTA = Waste Storage Tank Annulus.

The DST Monitor and Control Subsystem includes the hardware, software, instrumentation and controls, and data communication network, required to provide local monitoring and control of tank farm WFD activities. The major WFD activities that require local monitoring and control are the Store Waste, Prepare Waste and Transfer Waste functions shown in Figure 3-1. These functions require monitoring storage conditions of the waste, monitoring the local (tank farm) operation of mixer pumps and transfer pumps, and monitoring and controlling ancillary systems that support the operation of these pumps such as the DST Diluent and Flush Subsystem and pump seal gas and seal water systems.

The DST Monitor and Control Subsystem will monitor the WFD process, control portions of the WFD process by way of the equipment connected as outputs from the system, display status information, and accept operator input. The applications software will include the tools necessary to provide the required functions.

The DST master pump shutdown system is shown as a major subsystem of the DST Monitor and Control Subsystem because it also requires local monitoring and can thus share hardware and software with the DST Monitor and Control Subsystem. The DST master pump shutdown system contains software that enables the selection of a waste transfer route from an operator terminal located in the tank farm control room. The system verifies the correct valve alignment for the selected route and monitors the transfer piping and associated transfer structures for waste leaks during the transfer. Detection of leaks along the transfer route causes the transfer pump to shut down immediately. The major hardware components of the DST master pump shutdown system are the operator interface station and the programmable logic controllers (PLC). The

PLCs monitor the status of the leak detectors and valve position and implement the pump shutdown logic for a selected transfer route. Additional hardware consists of the field-located devices that monitor the leak detectors and transmit the detection of a leak to the PLCs.

The DST instrument and control system is included in the DST Monitor and Control Subsystem because it includes instrument systems that are not included in any other DST specification. The subject instruments normally would be included as components of the DST Storage function. The major components of the DST instrument and control system include the following:

- Annulus and tank bottom annulus leak detection instrumentation
- Tank waste level instrumentation
- Waste tank structure, dome, and bottom concrete temperature detection instrumentation
- Tank waste temperature detection instrumentation
- In-tank closed circuit television (CCTV) system.

3.1.2 Interface Definition

This Section identifies the major interfaces of the DST Monitor and Control Subsystem with other systems. The interface descriptions that follow are intended to help define the subsystem boundaries. These interface relationships are illustrated in Figure 3-6. This Section discusses the inputs from these interfacing systems and facilities. Outputs from the DST Monitor and Control Subsystem to other systems and facilities are discussed in Section 3.2.1.

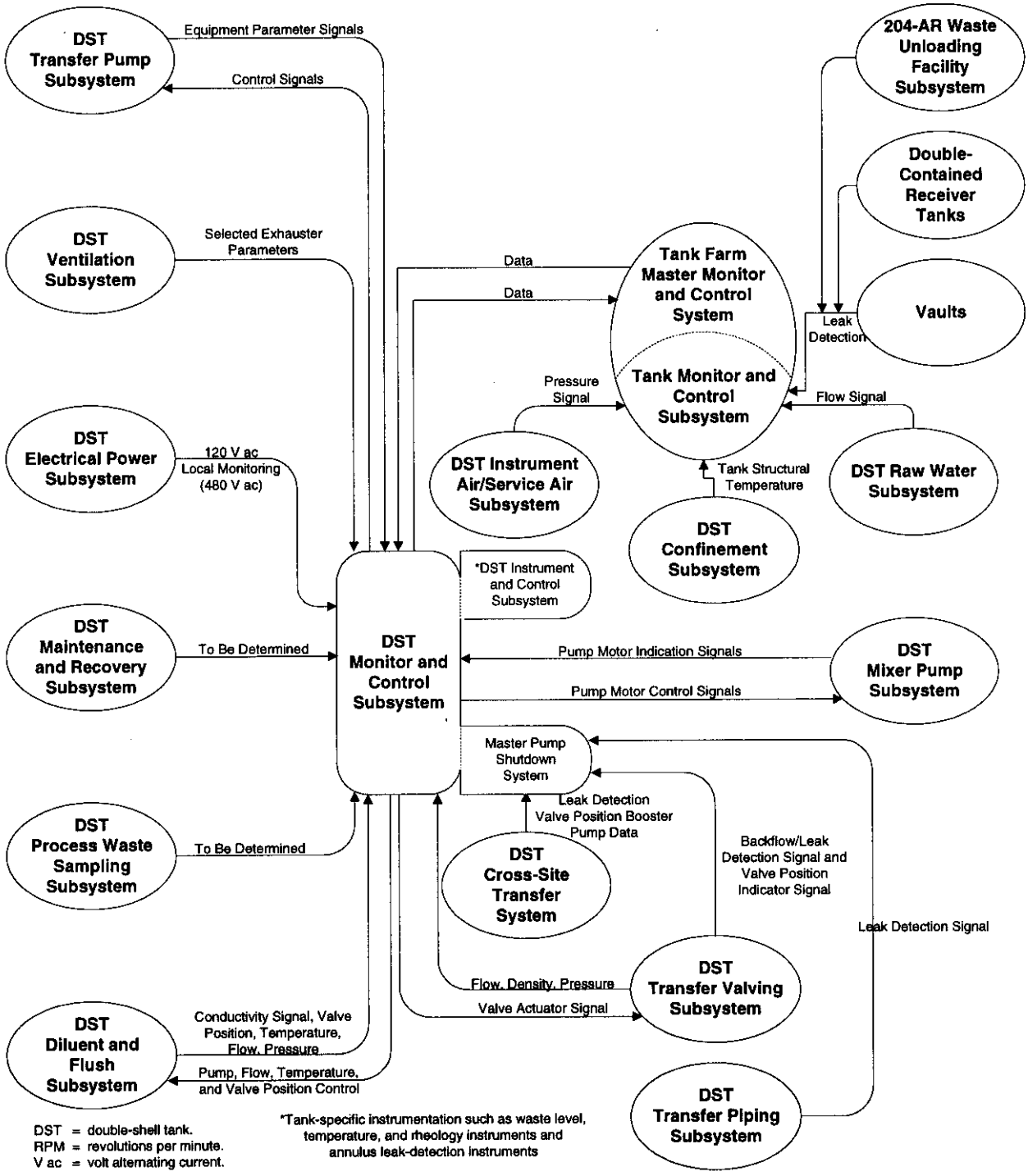
3.1.2.1 Functional Interfaces

3.1.2.1.1 Double-Shell Tank Confinement System. Certain instruments associated with the DST Confinement Subsystem are monitored by the DST Monitor and Control Subsystem and thus become a part of this specification. These instruments include the tank dome, structural, and bottom thermocouples that sense concrete temperature. The primary tank and annulus risers provide physical support for instruments that monitor tank and annulus liquid level and tank waste temperature. The risers also provide an access port for the in-tank closed-circuit television camera. These instruments have been assigned to the DST instrument and control system, which is a component of the DST Monitor and Control Subsystem.

3.1.2.1.2 Double-Shell Tank Ventilation Subsystem. The DST Monitor and Control Subsystem monitors DST Ventilation Subsystem sensors to provide safety interlocks and operator aids for WFD process control. The safety interlocks include high levels of flammable gas in the tank headspace low vacuum, high-efficiency particulate air (HEPA) filter differential pressure, and primary ventilation stack continuous air monitors (CAM).

3.1.2.1.3 Double-Shell Tank Transfer Valving Subsystem. The DST Monitor and Control Subsystem monitors DST Transfer Valving Subsystem valve position, mass and volumetric flow meters, transfer pump discharge pressure, any backflow into the diluent system, and any leaks detected in valve pits. The DST Monitor and Control Subsystem also provides for remote actuation of the DST Transfer Valving Subsystem motor-operated valves.

Figure 3-6. Major Interfaces of the Double-Shell Tank Monitor and Control Subsystem.



3.1.2.1.4 Double-Shell Tank Transfer Pump Subsystem. The DST Monitor and Control Subsystem monitors the transfer pump rotational speed, power consumption, and seal gas flow and pressure. The DST Monitor and Control Subsystem also provides manual/automatic control of the transfer pump flow and pressure.

3.1.2.1.5 Double-Shell Tank Transfer Piping Subsystem. The DST master pump shutdown component of the DST Monitoring and Control Subsystem monitors for leaks from the transfer piping containment boundary and transfer-associated structures.

3.1.2.1.6 Double-Shell Tank Cross-Site Transfer Subsystem. The DST Cross-Site Transfer Subsystem is monitored by the DST master pump shutdown component of the DST Monitor and Control Subsystem. This interface allows DST human machine interface (HMI) to access routing, leak, and flow conditions of transfers through the DST Cross-Site Transfer Subsystem.

3.1.2.1.7 Double-Shell Tank Mixer Pump Subsystem. The DST Monitor and Control Subsystem monitors mixer-pump operational parameters such as pump motor power draw; pump rotational speed; pump bearing and motor winding temperature; pump seal water flow; pump vibration; and pump nozzle pressure, position, and rotation speed. Mixer pump speed and start/stop control is controlled from the DST Monitor and Control Subsystem operator interface stations, located at the tank farms.

3.1.2.1.8 Double-Shell Tank Diluent and Flush Subsystem. The DST Monitor and Control Subsystem monitors and controls diluent system flow, temperature, valve position, pH and pressure to support preconditioning of the transfer route, initiation of waste transfers, dilution of waste during transfers, and dilution of waste in the tank.

3.1.2.1.9 Double-Shell Tank Maintenance and Recovery Subsystem. The DST Maintenance and Recovery Subsystem provides routine and corrective maintenance for DST Monitor and Control Subsystem components. This includes decontamination of waste or dome intrusive instrumentation that are removed from service for repair or replacement.

3.1.2.1.10 Double-Shell Tank Electrical Power Subsystem. The DST Electrical Power Subsystem provides 120 V ac conditioned power to the DST Monitor and Control Subsystem. The DST Monitor and Control Subsystem monitors the 480 V ac bus to provide safe shutdown of components (using an uninterruptible power supply) if a power failure occurs.

3.1.2.1.11 Double-Shell Tank Raw Water Subsystem. The DST Monitor and Control Subsystem monitors raw water flow rate and totalized flow at selected tank farms.

3.1.2.1.12 Double-Shell Tank Instrument Air Subsystem. The DST Monitor and Control Subsystem monitors instrument air header pressure as required at selected tank farms.

3.1.2.1.13 Double-Shell Tank Process Waste Sampling Subsystem. The DST Monitor and Control Subsystem monitors waste sampling equipment as required.

3.1.2.2 Physical Interfaces

Detailed physical interface definition and requirements associated with the DST Monitor and Control Subsystem are captured in interface control documents (ICD) that are application specific and are (to be) developed by line item project organizations responsible for the design of DST subsystems, as directed by the WFD Program Office.

3.1.3 Major Component List

Major components of the DST Monitor and Control Subsystem are listed in Section 3.1.1.

3.1.4 Government-Furnished Property List

Not applicable.

3.1.5 Government-Loaned Property Lists

Not applicable.

3.2 CHARACTERISTICS

This Section contains the minimum requirements related to performance characteristics, physical characteristics, reliability, maintainability, environmental conditions, transportability, and flexibility and expansion. Minimum requirements are identified by SHALL statements, while design goals are identified by SHOULD statements. If a requirement with a "should" statement cannot be satisfied, justification of an alternative design shall be submitted to the Design Authority for approval. The source documents that provide the basis for each requirement are identified in Appendix A.

3.2.1 Performance Characteristics

This Section contains requirements related to the functionality and performance capabilities for the DST Monitor and Control Subsystem.

3.2.1.1 Monitor Double Shell Tank Structure Temperature (as applicable per the tank specific Process Control Plan). The DST Monitor and Control Subsystem shall monitor tank bottom insulating concrete temperature and other selected structure temperatures as measured by existing temperature elements that are a part of the DST Confinement Subsystem.

3.2.1.1.1 Receive Double-Shell Tank Structure Temperature. The DST Monitor and Control Subsystem shall receive tank structure temperature signals from the DST Confinement Subsystem.

a. All tank bottom insulating concrete thermocouple signals shall be received at the DST Monitor and Control Subsystem input/output (I/O) as required, at a selectable polling rate, for tanks that contain sludge that is mobilized by mixer pumps.

b. Tank dome, middle wall, and bottom wall structure thermocouple signals shall be received as required, at a selectable polling rate at the DST Monitor and Control Subsystem I/O.

3.2.1.1.2 Compare Double-Shell Tank Structure Temperature. Not required, trending of temperature data (see 3.2.1.1.3) will provide data for comparison of temperatures.

3.2.1.1.3 Record Double-Shell Tank Structure Temperature. The DST Monitor and Control Subsystem shall record tank structural temperature data.

a. The DST Monitor and Control Subsystem shall provide on-line historical and real-time trending of process parameters with report capability for a period of one week.

3.2.1.1.4 Display Double-Shell Tank Structure Temperature. The DST Monitor and Control Subsystem shall display tank structural thermocouple data.

a. The DST Monitor and Control Subsystem shall provide indication of monitored parameters [resolution $\pm$ 0.06 °C ($\pm$ 0.1 °F)].

3.2.1.1.5 Respond to Off-Normal Double-Shell Tank Structure Temperature. There are no automatic responses to off-normal DST Structure Temperature identified for the DST Monitor and Control Subsystem other than:

a. Provide audible and visual annunciation for all alarm conditions.

3.2.1.2 Monitor Double-Shell Tank Waste Temperature

The DST instrument and control component of the DST Monitor and Control Subsystem shall monitor DST waste temperature to provide a signal that will help determine if operating limits are being exceeded, and to control WFD process operations. Monitoring includes measuring tank waste temperature and transmitting the data to the DST Monitor and Control Subsystem and/or the Tank Monitoring and Control System (TMACS), which will receive, record, display, and compare the waste-level data with operational limits.

3.2.1.2.1 Measure Double-Shell Tank Waste Temperature. The DST instrument and control component of the DST Monitor and Control Subsystem shall measure DST tank waste temperature.

a. Minimum range: 10 to 149 °C (50 to 300 °F)

Loop accuracy: $\pm$ 2.8 °C ($\pm$ 5 °F).

3.2.1.2.2 Receive Double-Shell Tank Waste Temperature. The DST Monitor and Control Subsystem shall receive tank waste temperature data.

a. DST Monitor and Control System shall receive DST Tank Waste Temperature from TMACS, at a selectable polling rate, via Tank Farms Local Area Network (TFLAN) for those temperature probes that are monitored by TMACS.

b. DST Monitor and Control System shall receive DST Tank Waste Temperature at a selectable polling rate at the DST Monitor and Control System local I/O for those temperature probes that are not monitored by TMACS.

3.2.1.2.3 Compare Double-Shell Tank Waste Temperature. The DST Monitor and Control Subsystem shall compare tank waste temperature to operational limits and also control WFD processes.

a. Tank waste temperature shall be compared to High and High-High limits.

3.2.1.2.4 Record Double-Shell Tank Waste Temperature. The DST Monitor and Control Subsystem shall record tank waste temperature.

a. The DST Monitor and Control Subsystem shall provide on-line historical and real-time trending of process parameters with report capability for a period of one week.

3.2.1.2.5 Display Double-Shell Tank Waste Temperature. The DST Monitor and Control Subsystem shall display tank waste temperature.

a. The DST Monitor and Control Subsystem shall provide indication of monitored parameters [resolution $\pm$ 0.06 °C (0.1 °F)].

3.2.1.2.6 Respond to Off-Normal Double-Shell Tank Temperature. The DST Monitor and Control Subsystem shall respond to off-normal DST Tank Temperature.

a. The following equipment will be shut down automatically upon detection of High-High waste temperature in a waste tank:

- Mixer Pumps
- Transfer Pump.

3.2.1.3 Monitor Double-Shell Tank Waste Level

The DST instrument and control component of the DST Monitor and Control Subsystem shall measure the DST liquid waste levels. The measured waste level is transmitted to the DST Monitoring and Control Subsystem and/or the TMACS that will receive, record, display, and compare the waste level data with operational limits.

3.2.1.3.1 Measure Double-Shell Tank Waste Level. The DST instrument and control component of the DST Monitor and Control Subsystem shall measure DST tank waste level.

a. Loop accuracy: $\pm$ 1.3 cm ($\pm$ ½ in.)

3.2.1.3.2 Receive Double-Shell Tank Waste Level. The DST Monitor and Control Subsystem shall receive tank waste level data.

a. DST Monitor and Control Subsystem shall receive DST Tank Waste Level from TMACS; via TFLAN, at a selectable polling rate, for those level gauges that are monitored by TMACS.

b. DST Monitor and Control Subsystem shall receive DST Tank Waste Level directly at the DST Monitor and Control System local I/O for those level gauges that are not monitored by TMACS.

3.2.1.3.3 Compare Double-Shell Tank Waste Level. The DST Monitor and Control Subsystem shall compare tank waste level to operational limits.

a. Interlocks for High and High-High and Low and Low-Low waste level will be provided to prevent equipment damage or harm to the environment or personnel. Interlock values differ from tank to tank.

3.2.1.3.4 Record Double-Shell Tank Level. The DST Monitor and Control Subsystem shall record tank waste level.

a. The DST Monitor and Control Subsystem shall provide on-line historical and real-time trending of process parameters with report capability for a period of one week.

3.2.1.3.5 Display Double-Shell Tank Waste Level. The DST Monitor and Control Subsystem shall display tank waste level.

a. The DST Monitor and Control Subsystem shall provide indication of monitored parameters (including tank level). [Recommended display resolution of 0.254 cm (0.1 in.)].

3.2.1.3.6 Respond to Off-Normal Double-Shell Tank Level. The DST Monitor and Control Subsystem shall respond to off-normal DST Level.

a. The following equipment will be shut down automatically upon detection of High-High waste level in a waste tank:

- Mixer Pumps
- Transfer Pump
- Close Caustic Supply System diluent outlet valve.

b. The following equipment will be automatically shut down upon detection of Low-Low tank waste level:

- Mixer Pumps
- Transfer Pump.

3.2.1.4 Monitor Double-Shell Tank Annulus for Primary Leaks

The DST instrument and control component of the DST Monitor and Control Subsystem shall monitor the DST annulus to determine if a liquid leak has occurred in the primary tank and to

measure the level of the liquid. Monitoring includes detecting leaks, measuring leak levels, and transmitting a signal to the DST Monitor and Control System and/or TMACS that will receive, display, compare, and record the annulus liquid leak data. The annulus CAM system also is used to detect primary tank leaks.

3.2.1.4.1 Measure Double-Shell Tank Waste Temperature. The DST instrument and control component of the DST Monitor and Control Subsystem shall measure DST Tank Annulus for primary leaks.

a. Each DST shall be equipped with three operating leak detector probes placed as equidistantly as possible within the annulus of each DST.

b. Operating annulus CAMs located at DSTs shall continuously monitor for airborne release into the annulus that could give an indication of a leak from the primary tank structure into the annulus.

3.2.1.4.2 Receive Double-Shell Tank Annulus Primary Leak Data. The DST Monitor and Control Subsystem shall receive tank annulus primary leak data.

a. DST Monitor and Control Subsystem shall receive DST annulus primary leak data from TMACS via TFLAN for those tanks whose annuli are monitored by TMACS.

b. DST Monitor and Control System shall receive DST annulus primary leak data directly at the DST Monitor and Control Subsystem local I/O for those tanks that are not monitored by TMACS.

3.2.1.4.3 Compare Annulus Primary Leak Data. (The DST Monitor and Control Subsystem does not perform a compare function in that a leak is detected by a sensor and annunciated at the DST Monitor and Control HMI screen, see 3.2.1.4.5).

3.2.1.4.4 Record Double-Shell Tank Annulus Primary Leak Data. The DST Monitor and Control Subsystem shall record DST annulus primary leak data.

a. The DST Monitor and Control Subsystem shall provide on-line historical and real-time trending of process parameters with report capability for a period of one week.

3.2.1.4.5 Display Double-Shell Tank Annulus Primary Leak Data. The DST Monitor and Control Subsystem shall display tank annulus primary leak data.

a. The DST Monitor and Control Subsystem shall provide indication of monitored parameters (including annulus primary leak data).

3.2.1.4.6 Respond to Annulus Primary Leak. (There are no automatic responses identified for the DST Monitor and Control Subsystem for Annulus Primary Leaks other than to annunciate a leak.)

3.2.1.5 Monitor Ventilation System Operation

DST Monitor and Control Subsystem shall monitor (receive, record, and display) the DST Ventilation System operational parameters to provide local, integrated status to the tank farm operator at the DST Monitor and Control Subsystem operator interface station and/or TMACS.

3.2.1.5.1 Receive Double-Shell Tank Ventilation System Data. The DST Monitor and Control Subsystem shall receive tank ventilation system data.

a. The DST Monitor and Control Subsystem shall receive the following DST ventilation system data from TMACS via TFLAN for those ventilation parameters monitored by TMACS:

- Tank vapor space pressure
- Annulus exhaust stack beta CAM alarm status
- Primary exhaust stack beta CAM alarm status
- Standard hydrogen monitor system (SHMS) hydrogen concentration and alarm status
- Primary exhauster run status
- Annulus exhauster run status
- HEPA filter differential pressure interlock status.

b. The DST Monitor and Control System shall receive DST ventilation system data directly at the DST Monitor and Control Subsystem local I/O for those ventilation parameters that are not monitored by TMACS.

3.2.1.5.2 Compare Double-Shell Tank Ventilation System Data. The DST Monitor and Control Subsystem shall compare ventilation system parameters with the desired value or status.

a. All ventilation parameters monitored by the DST Monitor and Control Subsystem except tank vapor space pressure are contact status from other equipment (The DST Monitor and Control Subsystem does not perform a comparison function).

b. Tank dome pressure shall be compared to operational limits.

3.2.1.5.3 Record Double-Shell Tank Ventilation System Data. The DST Monitor and Control Subsystem shall record DST ventilation system data.

a. The DST Monitor and Control Subsystem shall provide on-line historical and real-time trending of process parameters with report capability for a period of one week.

3.2.1.5.4 Display Double-Shell Tank Ventilation System Data. The DST Monitor and Control Subsystem shall display tank ventilation system data.

a. The DST Monitor and Control Subsystem shall provide indication of monitored (ventilation system) parameters.

3.2.1.5.5 Respond to Ventilation System Data. The DST Monitor and Control Subsystem shall respond to off-normal ventilation system data.

a. The following equipment shall be automatically shutdown upon detection of Low-Low vacuum in tank dome vapor space.

- Mixer Pumps
- Transfer Pump.

3.2.1.6 Position Motor-Operated Valves

3.2.1.6.1 Transmit Motor-Operated Valve Actuation. DST Monitor and Control Subsystem shall transmit motor-operated valve actuation control signal for remote control of valves in the transfer pump pits. This function transmits a control signal to the Receive Motor-Operated Valve Actuation function.

a. All remote-controlled valve auto/manual and position selections and indications shall be provided by the DST Monitor and Control Subsystem.

3.2.1.7 Monitor Valve Position

3.2.1.7.1 Receive Transfer Valve Position. The DST master pump shutdown system component of the DST Monitor and Control Subsystem shall receive transfer valve position data from the Transmit Transfer Valve Position Data function.

a. Transfer valve position sensors shall be connected to the DST local I/O (PLCs).

b. All remote-controlled valve auto/manual and position selections and indications shall be provided at the DST retrieval control system component of the DST Monitor and Control Subsystem.

3.2.1.7.2 Compare Transfer Valve Position Data. The DST master pump shutdown system component of the DST Monitor and Control Subsystem shall compare transfer valve position data with the desired position for selected route.

a. The valve positions are verified according to preprogrammed logic diagrams for approved transfer routes using the valve position verification HMI screens.

3.2.1.7.3 Record Transfer Valve Position Data. The DST master pump shutdown system component of the DST Monitoring and Control Subsystem shall record transfer valve position data.

a. Provide prioritized, grouped, and time/date stamped alarm summary screen and event log of the DST Monitor and Control Subsystem.

3.2.1.7.4 Display Transfer Valve Position Data. The DST master pump shutdown system component of the DST Monitor and Control Subsystem shall display transfer valve position data.

a. Operational Requirements – shall be able to display the valve position graphically.

b. The symbol for each open valve port will be green. The symbol each closed port will be white. When in transition, the valve symbols will be yellow.

3.2.1.7.5 Respond to Incorrect Valve Position. The DST master pump shutdown component of the DST Monitor and Control Subsystem shall respond to incorrect valve position indication by providing an interlock to prevent a waste transfer or terminating an existing transfer.

a. Monitor for selected DST master pump shutdown system inputs and automatically provide an interlock to prevent a transfer if a valve located in the transfer route is in the incorrect position.

3.2.1.8 Monitor Diluent/FlushWater Operation

The DST Monitor and Control Subsystem shall monitor (receive, compare, record, display, and control) the Diluent and Flush Water System to provide local-remote integrated monitoring and control of the system at the DST Monitor and Control Subsystem operator interface station.

3.2.1.8.1 Receive Diluent/Flush Water System Data. The DST Monitor and Control System shall receive data from the Diluent/Flush Water System.

a. The DST Monitor and Control Subsystem shall receive the following data from the Diluent/Flush Water System.

- Diluent/Flush Water Temperature
- Diluent/Flush Water Pressure
- Diluent/Flush Water Flow
- Diluent/Flush Water Chemical Composition
- Diluent/Flush Water Motor Operated Valve Position.

3.2.1.8.2 Compare Diluent/Flush Water Data. The DST Monitor and Control Subsystem shall compare diluent/flush water data with desired operating limits.

a. The following parameters shall be compared to desired operating limits (set points):

- Diluent/Flush Water Temperature (High/Low)
- Diluent/Flush Water Pressure (High/Low)
- Diluent/Flush Water Flow (High/Low)
- Diluent/Flush Water Chemical Composition (High/Low pH)
- Diluent/Flush Water Valve Position (Open/Closed).

3.2.1.8.3 Record Diluent/Flush Water Data. The DST Monitor and Control Subsystem shall record diluent/flush water data.

a. The DST Monitor and Control Subsystem shall provide on-line historical and real-time trending of process parameters with report capability for a period of one week.

3.2.1.8.4 Display Diluent/Flush Water Data. The DST Monitor and Control Subsystem shall display diluent/flush water data.

a. The DST Monitor and Control Subsystem shall provide indication of monitored parameters (including diluent/flush water data).

3.2.1.8.5 Respond to Diluent/Flush Water Data. The DST Monitor and Control Subsystem shall respond to off-normal diluent/flush water data.

a. The DST Monitor and Control Subsystem shall place the Diluent/Flush outlet valve to the waste tank into recirculation mode upon detection of the following:

- Loss of 120 V ac power to PLC Uninterruptible Power Supply
- Master Pump Shutdown
- Operator–Initiated Shutdown
- Waste Tank High-High Level.

b. The DST Monitor and Control Subsystem shall place the Diluent/Flush flush tank isolation valve in the closed condition upon detection of the following:

- Loss of 120 V ac power to Programmable Logic Controller Uninterruptible Power Supply
- Master Pump Shutdown
- Operator –Initiated Shutdown.

3.2.1.9 Monitor Waste Backflow

3.2.1.9.1 Receive Waste Backflow Detected. The DST master pump shutdown system component of the DST Monitor and Control Subsystem shall receive a waste-backflow-detected (leak past isolation valves into the raw water system) indication from the Transmit Waste Backflow Detected function.

a. The monitoring frequency of the (backflow) leak detection system shall be continuous.

3.2.1.9.2 Compare Waste Backflow Detected. The DST master pump shutdown system component of the DST Monitor and Control Subsystem shall compare waste backflow status to the desired status.

a. The required response time of the (backflow) leak detection system shall be instantaneous (less than or equal to 1 second).

3.2.1.9.3 Record Waste Backflow Detected. The DST master pump shutdown system component of the DST Monitor and Control Subsystem shall record waste backflow status received by the Receive Waste Backflow Detected function.

a. The DST master pump shutdown system shall be able to log (backflow) alarms to computer disk in sequence as they occur with time and date.

3.2.1.9.4 Display Waste Backflow Detected. The DST master pump shutdown component of the DST Monitor and Control Subsystem shall display waste backflow detection.

a. DST Monitor and Control Subsystem shall display (backflow) leak detection status.

3.2.1.9.5 Respond to Waste Backflow Detected. The DST master pump shutdown system component of the DST Monitor and Control Subsystem shall respond to waste backflow detection.

a. Respond to backflow detected with automatic shut down of transfer pump by DST master pump shutdown system.

3.2.1.10 Position Transfer Pump Suction Intake

3.2.1.10.1 Transmit Pump Intake Position Command. The DST Monitor and Control Subsystem shall transmit pump intake up/down position command as a control signal for moving the transfer pump suction intake to the desired height within the DST. The output of this function is provided to the suction intake winch direction controller.

a. The DST Monitor and Control Subsystem shall provide the control signal to raise or lower the suction bell to any position within its range of travel.

3.2.1.11 Monitor Position of Transfer Pump Suction Intake

3.2.1.11.1 Receive Transfer Pump Suction Intake Position. DST Monitor and Control Subsystem shall receive transfer pump suction intake position data.

a. The DST Monitor and Control Subsystem will receive the output of the suction bell position detection transducer.

3.2.1.11.2 Compare Transfer Pump Suction Intake Position. The DST Monitor and Control Subsystem shall compare the suction bell position with the tank level.

a. The tank level must be at least 61 cm (24 in.) above the winch (suction) position.

3.2.1.11.3 Record Transfer Pump Suction Intake Position.

Not a requirement

3.2.1.11.4 Display Transfer Pump Suction Intake Position. The DST Monitor and Control Subsystem shall display transfer pump suction intake position data.

a. The nominal winch (suction) position will be shown on the overview and tank-specific screens.

- Range: 0 to 635 cm (0 to 250 in.)
- Resolution: 2.54 cm (1 in.).

3.2.1.12 Pump Waste/Diluent

3.2.1.12.1 Transmit "Operate Transfer Pump" Command. The DST Monitor and Control Subsystem shall transmit operate transfer pump command as a control signal for initiating or halting the transfer pump operation or manually controlling pump speed to provide a desired flow or pressure. The output of this function is provided to the Receive Operate Transfer Pump Command function.

a. The DST Monitor and Control Subsystem will provide pump auto/manual, on/off, and start/stop selections and indications.

3.2.1.13 Monitor Transfer Pump Operation

3.2.1.13.1 Receive Transfer Pump Operation Data. The DST Monitor and Control Subsystem shall receive pump run status from the Transmit Transfer Pump Operation Data function.

a. Instrumentation will provide the following transfer pump monitoring and control functions to the DST Monitor and Control Subsystem:

- Motor Speed
- Motor Amperage
- Motor Winding Temperature
- Seal Gas Flow
- Seal Gas Pressure.

3.2.1.13.2 Compare Transfer Pump Operation Data. DST Monitor and Control Subsystem shall compare transfer pump operational data to operational limits.

a. Interlocks for the following parameters will be provided to prevent equipment damage or harm to the environment or personnel.

- Motor Amperage
- Seal Gas Flow
- Seal Gas Pressure.

3.2.1.13.3 Record Transfer Pump Operation Data. The DST Monitor and Control Subsystem shall record transfer pump operation data.

a. The DST Monitor and Control Subsystem shall provide on-line historical and real-time trending (recording) of process parameters with report capability for a period of one week for:

- Motor Speed
- Motor Amperage.

3.2.1.13.4 Display Transfer Pump Operation Data. The DST Monitor and Control Subsystem shall display transfer pump operation data received by the Receive Transfer Pump Operation Data function.

a. The running status of waste transfer pumps shall be displayed at the waste transfer annunciator set of HMI graphical screens.

- Motor Speed Range: 0 to 100 percent
- Motor Current Range: 0 to 100 percent
- Motor Winding Temperature Range: 0 to 204 °C (0 to 400 °F).

3.2.1.13.5 Respond to Abnormal Transfer Pump Operation. The DST Monitor and Control Subsystem shall respond to abnormal pump operation.

a. The DST Monitor and Control Subsystem shall provide a High transfer pump motor current alarm and shut down the transfer pump on High-High motor current. Off-normal values are programmable by a systems engineer.

b. The DST Monitor and Control Subsystem shall provide a High transfer pump motor winding temperature alarm and shut down the transfer pump motor on High-High-motor winding temperature. Off-normal values are programmable by a systems engineer.

3.2.1.14 Monitor Process Parameters for Waste Transfers

3.2.1.14.1 Receive Waste Transfer Flow (Mass/Volumetric) Rate. The DST Monitor and Control Subsystem shall receive waste transfer flow rate data from Transmit Waste Transfer Flow Rate function.

a. The DST Transfer Valving Subsystem shall provide the capability to measure and transmit the waste flow rate at the transfer pump discharge.

3.2.1.14.2 Compare Waste Transfer Flow Rate Data. The DST Monitor and Control Subsystem shall compare waste transfer flow rate data received by the Receive Waste Transfer Flow Rate function to operational limits to initiate an alarm of off-normal flow and/or provide automatic flow control, as required.

a. Monitoring and control of the waste transfer flow rate will be programmed into the PLC, including proportional, integral, and derivative (PID) algorithms.

b. Flow rate (mass flow and volumetric flow) loop accuracy shall be ±5 percent of process range.

3.2.1.14.3 Record Waste Transfer Flow Rate. The DST Monitor and Control Subsystem shall record waste transfer flow data.

a. The DST Monitor and Control Subsystem shall record transfer pump flow rate continuously (mass flow and volumetric flow).

3.2.1.14.4 Display Waste Transfer Flow Rate. The DST Monitor and Control Subsystem shall display waste transfer flow rate received by the Receive Waste Transfer Flow Rate function.

a. The dynamic process and equipment operating data associated with waste transfer routes shall be displayed on the DST Monitor and Control Subsystem waste transfer annunciator set of HMI graphical screens.

b. Volumetric flow-rate range is 0 to 628 L/min (0 to 166 gal/min).

3.2.1.14.5 Respond to Abnormal Transfer Flow Rate. The DST Monitor and Control Subsystem shall respond to abnormal waste transfer flow rate <TBD>. [See Appendix C(a)].

a. The transfer pump shall have a discharge flow Low-Low interlock (flow value <TBD>).

3.2.1.15 Monitor Transfer Pump Discharge Pressure

3.2.1.15.1 Receive Transfer Pump Discharge Pressure. The DST Monitor and Control Subsystem shall receive transfer pump discharge pressure from the Transmit Transfer Pump Discharge Pressure Data function.

a. The DST Transfer Valving Subsystem shall provide the capability to measure and transmit transfer pump discharge pressure.

3.2.1.15.2 Compare Transfer Pump Discharge Pressure Data. The DST Monitor and Control Subsystem shall compare waste transfer pump discharge pressure data with operational limits.

a. Transfer pump discharge pressure shall be compared to High and High-High operational limits (setpoints).

b. Pressure loop accuracy shall be ±5 percent of process range.

3.2.1.15.3 Record Transfer Pump Discharge Pressure Data. The DST Monitor and Control Subsystem shall record transfer pump discharge pressure data.

a. The DST Monitor and Control Subsystem shall continuously record transfer pump discharge pressure.

3.2.1.15.4 Display Transfer Pump Discharge Pressure Data. The DST Monitor and Control Subsystem shall display transfer pump discharge pressure data.

a. The dynamic process and equipment operating data associated with waste transfer routes shall be displayed on the DST Monitor and Control Subsystem waste transfer annunciator set of HMI graphical screens.

b. The pressure display range shall be 0 to 6,239 kPa (0 to 905 lbf/in^2) <TBR>.

3.2.1.15.5 Respond to Abnormal Transfer Pump Discharge Pressure. The DST Monitor and Control Subsystem shall respond to abnormal pump discharge pressure.

a. The transfer pump shall have a discharge pressure High alarm and High-High interlock (pressure value <TBD>).

3.2.1.16 Monitor Waste Transfer Density/Temperature

3.2.1.16.1 Receive Waste Transfer Density/Temperature Data. The DST Monitor and Control Subsystem shall receive the Waste Transfer Density/Temperature Data from the Transmit Waste Transfer Density/Temperature Data function.

a. The DST Transfer Valving Subsystem shall provide the capability to measure and transmit waste density (and temperature) at the transfer pump discharge.

3.2.1.16.2 Compare Waste Transfer Density/Temperature Data. The DST Monitor and Control Subsystem shall compare waste density/temperature data with operational limits.

a. Density shall have a loop accuracy of $\pm$5 percent of process range.

b. Temperature shall have a loop accuracy of $\pm$2.8 °C ($\pm$5 °F).

c. Density shall be compared to High and High-High operational limits (setpoints).

3.2.1.16.3 Record Waste Transfer Density/Temperature Data. The DST Monitor and Control Subsystem shall record waste density data received by the Receive Waste Transfer Density/Temperature Data function.

a. The system shall continuously record density and temperature of waste being transferred.

3.2.1.16.4 Display Waste Transfer Density/Temperature Data. The DST Monitoring and Control Subsystem shall display waste density/temperature data.

a. The dynamic analog data associated with waste transfer routes shall be displayed on the DST Monitor and Control Subsystem waste transfer annunciator set of HMI graphical screens.

b. Density range is 0.900 to 1.500 g/cm^3 (Note: display resolution to 0.001 g/cm^3 required to help indicate minor qualitative changes in density needed to assess slurry characteristics).

c. Temperature minimum range is –10.0 to 200.0 °C (14.0 to 392.0 °F).

3.2.1.16.5 Respond to Abnormal Density/Temperature Data. The DST Monitor and Control Subsystem shall respond to abnormal waste density/temperature <TBD see Appendix C (b)>.

3.2.1.17 Monitor for Leaks in Transfer-Associated Structures

3.2.1.17.1 Transmit Transfer-Associated Structure Leak Data. The DST master pump shutdown system component of the DST Monitor and Control Subsystem shall transmit transfer-associated structure leak sensor data to Receive Transfer-Associated Structure Leak Data function.

a. The leak detection system sensors shall be compatible with the DST Monitor and Control Subsystem.

3.2.1.17.2 Receive Transfer-Associated Structure Leak Data. The DST master pump shutdown system component of DST Monitor and Control Subsystem shall receive transfer-associated structure leak sensor data from Transmit Transfer-Associated Structure Leak Data function.

a. The monitoring frequency of the pit leak detection system shall be continuous (without interruption).

3.2.1.17.3 Compare Transfer-Associated Structure Leak Data. The DST master pump shutdown system component of the DST Monitor and Control Subsystem shall compare leak data to operating limits.

a. The required response time of the pit leak detection system shall be instantaneous (less than or equal to 1 second).

3.2.1.17.4 Record Transfer-Associated Structure Leak Data. The DST master pump shutdown system component of the DST Monitor and Control Subsystem shall record transfer-associated structure leak sensor data.

a. The DST master pump shutdown system shall be able to log alarms to computer disk with time and date in sequence as the alarms occur.

3.2.1.17.5 Display Transfer-Associated Structure Leak Data. The DST master pump shutdown system component of the DST Monitor and Control Subsystem shall display transfer associated structure leak sensor data.

a. The DST master pump shutdown system shall be able to display graphically on the HMIs the selected transfer routes (including status of input/output elements) in the waste transfer annunciator mode of operation.

3.2.1.17.6 Respond to Leak in Transfer-Associated Structure. The Master Pump Shutdown component of the DST Monitor and Control Subsystem shall respond to leak in transfer-associated structure.

a. Monitor for selected DST master pump shutdown system inputs and automatically (instantaneously) initiate the shut down the transfer pump if an input is detected.

3.2.1.18 Monitor for Double-Shell Tank Transfer Pipe Leakage

3.2.1.18.1 Transmit Primary Confinement Piping Leak Detection Data. The DST Transfer Piping Subsystem shall detect and transmit primary confinement piping leak detection data to Receive Primary Confinement Piping Leak Detection Data function.

a. The DST Transfer Piping System shall detect leakage from the primary confinement piping into the secondary confinement piping and transmit leak data to DST Monitor and Control Subsystem.

3.2.1.18.2 Receive Primary Confinement Piping Leak Detection Data. The DST master pump shutdown system component of the DST Monitor and Control Subsystem shall receive leak data from the Transmit Primary Confinement Piping Leak Detection Data function.

a. The monitoring frequency of the low point leak detection system shall be continuous (without interruption).

3.2.1.18.3 Compare Primary Confinement Piping Leak Data. DST Monitor and Control Subsystem shall compare primary confinement piping leak data with operating limits.

a. The required response time of the low point leak detection system shall be instantaneous (less than or equal to 1 second).

3.2.1.18.4 Record Primary Confinement Piping Leak Detection Data. DST Monitor and Control Subsystem shall record primary confinement piping leak detection data.

a. The DST Monitor and Control Subsystem shall be able to log alarms to computer disk with time and date in the sequence as the alarms occur.

3.2.1.18.5 Display Primary Confinement Piping Leak Detection Data. The DST master pump system shutdown component of the DST Monitor and Control Subsystem shall display primary confinement piping leak detection data.

a. The DST master pump shutdown system shall be able to display graphically on the HMIs the selected transfer routes (including status of input/output elements) in the waste transfer annunciator mode of operation.

3.2.1.18.6 Respond to Primary Confinement Piping Leak. The DST master pump shutdown system component of the DST Monitor and Control Subsystem shall respond to a primary confinement piping leak.

a. Monitor for selected DST master pump shutdown system inputs and automatically shuts down the transfer pump if an input is detected.

3.2.1.19 Perform Material Balance for Double-Shell Tank Transfers

The DST Monitor and Control Subsystem shall provide data that will be used to perform material balance periodically during the waste transfer to determine that the amount of waste being delivered to the destination agrees with the amount of waste being removed from the source tank.

a. Loop accuracy: ±1.3 cm (±1/2 in.) for sending and receiving tank plus error in transfer line volume as applicable for tank level to tank level material balance.

b. Accuracy: ±5 percent of range for volumetric flow totalizer and ±1.3 cm (±1/2 in.) for level for totalized flow to tank level comparison.

3.2.1.20 Perform Material Balance Post Double-Shell Tank Transfer

DST Monitor and Control Subsystem shall provide data that will be used to perform material balance following completion of waste transfer to determine that the amount of waste delivered to the destination agrees with the amount of waste removed from the source tank.

a. Loop accuracy: ±1.3 cm (±1/2 in.) for sending and receiving tank plus error in transfer line volume as applicable for tank level to tank level material balance.

b. Accuracy: ±5 percent of range for volumetric flow totalizer and ±1.3 cm (±1/2 in.) for level for totalized flow to tank level comparison.

3.2.1.21 Operate Mixer Pump

3.2.1.21.1 Transmit Operate Mixer Pump Command. DST Monitor and Control Subsystem shall transmit operate mixer pump command as a control signal input for initiating, modifying, or halting the mixer pump operation. This function is provided to the Receive Operate Mixer Pump Command function.

a. All pump auto/manual, on/off, and start/stop selections and indications will be provided to the monitoring system.

3.2.1.22 Monitor Mixer Pump Operation

DST Monitor and Control Subsystem shall provide indication of the mixer pump operational parameters.

3.2.1.22.1 Receive Mixer Pump Operation Data. DST Monitor and Control Subsystem shall receive data from the Transmit Mixer Pump Operation Data function.

a. Instrumentation shall provide the following monitoring and control functions for the mixer pump: motor speed and amperage, motor bearing temperature, motor starter winding temperature, turntable rotation and orientation, pump vibration, and nozzle discharge pressure.

3.2.1.22.2 Compare Mixer Pump Operational Parameters Data. DST Monitor and Control Subsystem shall compare mixer pump operational parameters with operational limits.

a. Interlocks will be provided to prevent equipment damage or harm to the environment or personnel (this implies that a pump parameter is compared with an operational limit). The interlocks are:

- Motor vibration (High-High)
- Motor current (High-High)
- Motor winding temperature (High-High)
- Motor upper and lower bearing temperature (High-High).

3.2.1.22.3 Record Mixer Pump Operation Data. DST Monitor and Control Subsystem shall record mixer pump operation data.

a. The DST Monitor and Control Subsystem shall provide on-line historical and real-time trending (recording) of process parameters with report capability for a period of one week. Recorded parameters are:

- Mixer pump speed
- Mixer pump current.

3.2.1.22.4 Display Mixer Pump Operation Data. DST Monitor and Control Subsystem shall display mixer pump operation data.

a. The DST Monitor and Control Subsystem shall provide indication of mixer pump operational data.

3.2.1.22.5 Respond to Abnormal Mixer Pump Operation Data. DST Monitor and Control Subsystem shall respond to off-normal mixer pump operational parameter by providing mixer pump shutdown interlocks.

a. Shut down mixer pump for the following reasons:

- Motor vibration (High-High)
- Motor current (High-High)
- Motor winding temperature (High-High)
- Bearing temperature (High-High)
- Off-normal values <TBD>.

3.2.1.23 Monitor Double-Shell Tank Service Water Usage

3.2.1.23.1 Receive Service Water Totalized Flow. The DST Monitor and Control Subsystem shall receive service water totalized flow from the Transmit Service Water Totalized Flow function for those tank farms that provide service water transmitters.

a. The service water usage shall be monitored every 24 hours as a minimum (however service water flow totalizers with transmitters allow continuous monitoring).

3.2.1.23.2 Compare Service Water Totalized Flow Data. The DST Monitor and Control Subsystem shall compare service water totalized flow with operational limits.

a. Compare current totalizer value with previous value to verify that there has been no unaccounted for service water usage.

3.2.1.23.3 Record Service Water Totalized Flow Data. The DST Monitor and Control Subsystem shall record service water totalized flow data.

a. Service water totalized flow must be recorded from monitoring period to monitoring period to provide data to perform a usage comparison.

3.2.1.23.4 Display Service Water Totalized Flow Data. The DST Monitor and Control Subsystem shall display service water totalized flow.

a. Non-resettable service water totalized flow shall be displayed on the HMI graphical screens to provide visual access to the remotely transmitted totalizer value.

3.2.2 Physical Characteristics

This Section contains requirements related to physical characteristics (maximum/minimum physical size, weight, shape, etc.).

a. All permanently installed operator interface screens shall be sized such that they are readable from a distance of 1.52 m (5 ft) [suggest a minimum 53 cm (21 in.) diagonal measurement].

b. The physical arrangement and location of controls, displays, and alarms on control panels and HMI displays shall provide for efficient use of controls and rapid and accurate viewing of the displays and shall be in-accordance with *General Design Criteria*, DOE Order 6430.1A. (Recommend 10 megabits per second for TFLAN network to ensure that operator response to query on the network is less than 2 seconds and operator feedback to control action is less than 0.2 seconds.)

3.2.3 Reliability

This Section contains the requirements and other features that promote reliability.

a. The overall mission system reliability (from sensor to actuating device) shall have, at the minimum, a 90 percent chance of completing a seven day (168 h) transfer.

b. Only the transfer or booster pump associated with a shutdown of a transfer shall be shut down if simultaneous waste transfers are taking place.

3.2.4 Maintainability

The design shall consider the maintainability factors peculiar to the specific equipment to be used in the DST Monitor and Control Subsystem.

a. The maintainability guidance provided in *Human Factors Design Guidelines for Maintainability of DOE Nuclear Facilities*, UCRL 15673, shall be considered during subsystem design.

b. Equipment and instruments requiring personnel access for periodic calibration or maintenance shall not be located beneath cover blocks or in areas where personnel exposures are not as low as reasonably achievable (ALARA).

c. Instrument isolation valves for instrument sensor isolation and equalization shall be located outside of the primary transfer-associated structures.

3.2.5 Environmental Conditions

This Section provides design requirements relevant to natural and induced environmental conditions.

3.2.5.1 Natural Environments

This Section defines the natural conditions (e.g., weather).

a. The subsystem shall be designed for the natural environmental conditions specified in *Natural Phenomena Hazards, Hanford Site, Washington,* HNF-SD-GN-ER-501.

b. The subsystem shall be designed to withstand the natural phenomena hazards as specified in *Engineering Design and Evaluation*, RPP-PRO-097.

3.2.5.2 Induced Environments

This Section defines the induced environment impinging on the subsystem including waste chemistry, radiation, and other requirements.

3.2.5.2.1 Chemistry. The subsystem components shall be designed to perform their intended function in the chemical environment defined in *Estimated Maximum Concentration of Radionuclides and Chemical Analytes in Phase 1 and Phase 2 Transfers*, HNF-2937.

3.2.5.2.2 Radiation. The subsystem shall be designed for maximum (calculated) bounding radiation environment for direct contact with tank waste as defined in *Estimated Dose to In-Tank Equipment and Ground-Level Transfer Equipment During Privatization*, HNF-2004.

3.2.6 Transportability

Not applicable.

3.2.7 Flexibility and Expansion

The subsystem shall satisfy the following flexibility and expansion requirements:

a. The DST Monitor and Control Subsystem design shall allow for the provision of spare or expandable input/output capability and the flexibility to change software to provide for future expansion. (Recommend 10 percent to 20 percent spare input and output slots for PLCs.)

b. DST Monitor and Control Subsystem HMI stations shall be able to access the screens of any other DST Monitor and Control Subsystem HMI stations.

3.3 DESIGN AND CONSTRUCTION

The DST Monitor and Control Subsystem shall comply with DOE Order 6430.1A, Sections 1300-7 and 1323.

3.3.1 Materials, Processes, and Parts

This Section defines DST Monitor and Control Subsystem requirements governing the use of materials and processes.

a. Drawings for projects shall be prepared in accordance with the requirements of *Preparation and Control Standard for Engineering Drawings,* RPP-PRO-709.

b. Electrical materials and equipment shall be Underwriters Laboratories, Inc. (UL)- or factory material (FM)-tested, with label attached, for the purpose intended, whenever such products are available. When no UL- or FM-listed products are available, testing and certification by another nationally recognized testing agency may be acceptable. Installation methods shall be in accordance with the manufacturer's instructions, with *National Electrical Code*, NFPA 70, and with other applicable requirements.

3.3.2 Electromagnetic Radiation

The subsystem shall comply with electromagnetic radiation emission requirements set forth in *A List of EMI/EMC Requirements*, HNF-2962.

3.3.3 Nameplates and Product Marking

This Section defines marking and nameplate requirements of the various assemblies and subassemblies that make up the DST Monitor and Control Subsystem.

a. The subsystem shall label new equipment and/or modifications to existing equipment in a standardized format in accordance with the tank farm labeling program as specified in *RPP Administration,* "Tank Farm Operations Equipment Labeling," HNF-IP-0842, Volume II, Section 6.1. Equipment identifiers within the HMI interface screens shall be consistent with the equipment label in the field.

3.3.4 Workmanship

Reserved. The requirements for workmanship are to be addressed in lower level project design documentation (drawings, procurement specifications, etc.).

3.3.5 Interchangeability

All like equipment and parts shall be interchangeable/standardized to the maximum extent practical.

3.3.6 Safety

The subsystem shall be designed to protect the public, environment, workers, and equipment in accordance with the requirements of this section.

3.3.6.1 Personnel Safety

Personnel shall be protected from work place hazards in accordance with the following requirements:

a. The subsystem shall incorporate design features that comply with the requirements of 29 CFR 1910, Subparts D, E, G, J, L, M, O, and S.

b. The DST Monitor and Control Subsystem shall be designed to keep personnel exposures ALARA in accordance with *Radiological Design Review Process*, RPP-PRO-1622, and *ALARA Decision-Making Methods*, RPP-PRO-1621.

c. Auditory warning and alarm systems shall be designed to ensure that they can be heard at the local noise levels of the area they are intended to cover and visual alarm stimuli must provide effective alerting stimulus.

3.3.6.2 Equipment Protection

The DST Monitor and Control Subsystem shall be designed to avoid damage to other components.

a. All activities shall satisfy the tank dome loading requirements specified in HNF-SD-WM-TSR-006, Section 5.16.

3.3.6.3 Environmental Safety

The DST Monitor and Control Subsystem shall be designed to protect the public and environment in accordance with the following requirements:

a. The DST Monitor and Control Subsystem and components shall be designed in accordance with safety classifications. The safety classification shall be determined using the processes described in "Safety Analysis and Technical Safety Requirements," HNF-IP-0842, Vol. IV, Section 6.12; "Safety Analysis Process - Facility Change or Modification," HNF-IP-0842, Vol. IV, Section 6.11; "Safety Analysis Process - New Project," HNF-IP-0842, Vol. IV, Section 6.10; and "Hazard and Accident Analysis Process," HNF-IP-0842, Vol. IV, Section 6.9. Preliminary safety classifications area provided for reference in Appendix B.

b. All equipment installed in areas in and around the tank that are subject to ignition controls shall be designed to meet the requirements of HNF-SD-WM-TSR-006, Section 5.10, "Ignition Controls." Areas requiring controls are delineated in HNF-SD-WM-SAR-067, Appendix K. The Flammable Gas Equipment Advisory Board shall be consulted whenever the application or interpretation of the requirements is unclear.

3.3.7 Human Performance/Human Engineering

The subsystem shall be designed for ease of operation.

a. Subsystem design shall comply with DOE Order 6430.1A, Section 1300.12, "Human Factors Engineering."

b. HMI screen symbology, legends, and color coding shall be identical for each project to enable the same Operators to operate each project's HMI.

3.3.8 Decontamination and Decommissioning

This Section defines features found to enhance decontamination at the end of the DST Monitor and Control Subsystem's life.

a. All components that may become contaminated with radioactive or other hazardous materials under normal or abnormal operating conditions shall be designed to incorporate measures to simplify future decontamination and decommissioning in accordance with DOE Order 6430.1A, Section 1300-11.

3.4 DOCUMENTATION

This Section defines the procedures that will control various documents associated with the DST Monitor and Control Subsystem.

a. Records, documents, and drawing control pertinent to design functions shall be in accordance with *Quality Assurance Records Standards*, RPP-PRO-222, and *Document Control Program Standards*, RPP-PRO-224. Engineering document development shall be in accordance with RPP-PRO-709.

b. All DST Monitor and Control Subsystem structures, systems, and components (SSC) shall be incorporated into the master equipment list and Safety Equipment List in accordance with <TBD>.

c. Procured software within the definitions of *Computer Software Quality Assurance Requirements,* HNF-PRO-309, shall be subject to the controls and documentation requirements listed in HNF-PRO-309, Section 2.3.

d. Software generated on site and within the definitions of HNF-PRO-309 shall be developed, verified, and validated; shall meet the documentation requirements; and shall be under the configuration management controls of HNF-PRO-309.

3.5 LOGISTICS

This Section identifies maintenance infrastructure support requirements.

3.5.1 Maintenance

Facility design shall provide for routine preventive maintenance/calibration, where required, and maintenance, repair, or replacement of equipment subject to failure. The subsystem shall be designed to be maintained in accordance with the following requirements:

a. Instrument components external to transfer-associated structures shall be designed for minimal contact maintenance and hands-on operation.

b. All components requiring maintenance, calibration, or hands-on operation shall be located external to the pits. Transmitters for the liquid level, flow, and pressure shall be located external to the pits.

c. The design shall consider the maintainability factors peculiar to the specific equipment to be used in the facility. (This includes software changes or upgrades and associated outages in addition to hardware maintenance.)

3.5.2 Supply

The subsystem shall use readily available commercial parts and components to the greatest extent practical.

a. Minimum numbers of spares for like components shall be based on mean time between failure and the number of like components installed.

3.5.3 Facility and Facility Equipment

Not applicable.

3.6 PERSONNEL AND TRAINING

Not applicable.

3.7 CHARACTERISTICS OF SUBELEMENTS

The major elements of the DST Monitor and Control Subsystem are as follows:

- DST master pump shutdown system
- DST instrument and control system.

3.7.1 Double-Shell Tank Master Pump Shutdown System

The DST master pump shutdown system monitors transfer pipe encasement leak detectors, transfer-associated structure leak detectors, back-flow prevention leak detection equipment, and certain radiation detectors for waste leaks during waste transfers. The system also monitors the position of certain manually and automatically operated transfer valves that provide input to an operator interface station that graphically shows the transfer route and the open/closed status of the valves. The status of the leak detectors is also shown for the route. The DST master pump shutdown system operator interface stations and PLCs contain the logic software that establishes and monitors transfer routes and provides the pictorial representation of established routes or newly created routes (if required). The status of the valve position switches, leak detectors, and radiation detectors are monitored continuously for off-normal conditions that, when detected, provide interlocks that do not allow a transfer to begin or that terminate an existing transfer.

3.7.2 Double-Shell Tank Instrument and Control System

The DST Instrument and Control Subsystem consists of the annulus and tank bottom annulus leak detection instrumentation, tank waste level instrumentation, waste tank structure, dome and bottom concrete temperature detection instrumentation, and in-tank CCTV camera. This equipment, except for the CCTV camera, already exists in DSTs. CCTV cameras have only been installed in tanks SY-101, AY-102, and AZ-101. With the exception of the waste tank structure, dome and bottom temperature detection instrumentation (thermocouples which are very difficult to replace), the remaining instruments have been upgraded over the years as the technology has advanced. The current instruments are acceptable for performing WFD functions, assuming that they are operational. An exception would be the CCTV camera, which may require use of miniature models instead of the existing camera so that it can be installed in smaller tank risers. This would allow the larger risers to be used for other equipment. Annulus leak detectors use a combination of conductivity probes, manual tapes, and automated level sensing devices similar to the tank waste level sensing devices. Finally, some waste-intrusive instrument probes or trees are being replaced because they may not withstand the hydraulic forces of the mixer pump/pumps. The new instrument trees have been designed and fabricated for tank 241-AZ-101, and it is expected that their design specification will be used for the remaining DSTs.

Currently the annulus leak detectors, tank structure thermocouples (Tanks 241-SY-101, 241-AW–101, –102, –103, –104, –105, and –106, and selected AN tanks), and tank waste level are monitored by TMACS for DSTs. A data communication interface between TMACS and the DST Monitor and Control Subsystem addressed in *Double-Shell Tank Monitor and Control Subsystem Definition Report*, RPP-5586, will allow these parameters to be monitored at the DST Monitor and Control Subsystem operator interface station. However, process control considerations for critical parameters may require that certain of the parameters monitored by TMACS be hard wired to the DST Monitor and Control System to increase reliability or limit the consequence of a data link failure.

The existing specifications for the DST Instrument and Control equipment mentioned above are satisfactory for WFD activities and thus this document will not reiterate those requirements. However, any upgrades or replacement of these instruments must maintain the existing level of monitoring currently in place, or, if they are going to be connected directly to the DST Monitor and Control Subsystem in the future, they must provide the correct interface hardware and/or software upgrades as required.

3.8 PRECEDENCE

Except in those instances where Washington State has been granted regulatory authority by the Federal Government, the hierarchical relationship among requirements specified in Section 3.0 is as follows:

- Federal requirements (e.g., *Code of Federal Regulations*, DOE orders)
- State requirements (e.g., Revised Code of Washington, as specified in the *Washington Administrative Code*)

- Local ordinances
- RPP procedures
- National consensus codes and standards.

The hierarchy is useful in establishing the relative order of precedence of the requirements documents levied in this specification.

3.9 SECURITY

The subsystem shall be designed such that access controls to radiation and high-radiation areas meet the requirements of *Tank Farms Radiological Control Manual,* HNF-5183 (local implementation of 10 CFR 835).

a. Operator interface station and engineering workstations must maintain personnel access software so that the system will only allow certain log-in groups to perform the desired functions.

3.10 COMPUTER RESOURCE RESERVE CAPACITY

Not applicable.

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4.0 QUALITY ASSURANCE PROVISIONS

Quality assurance for the DST Monitor and Control Subsystem shall be performed in accordance with "Quality Assurance Program," HNF-IP-0842, Volume XI, Section 1.0.

4.1 GENERAL

Quality assurance provisions, as defined in Section 4.2, shall be conducted during the design and development of the DST Monitor and Control Subsystem to provide assurance of compliance with the requirements of this specification. Field verification, which takes place during the construction/turnover life-cycle phase, is not addressed in this specification. Field verification is addressed at the construction project level in operational test plans/procedures and acceptance test plans/procedures.

4.1.1 Responsibility

The design agent shall be responsible for the performance and documentation of design verifications (see Section 4.2) for each subsystem developed in accordance with this specification. Design verifications shall be conducted at the design agent's facilities or the facilities of the design agent's choice with the approval of the sponsor organization. The sponsor organization reserves the right to witness the specified design verifications.

4.1.2 Special Tests

Not applicable.

4.2 DESIGN VERIFICATION

Design verification shall be performed on the DST Monitor and Control Subsystem, as represented in design drawings, prototypes, engineering models, etc., for the purposes of verifying that the design meets the requirements of this specification. Design verification is subject to the procedure identified in *Engineering Requirements*, RPP-PRO-1819, Section 2.5.1. Inspection of the subsystem design to ensure compliance with the requirements of Section 2.5.2 shall be performed by one or more of the following methods: qualification testing, reviews, and/or alternate calculations. The verification method(s) that applies to each specification requirement is identified in Appendix A. Definitions of qualification testing, reviews, and alternate calculations are as follows.

a. Qualification testing is a design verification method consisting of tests on hardware representative of the design being verified. Qualification testing can be subdivided into methods that consist of checking functional operation (Demonstration) and methods that consist of measuring specific hardware inputs/outputs (Test) to verify compliance of the design with requirements.

i. Demonstration is a subcategory of the "qualification testing" design verification method. Demonstration is limited to readily observable functional operation to determine compliance with requirements. Demonstration does not require the use of special equipment or sophisticated instrumentation.

ii. Test is another subcategory of the "qualification testing" design verification method. Test employs technical means including, but not limited to, the evaluation of functional characteristics by use of special equipment or instrumentation and the application of established principles and procedures to determine compliance with requirements. The evaluation of data derived from test is an integral part of Test.

b. Review is a design verification method that consists of an investigation of the existing design information. This can be done via a simple review of the design media (Examination) or a rigorous analysis of the design, as represented in the design media (Analysis).

i. Examination is a subcategory of the "review" design verification method. Examination consists of investigation without the use of special laboratory equipment or procedures to determine compliance with requirements. Examination can be performed on design media such as drawings, design reports, etc.

ii. Analysis is a subcategory of the "review" design verification method. Analysis takes the form of processing accumulated results and conclusions, intended to provide proof that verification of a requirement has been accomplished. The analytical results may comprise a compilation/interpretation of existing information or may be obtained from lower level examination, tests, demonstrations, or analyses.

c. Alternate calculation is a verification of a calculation or analysis using alternate methods or procedures.

Field verification of DST Monitor and Control Subsystem performance/design features and acceptance inspection of construction is called out in Section 2.5.2.5 of RPP-PRO-1819.

5.0 PREPARATION FOR DELIVERY

Safety-class and safety-significant SSCs will require special packaging to protect against corrosion, contamination, physical damage, or any effect that would lower the quality or cause the items to deteriorate during the time they are shipped and handled. Packaging, receipt, and storage requirements will depend on the classification level of the items shown in *Quality Assurance Requirements for Nuclear Facility Applications,* ASME NQA-1, Subpart 2.2, Section 3-2. Lower level specifications (e.g., procurement specifications) will establish the specific packaging requirements for SSCs.

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6.0 NOTES

6.1 DEFINITIONS

Accuracy—Accuracy of an instrument including drift, hysteresis, linearity, and repeatability.

Confinement System—The barrier and its associated systems (including ventilation) between areas containing hazardous materials and the environment or other areas in the facility that are normally expected to have levels of hazardous materials lower than allowable concentration limits.

Continuously Monitor or Record — Monitor at a polling rate or record at a read rate that will provide satisfactory continuity of data.

Human Factors—The biomedical, psychosocial, workplace environment, and engineering considerations pertaining to people in a human-machine system. Some of these considerations are allocation of functions, task analysis, human reliability, training requirements, job performance aiding, personnel qualifications and selection, staffing requirements, procedures, organizational effectiveness, and workplace environmental conditions.

Local–Remote—A remote station normally located adjacent to the tank farms for which the equipment is being operated and monitored.

Loop Accuracy—Accumulative error of all elements of a measurement system, usually expressed as the root mean square of the combined errors of all the elements.

Resolution—The smallest signal movement that can be detected by a measurement system or the least significant digit of a display.

Safety Class (SC) SSC—An SSC that prevents or mitigates releases to the public that would otherwise exceed the offsite radiological risk guidelines, or that prevents a nuclear criticality (HNF-SD-WM-SAR-067, Section 4.1).

Safety Significant (SS) SSC – An SSC that prevents or mitigates releases of radiological materials to onsite workers and toxic chemicals to the offsite public and onsite workers. Safety Significant also describes worker safety SSCs that protect the facility worker from serious injury (or fatality) caused by hazards not controlled by institutional safety programs. Facility SSCs that are major contributors to defense-in-depth are identified as Safety-Significant SSCs (HNF-SD-WM-SAR-067, Section 4.1).

NOTE: Safety-Significant SSC distinguishes a specific category of SSCs other than Safety-Class SSCs. It should not be confused with the generic modifier "safety significant" used in DOE orders (e.g., *Nuclear Safety Analysis Reports*, DOE Order 5480.23).

Shall—Denotes a requirement.

Should—Denotes a recommendation. If a "should" requirement cannot be satisfied, justification of an alternative design shall be submitted to the Design Authority for approval.

TBD—To be determined. A study and/or calculation needs to be performed to provide a sufficient technical basis for the requirement.

Transfer-Associated Structure—Pump pits, valve pits, diversion boxes, or cleanout boxes.

6.2 LIST OF TERMS

ALARA	as low as reasonably achievable
CAM	continuous air monitor
CCTV	closed-circuit television
DOE	U.S. Department of Energy
DST	double-shell tank
FM	factory material
HEPA	high-efficiency particulate air
I/O	input/output
ICD	interface control document
HMI	human machine interface
MPS	master pump shutdown
MTBF	mean time between failures
NFPA	National Fire Protection Association
ORP	Office of River Protection
PID	proportional, integral, and derivative
PLC	programmable logic controller
RPP	River Protection Project
SHMS	standard hydrogen monitor system
SS	safety significant
SSC	structures, systems, and component
TBD	to be determined
TBR	to be refined
TFLAN	Tank Farms Local Area Network
TMACS	Tank Monitoring and Control System
UL	Underwriters Laboratories, Inc.
V ac	volts alternating current
WFD	waste feed delivery

7.0 REFERENCES

HNF-1939, Rev. 0a, 1999, *Waste Feed Delivery Technical Basis*, Vol. II, Addendum 1-1, "Waste Feed Delivery Flow Sheet for Tank 241-AZ-101," Numatec Hanford Corporation for Fluor Daniel Hanford, Inc., Richland, Washington.

HNF-1939, Rev. 0b, 1999, *Waste Feed Delivery Technical Basis*, Vol. II, Addendum 2-1, "Waste Feed Delivery Flow Sheet for Tank 241-AN-105," Numatec Hanford Corporation for Fluor Daniel Hanford, Inc., Richland, Washington.

HNF-1939, Rev. 0c, 1999, *Waste Feed Delivery Technical Basis*, Vol. II, Addendum 3-1, "Waste Feed Delivery Flow Sheet for Tank 241-AN-104," Numatec Hanford Corporation for Fluor Daniel Hanford, Inc., Richland, Washington.

HNF-5136, 2000, *Functional Analysis for Double-Shell Tank Subsystems,* Rev. 0, Numatec Hanford Corporation for CH2M HILL Hanford Group, Inc., Richland, Washington.

HNF-SD-WM-SP-012, 1999, *Tank Waste Remediation System Operation and Utilization Plan to Support Waste Feed Delivery*, Rev. 1, Numatec Hanford Corporation, Lockheed Martin Hanford Corporation, and COGEMA Engineering Corporation for Fluor Daniel Hanford, Inc., Richland, Washington.

HNF-SD-WM-TRD-007, 2000, *System Specification for the Double-Shell Tank System*, Rev. 0, Numatec Hanford Corporation for CH2M HILL Hanford Group, Inc., Richland, Washington.

RPP-5586, 2000, *Double-Shell Tank Monitor and Control Subsystem Definition Report,* Rev. 0, Numatec Hanford Corporation for CH2M HILL Hanford Group, Inc., Richland, Washington.

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SOURCE DOCUMENTS AND TEST METHODS

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SOURCE DOCUMENTS AND TEST METHODS

Section	Function/Requirement	Source Document(s)	Remarks	Verification Method					
				Exam	Demo	Test	Anal	Alt Calc	N/A
3.2.1.1.1.a	All tank bottom insulating concrete thermocouple signals shall be received at the DST Monitor and Control Subsystem input/output (I/O) as required, at a selectable polling rate, for tanks that contain sludge that is mobilized by mixer pumps.	RPP-6548			X				
3.2.1.1.1.b	Tank dome, middle wall, and bottom wall structure thermocouple signals shall be received as required, at a selectable polling rate at the DST Monitor and Control Subsystem I/O.	RPP-6548			X				
3.2.1.1.3.a	The DST Monitor and Control Subsystem shall provide on-line historical and real-time trending of process parameters with report capability for a period of one week.	HNF-3514, Section II.B			X				
3.2.1.1.4.a	The DST Monitor and Control Subsystem shall provide indication of monitored parameters [resolution ±0.06 °C (±0.1 °F)].	HNF-3514, Section II.B			X				
3.2.1.1.5.a	Provide audible and visual annunciation for all alarm conditions.	HNF-3514, Section II.B			X				
3.2.1.2.1.a	• Minimum range: 10 to 149 °C (50 to 300 °F) • Loop accuracy: +2.8 °C (+5 °F).	HNF-IP-1266, Section 5.12; OSD-T-151-00007, Section 7.2.6; OSD-T-151-00017, Section 17.4.5; Internal letter from S. D. Estey to R. R. Bafus (Appendix D)			X				

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Section	Function/Requirement	Source Document(s)	Remarks	Verification Method					
				Exam	Demo	Test	Anal	Alt Calc	N/A
3.2.1.2.2.a	DST Monitor and Control System shall receive DST Tank Waste Temperature from TMACS, at a selectable polling rate, via TFLAN for those temperature probes that are monitored by TMACS.	HNF-1507, Section 5.3			X				
3.2.1.2.2.b	DST Monitor and Control System shall receive DST Tank Waste Temperature at a selectable polling rate at the DST Monitor and Control System local I/O for those temperature probes that are not monitored by TMACS.	RPP-5932, Section III.3.6			X				
3.2.1.2.3.a	The waste temperature shall be compared to High and High-High limits.	HNF-SD-WM-TSR-006, Section 3.3.2			X				
3.2.1.2.4.a	The DST Monitor and Control Subsystem shall provide on-line historical and real-time trending of process parameters with report capability for a period of one week.	HNF-3514, Section II.B			X				
3.2.1.2.5.a	The DST Monitor and Control Subsystem shall provide indication of monitored parameters [resolution ±0.06 °C (0.1° F)].	HNF-3514, Section II.B			X				
3.2.1.2.6.a	The following equipment will be shut down automatically upon detection of High-High waste temperature in a waste tank: • Mixer Pumps • Transfer Pump.	HNF-3695, Section IV.D			X				

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Section	Function/Requirement	Source Document(s)	Remarks	Verification Method					
				Exam	Demo	Test	Anal	Alt Calc	N/A
3.2.1.3.1.a	• Loop accuracy: ±1.3 cm (±½ in.)	HNF-SD-WM-SAR-067, Chapter 4, Section 4.4.9; OSD-T-151-00017, Section 17.2.3; Internal letter from S. D. Estey to R. R. Bafus (Appendix D)			X				
3.2.1.3.2.a	DST Monitor and Control Subsystem shall receive DST Tank Waste Level from TMACS, via TFLAN, at a selectable polling rate, for those level gauges that are monitored by TMACS.	HNF-1507, Section 5.3			X				
3.2.1.3.2.b	DST Monitor and Control Subsystem shall receive DST Tank Waste Level directly at the DST Monitor and Control System local I/O for those level gauges that are not monitored by TMACS.	HNF-3695, Section III.C.6			X				
3.2.1.3.3.a	Interlocks for High and High-High and Low and Low-Low waste level will be provided to prevent equipment damage or harm to the environment or personnel. Interlock values differ from tank to tank.	HNF-3695, Section IV.D			X				
3.2.1.3.4.a	The DST Monitor and Control Subsystem shall provide on-line historical and real-time trending of process parameters with report capability for a period of one week.	HNF-3514, Section II.B			X				
3.2.1.3.5.a	The DST Monitor and Control Subsystem shall provide indication of monitored parameters (including tank level). [Recommended display resolution of 0.254 cm (0.1 in.)].	HNF-3514, Section II.B			X				

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Section	Function/Requirement	Source Document(s)	Remarks	Verification Method					
				Exam	Demo	Test	Anal	Alt Calc	N/A
3.2.1.3.6.a	The following equipment will be shut down automatically upon detection of High-High waste level in a waste tank: • Mixer Pumps • Transfer Pump • Close Caustic Supply System diluent outlet valve.	HNF-3695, Section IV.D			X				
3.2.1.3.6.b	The following equipment will be automatically shut down upon detection of Low-Low tank waste level: • Mixer Pumps • Transfer Pump.	HNF-3695, Section IV.D			X				
3.2.1.4.1.a	Each DST shall be equipped with three operating leak detector probes placed as equidistantly as possible within the annulus of each DST.	PCHB No. 98-249; No. 98-250			X				
3.2.1.4.1.b	Operating annulus CAMs located at DSTs shall continuously monitor for airborne release into the annulus that could give an indication of a leak from the primary tank structure into the annulus.	PCHB No. 98-249; No. 98-250			X				
3.2.1.4.2.a	DST Monitor and Control Subsystem shall receive DST annulus primary leak data from TMACS via TFLAN for those tanks whose annuli are monitored by TMACS	HNF-1507, Section 5.3			X				

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Section	Function/Requirement	Source Document(s)	Remarks	Verification Method					
				Exam	Demo	Test	Anal	Alt Calc	N/A
3.2.1.4.2.b	DST Monitor and Control System shall receive DST annulus primary leak data directly at the DST Monitor and Control Subsystem local I/O for those tanks that are not monitored by TMACS.	HNF-3695, Section IV.D			X				
3.2.1.4.4.a	The DST Monitor and Control Subsystem shall provide on-line historical and real-time trending of process parameters with report capability for a period of one week.	HNF-3514, Section II.B			X				
3.2.1.4.5.a	The DST Monitor and Control Subsystem shall provide indication of monitored parameters (including annulus primary leak data).	HNF-3514, Section II.B			X				

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Section	Function/Requirement	Source Document(s)	Remarks	Verification Method					
				Exam	Demo	Test	Anal	Alt Calc	N/A
3.2.1.5.1.a	The DST Monitor and Control Subsystem shall receive the following DST ventilation system data from TMACS via TFLAN for those ventilation parameters monitored by TMACS: • Tank vapor space pressure • Annulus exhaust stack beta CAM alarm status • Primary exhaust stack beta CAM alarm status • Standard hydrogen monitor system (SHMS) hydrogen concentration and alarm status • Primary exhauster run status • Annulus exhauster run status • HEPA filter differential pressure interlock status.	HNF-4553, Supplement (to be incorporated in Rev. 1)			X				
3.2.1.5.1.b	The DST Monitor and Control System shall receive DST ventilation system data directly at the DST Monitor and Control Subsystem local I/O for those ventilation parameters that are not monitored by TMACS.	HNF-3695, Section III.C.6			X				

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Section	Function/Requirement	Source Document(s)	Remarks	Verification Method					
				Exam	Demo	Test	Anal	Alt Calc	N/A
3.2.1.5.2.a	All ventilation parameters monitored by the DST Monitor and Control Subsystem except tank vapor space pressure are contact status from other equipment (the DST Monitor and Control Subsystem does not perform a comparison function).	HNF-4553, Supplement (to be incorporated in Rev. 1)			X				
3.2.1.5.2.b	Tank dome pressure shall be compared to operational limits.	HNF-3695, Appendix B			X				
3.2.1.5.3.a	The DST Monitor and Control Subsystem shall provide on-line historical and real-time trending of process parameters with report capability for a period of one week.	HNF-3514, Section II.B			X				
3.2.1.5.4.a	The DST Monitor and Control Subsystem shall provide indication of monitored (ventilation system) parameters.	HNF-3514, Section II.B			X				
3.2.1.5.5.a	The following equipment shall be automatically shutdown upon detection of Low-Low vacuum in tank dome vapor space. • Mixer Pumps • Transfer Pump.	HNF-3695, Section IV.D			X				
3.2.1.6.1.a	All remote-controlled valve auto/manual and position selections and indications shall be provided by the DST Monitor and Control Subsystem.	HNF-4553, Section 3.2; HNF-3695, Section III.C.9			X				
3.2.1.7.1.a	Transfer valve position sensors shall be connected to the DST local I/O (PLCs).	HNF-SD-W314-TI-008, Section 3.2.4.6			X				

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Section	Function/Requirement	Source Document(s)	Remarks	Verification Method					
				Exam	Demo	Test	Anal	Alt Calc	N/A
3.2.1.7.1.b	All remote-controlled valve auto/manual and position selections and indications will be provided at the DST retrieval control system component of the DST Monitor and Control Subsystem.	HNF-3695, Section III.C.9			X				
3.2.1.7.2.a	The valve positions are verified according to the logic diagrams for approved transfer routes using the valve position verification HMI screens.	HNF-SD-W314-TI-008, Section 3.2.4.6			X				
3.2.1.7.3.a	Provide prioritized, grouped, and time/date stamped alarm summary screen and event log of the DST Monitor and Control Subsystem.	HNF-3695, Section III			X				
3.2.1.7.4.a	Operational Requirements – shall be able to display the valve position graphically.	HNF-SD-W314-TI-008, Section 2.3.3.2							
3.2.1.7.4.b	The symbol for each open valve port will be green. The symbol each closed port will be white. When in transition, the valve symbols will be yellow.	HNF-3695, Section III.A.9.b			X				
3.2.1.7.5.a	Monitor for selected DST master pump shutdown system inputs and automatically provide an interlock to prevent a transfer if a valve located in the transfer route is in the incorrect position.	HNF-SD-W314-TI-008, Section 2.3.13.			X				

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Section	Function/Requirement	Source Document(s)	Remarks	Verification Method					
				Exam	Demo	Test	Anal	Alt Calc	N/A
3.2.1.8.1.a	The DST Monitor and Control Subsystem shall receive the following data from the Diluent/Flush Water System. • Diluent/Flush Water Temperature • Diluent/Flush Water Pressure • Diluent/Flush Water Flow • Diluent/Flush Water Chemical Composition • Diluent/Flush Water Motor Operated Valve Position.	HNF-4163, Section 3.3.1.o			X				
3.2.1.8.2.a	The following parameters shall be compared to desired operating limits: • Diluent/Flush Water Temperature (High/Low) • Diluent/Flush Water Pressure (High/Low) • Diluent/Flush Water Flow (High/Low) • Diluent/Flush Water Chemical Composition (High/Low pH) • Diluent/Flush Water Valve Position (Open/Closed).	HNF-4163, Section 3.3.1.o			X				

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Section	Function/Requirement	Source Document(s)	Remarks	Verification Method					
				Exam	Demo	Test	Anal	Alt Calc	N/A
3.2.1.8.3.a	The DST Monitor and Control Subsystem shall provide on-line historical and real-time trending of process parameters with report capability for a period of one week.	HNF-3514, Section II.B			X				
3.2.1.8.4.a	The DST Monitor and Control Subsystem shall provide indication of monitored parameters.	HNF-3514, Section II.B			X				
3.2.1.8.5.a	The DST Monitor and Control Subsystem shall place the Diluent/Flush outlet valve to the waste tank into recirculation mode upon detection of the following: • Loss of 120 V ac power to PLC Uninterruptible Power Supply • Master Pump Shutdown • Operator –Initiated Shutdown • Waste Tank High-High Level.	HNF-3695, Section IV.D			X				
3.2.1.8.5.b	The DST Monitor and Control Subsystem shall place the Diluent/Flush flush tank isolation valve in the closed condition upon detection of the following: • Loss of 120 V ac power to Programmable Logic Controller Uninterruptible Power Supply • Master Pump Shutdown • Operator –Initiated Shutdown.	HNF-3695, Section IV.D			X				

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Section	Function/Requirement	Source Document(s)	Remarks	Verification Method					
				Exam	Demo	Test	Anal	Alt Calc	N/A
3.2.1.9.1.a	The monitoring frequency of the (backflow) leak detection system shall be continuous.	HNF-4160, Section 3.2.1.14			X				
3.2.1.9.2.a	The required response time of the (backflow) leak detection system shall be instantaneous (less than or equal to 1 second).	HNF-SD-W-314-PDS-003, Section 3.2.1.1.5			X				
3.2.1.9.3.a	The DST master pump shutdown system shall be able to log (backflow) alarms to computer disk in sequence as they occur with time and date.	HNF-SD-W314-TI-008, Section 2.3.16.11			X				
3.2.1.9.4.a	DST Monitor and Control Subsystem shall display (back flow) leak detection status.	HNF-SD-W314-TI-008, Section 2.3.10.1			X				
3.2.1.9.5.a	Respond to backflow detected with automatic shut down of transfer pump by DST master pump shutdown system.	HNF-SD-WM-SAR-067, Chapter 4, Section 4.3.6.1 and 4.3.6.2			X				
3.2.1.10.1.a	The DST Monitor and Control Subsystem shall provide the control signal to raise or lower the suction bell to any position within its range of travel.	HNF-3514, Section III.D.2			X				
3.2.1.11.1.a	The DST Monitor and Control Subsystem will receive the output of the suction bell position detection transducer.	HNF-3514, Section III.D.2			X				
3.2.1.11.2.a	The tank level must be at least 61 cm (24 in.) above the winch (suction) position.	HNF-3514, Section III.D.2			X				
3.2.1.11.4.a	The nominal winch (suction) position will be shown on the overview and tank-specific screens. • Range: 0 to 635 cm (0 to 250 in.) • Resolution: 2.54 cm (1 in.)	HNF-3514, Section III.D.2			X				

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Section	Function/Requirement	Source Document(s)	Remarks	Verification Method					
				Exam	Demo	Test	Anal	Alt Calc	N/A
3.2.1.12.1.a	The DST Monitor and Control Subsystem will provide pump auto/manual, on/off, and start/stop selections and indications.	HNF-3514, Section III.C.8			X				
3.2.1.13.1.a	Instrumentation will provide the following transfer pump monitoring and control functions to the DST Monitor and Control Subsystem: • Motor Speed • Motor Amperage • Motor Winding Temperature • Seal Gas Flow • Seal Gas Pressure.	HNF-3514, Section II			X				
3.2.1.13.2.a	Interlocks for the following parameters will be provided to prevent equipment damage or harm to the environment or personnel. • Motor Amperage • Seal Gas Flow • Seal Gas Pressure.	HNF-3514, Section IV.E			X				
3.2.1.13.3.a	The DST Monitor and Control Subsystem shall provide on-line historical and real-time trending (recording) of process parameters with report capability for a period of one week for: • Motor Speed • Motor Amperage.	HNF-3514, Section II.B			X				

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Section	Function/Requirement	Source Document(s)	Remarks	Verification Method					
				Exam	Demo	Test	Anal	Alt Calc	N/A
3.2.1.13.4.a	The running status of waste transfer pumps shall be displayed at the waste transfer annunciator set of master pump shutdown system HMI graphical screens. • Motor Speed Range: 0 to 100 percent • Motor Current Range: 0 to 100 percent • Motor Winding Temperature Range: 0 to 204 °C (0 to 400 °F).	HNF-SD-W314-TI-008, Section 2.3.16.3			X				
3.2.1.13.5.a	The DST Monitor and Control Subsystem shall provide a High transfer pump motor current alarm and shut down the transfer pump on High-High motor current. Off-normal values are programmable by a systems engineer	HNF-3514, Section IV.E			X				
3.2.1.13.5.b	The DST Monitor and Control Subsystem shall provide a High transfer pump motor winding temperature alarm and shut down the transfer pump motor on High-High motor winding temperature. Off-normal values are programmable by a systems engineer.								
3.2.1.14.1.a	The DST Transfer Valving Subsystem shall provide the capability to measure and transmit the waste flow rate at the transfer pump discharge.	HNF-4160, Section 3.2.1.7.1			X				
3.2.14.2.a	Monitoring and control of the waste transfer flow rate will be programmed into the PLC, including proportional, integral, and derivative (PID) algorithms.	HNF-3514, Section III.C.6			X				

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Section	Function/Requirement	Source Document(s)	Remarks	Verification Method					
				Exam	Demo	Test	Anal	Alt Calc	N/A
3.2.14.2.b	Flow rate (mass flow and volumetric flow) loop accuracy shall be ±5 percent of process range.	Internal letter from S. D. Estey to R. R. Bafus (Appendix D)			X				
3.2.14.3.a	The DST Monitor and Control Subsystem shall record transfer pump flow rate continuously (mass flow and volumetric flow).	Internal letter from S. D. Estey to R. R. Bafus (Appendix D)			X				
3.2.1.14.4.a	The dynamic process and equipment operating data associated with waste transfer routes shall be displayed on the DST Monitor and Control Subsystem waste transfer annunciator set of HMI graphical screens.	HNF-SD-W314-TI-008, Section 2.3.16.4			X				
3.2.1.14.4.b	Volumetric flow-rate range is 0 to 628 L/min (0 to 166 gal/min).	RPP-5346			X				
3.2.1.14.5.a	The transfer pump shall have a discharge flow Low-Low interlock (flow value <TBD>).								
3.2.1.15.1.a	The DST Transfer Valving Subsystem shall provide the capability to measure and transmit transfer pump discharge pressure.	HNF-4160, Section 3.2.1.7.2			X				
3.2.1.15.2.a	Transfer pump discharge pressure shall be compared to High and High-High operational limits (setpoints).	HNF-3695, Appendix B			X				
3.2.1.15.2.b	Pressure loop accuracy shall be ±5 percent of process range.	Internal letter from S. D. Estey to R. R. Bafus (Appendix D)			X				
3.2.1.15.3.a	The DST Monitor and Control Subsystem shall continuously record transfer pump discharge pressure.	Internal letter from S. D. Estey to R. R. Bafus (Appendix D)			X				

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Section	Function/Requirement	Source Document(s)	Remarks	Verification Method					
				Exam	Demo	Test	Anal	Alt Calc	N/A
3.2.1.15.4.a	The dynamic process and equipment operating data associated with waste transfer routes shall be displayed on the DST Monitor and Control Subsystem waste transfer annunciator set of HMI graphical screens.	HNF-SD-W314-TI-008, Section 2.3.16.4			X				
3.2.1.15.4.b	The pressure display range shall be 0 to 6,239 kPa (0 to 905 lbf/in^2) <TBR>.	RPP-5346			X				
3.2.1.15.5.a	The transfer pump shall have a discharge pressure High alarm and High-High interlock (pressure value <TBD>).	HNF-3514, Section IV.E			X				
3.2.1.16.1.a	The DST Transfer Valving Subsystem shall provide the capability to measure and transmit waste density (and temperature) at the transfer pump discharge.	HNF-4160, Section 3.2.1.7.4			X				
3.2.1.16.2.a	Density shall have a loop accuracy of $\pm$5 percent of process range.	Internal letter from S. D. Estey to R. R. Bafus (Appendix D)			X				
3.2.1.16.2.b	Temperature shall have a loop accuracy of $\pm$2.8 °C ($\pm$5 °F).	Internal letter from S.D. Estey to R. R. Bafus (Appendix D)			X				
3.2.1.16.2.c	Density shall be compared to High and High-High operational limits (setpoints).	HNF- 3695, Appendix B							
3.2.1.16.3.a	The system shall continuously record density and temperature of waste being transferred.	Internal letter from S. D. Estey to R. R. Bafus (Appendix D)			X				
3.2.1.16.4.a	The dynamic analog data associated with waste transfer routes shall be displayed on the DST Monitor and Control Subsystem waste transfer annunciator set of HMI graphical screens.	HNF-SD-W314-TI-008, Section 2.3.16.4			X				

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Section	Function/Requirement	Source Document(s)	Remarks	Verification Method					
				Exam	Demo	Test	Anal	Alt Calc	N/A
3.2.1.16.4.b	Density range is 0.900 to 1.500 g/cm^3 (Note: display resolution to 0.001g/cm^3 required to help indicate minor qualitative changes in density needed to assess slurry characteristics).	HNF-4160, Section 3.2.1.7.4			X				
3.2.1.16.4.c	Temperature range is –10.0 to 200.0 °C (14.0 to 392.0 °F).	OSD-T-151-00007, Section 7.2.6; OSD-T-151-00017, Section 17.4.5			X				
3.2.1.16.5	The DST Monitor and Control Subsystem shall respond to abnormal waste density/temperature <TBD see Appendix C (b)>.								
3.2.1.17.1.a	The leak detection system sensor shall be compatible with the DST Monitor and Control Subsystem.	HNF-4160, Section 3.2.1.9			X				
3.2.1.17.2.a	The monitoring frequency of the pit leak detection system shall be continuous (without interruption).	HNF-SD-W314-PDS-003, Section 3.2.1.1.4			X				
3.2.1.17.3.a	The required response time of the pit leak detection system shall be instantaneous (less than or equal to 1 second).	HNF-SD-W314-PDS-003, Section 3.2.1.1.5			X				
3.2.1.17.4.a	The DST master pump shutdown system shall be able to log alarms to computer disk with time and date in sequence as the alarms occur.	HNF-SD-W314-TI-008, Section 2.3.16.11			X				

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Section	Function/Requirement	Source Document(s)	Remarks	Verification Method					
				Exam	Demo	Test	Anal	Alt Calc	N/A
3.2.1.17.5.a	The DST master pump shutdown system shall be able to display graphically on the HMIs the selected transfer routes (including status of input/output elements) in the waste transfer annunciator mode of operation.	HNF-SD-W314-TI-008, Section 2.3.2.6.			X				
3.2.1.17.6.a	Monitor for selected DST master pump shutdown system inputs and automatically shut down the transfer pump if an input is detected.	HNF-SD-W314-TI-008, Section 2.3.13			X				
3.2.1.18.1.a	The DST Transfer Piping System shall detect leakage from the primary confinement piping into the secondary confinement piping and transmit leak data to DST Monitor and Control Subsystem.	HNF-4160, Section 3.2.1.3			X				
3.2.1.18.2.a	The monitoring frequency of the low point leak detection system shall be continuous (without interruption).	HNF-SD-W314-PDS-001, Section 3.7.2.1.1.3			X				
3.2.1.18.3.a	The required response time of the low point leak detection system shall be instantaneous (less than or equal to 1 second).	HNF-SD-W314-PDS-001, Section 3.7.2.1.1.4			X				
3.2.1.18.4.a	The DST Monitor and Control Subsystem shall be able to log alarms to computer disk with time and date in the sequence as the alarms occur	HNF-SD-W314-TI-008, Section 2.3.16.11			X				
3.2.1.18.5.a	The DST master pump shutdown system shall be able to display graphically on the HMIs the selected transfer routes (including status of input/output elements) in the waste transfer annunciator mode of operation.	HNF-SD-W314-TI-008, Section 2.3.2.6			X				

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Section	Function/Requirement	Source Document(s)	Remarks	Verification Method					
				Exam	Demo	Test	Anal	Alt Calc	N/A
3.2.1.18.6.a	Monitor for selected DST master pump shutdown system inputs and automatically shuts down the transfer pump if an input is detected.	HNF-SD-W314-TI-008, Section 2.3.13			X				
3.2.1.19.a	Loop accuracy: ±1.3 cm (±1/2 in.) for sending and receiving tank plus error in transfer line volume as applicable for tank level to tank level material balance	Internal letter from S. D. Estey to R. R. Bafus (Appendix D)			X				
3.2.1.19.b	Accuracy: ±5 percent of range for volumetric flow totalizer and ±1.3 cm (±1/2 in.) for level for totalized flow to tank level comparison.	Internal letter from S. D. Estey to R. R. Bafus (Appendix D)			X				
3.2.1.20.a	Loop accuracy: ±1.3 cm (±1/2 in.) for sending and receiving tank plus error in transfer line volume as applicable for tank level to tank level material balance	Internal letter from S. D. Estey to R. R. Bafus (Appendix D)			X				
3.2.1.20.b	Accuracy: ±5 percent of range for volumetric flow totalizer and ±1.3 cm (±1/2 in.) for level for totalized flow to tank level comparison.	Internal letter from S. D. Estey to R. R. Bafus (Appendix D)							
3.2.1.21.1.a	All pump auto/manual, on/off, and start/stop selections and indications will be provided to the monitoring system.	HNF-3514, Section III.C.8			X				
3.2.1.22.1.a	Instrumentation shall provide the following monitoring and control functions for the mixer pump: motor speed and amperage, motor bearing temperature, motor stator winding temperature, turntable rotation and orientation, pump vibration, and nozzle discharge pressure.	HNF-3514, Section II			X				

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Section	Function/Requirement	Source Document(s)	Remarks	Verification Method					
				Exam	Demo	Test	Anal	Alt Calc	N/A
3.2.1.22.2.a	Interlocks will be provided to prevent equipment damage or harm to the environment or personnel (this implies that a pump parameter is compared with an operational limit). The interlocks are: • Motor vibration (High-High) • Motor current (High-High) • Motor winding temperature (High-High) • Motor upper and lower bearing temperature (High-High).	HNF-3514, Section IV.E			X				
3.2.1.22.3.a	The DST Monitor and Control Subsystem shall provide on-line historical and real-time trending (recording) of process parameters with report capability for a period of one week. Recorded parameters are: • Mixer pump speed • Mixer pump current.	HNF-3514, Section II.B			X				
3.2.1.22.4.a	The DST Monitor and Control Subsystem shall provide indication of mixer pump operational data.	HNF-3514, Section II, B			X				
3.2.1.22.5.a	Shut down mixer pump for the following reasons: • Motor Vibration (High-High) • Motor current (High-High) • Motor winding temperature (High-High) • Bearing temperature (High-High) • Off-normal values <TBD>.	HNF-3514, Section IV, E			X				

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Section	Function/Requirement	Source Document(s)	Remarks	Verification Method					
				Exam	Demo	Test	Anal	Alt Calc	N/A
3.2.1.23.1.a	The service water usage shall be monitored every 24 hours (however service water totalizers with transmitters allow continuous monitoring).	HNF-SD-WM-TSR-006, Section 5.21			X				
3.2.1.23.2.a	Compare current totalizer value with previous value to verify that there has been no unaccounted for service water usage.	HNF-SD-WM-TSR-006, Section 5.21			X				
3.2.1.23.3.a	Service water totalized flow must be recorded from monitoring period to monitoring period to provide data to perform a usage comparison.	Implied by HNF-SD-WM-TSR-006, Section 5.21			X				
3.2.1.23.4.a	Non-resettable service water totalized flow shall be displayed on the HMI graphical screens to provide access to the remotely transmitted totalizer value.	Implied by H:NF-SD-WM-TSR-006, Section 5.21			X				
3.2.2.a	All permanently installed operator interface screens shall be sized such that they are readable from a distance of 1.52 m (5 ft) [suggest a minimum 53 cm (21 in.) diagonal measurement].	DOE Order 6430.1A, Section 1300-12			X				

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Section	Function/Requirement	Source Document(s)	Remarks	Verification Method					
				Exam	Demo	Test	Anal	Alt Calc	N/A
3.2.2.b	The physical arrangement and location of controls, displays, and alarms on control panels and HMI displays shall provide for efficient use of controls and rapid and accurate viewing of the displays and shall be in-accordance with *General Design Criteria*, DOE Order 6430.1A. (Recommend 10 megabits per second for TFLAN network to ensure that operator response to query on the network is less than 2 seconds and operator feedback to control action is less than 0.2 seconds.)	DOE Order 6430.1A, Section 1300-12.4.4, 1300-12.4.6,			X				
3.2.3.a	The overall mission system reliability (from sensor to actuating device) shall have, at the minimum, a 90 percent chance of completing a seven day (168 h) transfer.	HNF-SD-W314-TI-008, Section 2.1					X		
3.2.3.b	Only the transfer or booster pump associated with a shutdown of a transfer shall be shut down if simultaneous waste transfers are taking place.	HNF-SD-W314-TI-008, Section 2.3.13.2			X				
3.2.4.a	The maintainability guidance provided in *Human Factors Design Guidelines for Maintainability of DOE Nuclear Facilities*, UCRL, 15673, shall be considered during subsystem design.	DOE Order 6430.1A, Section 1300-12.4.10		X					
3.2.4.b	Equipment and instruments requiring personnel access for periodic calibration or maintenance shall not be located beneath cover blocks or in areas where personnel exposures are not as low as reasonably achievable (ALARA).	DOE ORDER 6430.1A, Section 1300-3.5, 1300-6.1		X					

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Section	Function/Requirement	Source Document(s)	Remarks	Verification Method					
				Exam	Demo	Test	Anal	Alt Calc	N/A
3.2.4.c	Instrument isolation valves for instrument sensor isolation and equalization shall be located outside of the primary transfer-associated structures.	HNF-4553	To be added to HNF-4553 per Memorandum of Understanding dated 10/28/99 between Cary Graves and Gary Duncan.	X					
3.2.5.1.a	The subsystem shall be designed for the natural environmental conditions specified in *Natural Phenomena Hazards, Hanford Site, Washington,* HNF-SD-GN-ER-501.	HNF-SD-GN-ER-501					X		
3.2.5.1.b	The subsystem shall be designed to withstand the natural phenomena hazards as specified in *Engineering Design and Evaluation,* RPP-PRO-097.	RPP-PRO-097					X		
3.2.5.2.1	The subsystem components shall be designed to perform their intended function in the chemical environment defined in *Estimated Maximum Concentration of Radionuclides and Chemical Analytes in Phase 1 and Phase 2 Transfers,* HNF-2937.	HNF-2937					X		
3.2.5.2.2	The subsystem shall be designed for maximum (calculated) bounding radiation environment for direct contact with tank waste as defined in *Estimated Dose to In-Tank Equipment and Ground-Level Transfer Equipment During Privatization,* HNF-2004..	HNF-2004					X		
3.2.6.	Not applicable.	N/A							X

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Section	Function/Requirement	Source Document(s)	Remarks	Verification Method					
				Exam	Demo	Test	Anal	Alt Calc	N/A
3.2.7.a	The DST Monitor and Control Subsystem design shall allow for the provision of spare or expandable input/output capability and the flexibility to change software to provide for future expansion. (Recommend 10 percent to 20 percent spare input and output slots for PLCs.)	DOE Order 6430.1A, Section 0110-3		X					
3.2.7.b	The DST Monitor and Control Subsystem HMI stations shall be able to access the screens of any other DST Monitor and Control Subsystem HMI stations.	HNF-3695, Section II.D			X				
3.3	The DST Monitor and Control Subsystem shall comply with DOE Order 6430.1A, Sections 1300-7 and 1323.	DOE Order 6430.1A, Sections 1300 and 1323							X
3.3.1.a	Drawings for projects shall be prepared in accordance with the requirements of *Preparation and Control Standard for Engineering Drawings*, RPP-PRO-709.	RPP-PRO-709		X					

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Section	Function/Requirement	Source Document(s)	Remarks	Verification Method					
				Exam	Demo	Test	Anal	Alt Calc	N/A
3.3.1.b	Electrical materials and equipment shall be Underwriters Laboratories, Inc. (UL)- or factory material (FM)-tested, with label attached, for the purpose intended, whenever such products are available. When no UL- or FM-listed products are available, testing and certification by another nationally recognized testing agency may be acceptable. Installation methods shall be in accordance with the manufacturer's instructions, with *National Electrical Code*, NFPA 70, and with other applicable requirements.	RPP-PRO-1819 RPP-PRO-709		X					
3.3.2	The subsystem shall comply with electromagnetic radiation emission requirements set forth in *A List of EMI/EMC Requirements*, HNF-2962.	HNF-2962		X			X		
3.3.3.a	The subsystem shall label new equipment and/or modifications to existing equipment in a standardized format in accordance with the tank farm labeling program as specified in *RPP Administration,* "Tank Farm Operations Equipment Labeling," HNF-IP-0842, Volume II, Section 6.1. Equipment identifiers within the HMI interface screens shall be consistent with the equipment label in the field.	HNF-IP-0842, Volume II, Section 6.1		X					
3.3.4	Reserved. The requirements for workmanship are to be addressed in lower level project design documentation (drawings, procurement specifications, etc.).	N/A							X

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Section	Function/Requirement	Source Document(s)	Remarks	Verification Method					
				Exam	Demo	Test	Anal	Alt Calc	N/A
3.3.5	All like equipment and parts shall be interchangeable/standardized to the maximum extent practical.	DOE Order 6430.1A, Sections 0110-3, 1100		X					
3.3.6.1.a	The subsystem shall incorporate design features that comply with the requirements of 29 CFR 1910, Subparts D, E, G, J, L, M, O, and S..	RPP-PRO-097		X					
3.3.6.1.b	The DST Monitor and Control Subsystem shall be designed to keep personnel exposures ALARA in accordance with *Radiological Design Review Process*, RPP-PRO-1622, and *ALARA Decision-Making Methods*, RPP-PRO-1621.	DOE Order 6430.1A, Section 1300-1.3; RPP-PRO-1621; RPP-PRO-1622		X					
3.3.6.1.c	Auditory warning and alarm systems shall be designed to ensure that they can be heard at the local noise levels of the area they are intended to cover and visual alarm stimuli must provide effective alerting stimulus.	DOE Order 6430.1A, Section 1300-12.4.8			X				
3.3.6.2.a	All activities shall satisfy the tank dome loading requirements specified in HNF-SD-WM-TSR-006, Section 5.16.	HNF-SD-WM-TSR-006, Section 5.16					X		

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Section	Function/Requirement	Source Document(s)	Remarks	Verification Method					
				Exam	Demo	Test	Anal	Alt Calc	N/A
3.3.6.3.a	The DST Monitor and Control Subsystem and components shall be designed in accordance with safety classifications. The safety classification shall be determined using the processes described in "Safety Analysis and Technical Safety Requirements," HNF-IP-0842, Vol. IV, Section 6.12; "Safety Analysis Process - Facility Change or Modification," HNF-IP-0842, Vol. IV, Section 6.11; "Safety Analysis Process - New Project," HNF-IP-0842, Vol. IV, Section 6.10; and "Hazard and Accident Analysis Process," HNF-IP-0842, Vol. IV, Section 6.9. Preliminary safety classifications area provided for reference in Appendix B.	HNF-IP-0842, Vol. IV, Sections 6.9, 6.10, 6.11, and 6.12		X					
3.3.6.3.b	All equipment installed in areas in and around the tank that are subject to ignition controls shall be designed to meet the requirements of HNF-SD-WM-TSR-006, Section 5.10, "Ignition Controls." Areas requiring controls are delineated in HNF-SD-WM-SAR-067, Appendix K. The Flammable Gas Equipment Advisory Board shall be consulted whenever the application or interpretation of the requirements is unclear.	HNF-SD-WM-TSR-006, Section 5.10; HNF-SD-WM-SAR-067, Appendix K		X					
3.3.7.a	Subsystem design shall comply with DOE Order 6430.1A, Section 1300.12, "Human Factors Engineering."	DOE Order 6430.1A, Section 1300-12		X					

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Section	Function/Requirement	Source Document(s)	Remarks	Verification Method					
				Exam.	Demo	Test	Anal	Alt Calc	N/A
3.3.7.b	HMI screen symbology, legends, and color coding shall be identical for each project to enable the same Operators to operate each project's HMI.	HNF-SD-W314-PDS-004 Section 3.3.7.9		X					
3.3.8.a	All components that may become contaminated with radioactive or other hazardous materials under normal or abnormal operating conditions shall be designed to incorporate measures to simplify future decontamination and decommissioning in accordance with DOE Order 6430.1A, Section 1300-11.	DOE Order 6430.1A, Section 1300-11.							X
3.4.a	Records, documents, and drawing control pertinent to design functions shall be in accordance with *Quality Assurance Records Standards*, RPP-PRO-222, and *Document Control Program Standards*, RPP-PRO-224. Engineering document development shall be in accordance with RPP-PRO-709.	RPP-PRO-222; RPP-PRO-224; RPP-PRO-709		X					
3.4.b	All DST Monitor and Control Subsystem structures, systems, and components (SSC) shall be incorporated into the master equipment list and Safety Equipment List in accordance with <TBD>.	<TBD>							X
3.4.c	Procured software within the definitions of *Computer Software Quality Assurance Requirements*, HNF -PRO-309, shall be subject to the controls and documentation requirements listed in HNF-PRO-309, Section 2.3.	HNF-PRO-309		X					

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Section	Function/Requirement	Source Document(s)	Remarks	Verification Method					
				Exam	Demo	Test	Anal	Alt Calc	N/A
3.4.d	Software generated on site and within the definitions of HNF-PRO-309 shall be developed, verified, and validated; shall meet the documentation requirements, and shall be under the configuration management controls of HNF-PRO-309.	HNF-PRO-309		X					
3.5.1	Facility design shall provide for routine preventive maintenance/calibration, where required, and maintenance, repair, or replacement of equipment subject to failure. The subsystem shall be designed to be maintained in accordance with the following requirements:	DOE Order 6430.1A		X					
3.5.1.a	Instrument components external to transfer-associated structures shall be designed for minimal contact maintenance and hands-on operation.	DOE Order 6430.1A, Section 1300-6.3		X					
3.5.1.b	All components requiring maintenance, calibration, or hands-on operation shall be located external to the pits. Transmitters for the liquid level, flow, and pressure shall be located external to the pits.	DOE Order 6430.1A, Section 1300-3.5		X					
3.5.1.c	The design shall consider the maintainability factors peculiar to the specific equipment to be used in the facility. (This includes software changes or upgrades and associated outages in addition to hardware maintenance.)	DOE Order 6430.1A, Section 1300-3.5		X					

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				Exam	Demo	Test	Anal	Alt Calc	N/A
3.5.2	Minimum numbers of spares for like components shall be based on mean time between failure and the number of like components installed.	DOE Order 6430.1A, Section 1100		X					
3.5.2.a	Minimum numbers of spares for like components shall be determined during design, based on mean time between failure and the number of like components installed.	HNF-4553					X		
3.5.3	Not applicable.	N/A							X
3.6	Not applicable.	N/A							X
3.7	The major elements of the DST Monitor and Control Subsystem are as follows: • DST master pump shutdown system • DST instrument and control system.	N/A							X

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Section	Function/Requirement	Source Document(s)	Remarks	Verification Method					
				Exam.	Demo	Test	Anal	Alt Calc	N/A
3.8	Except in those instances where Washington State has been granted regulatory authority by the Federal Government, the hierarchical relationship among requirements specified in Section 3.0 is as follows: • Federal requirements (e.g., *Code of Federal Regulations*, DOE orders) • State requirements (e.g., Revised Code of Washington, as specified in the *Washington Administrative Code*) • Local ordinances • RPP procedures • National consensus codes and standards. The hierarchy is useful in establishing the relative order of precedence of the requirements documents levied in this specification.	DOE/RL-96-109							X
3.9.a	Operator interface station and engineering workstations must maintain personnel access software so that the system will only allow certain log-in groups to perform the desired functions.	HNF-5183		X					
3.10	Not applicable.								X
4.0	Quality assurance for the DST Monitor and Control Subsystem shall be performed in accordance with "Quality Assurance Program," HNF-IP-0842, Volume XI, Section 1.0.	HNF-IP-0842, Volume XI, Section 1.0							X

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				Exam	Demo	Test	Anal	Alt Calc	N/A
4.1.2	Not applicable.								X
4.2	Design Verification.	RPP-PRO-1819, Sections 2.5.1 and 2.5.2							X

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REFERENCES

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

DOE/RL-96-109, 1999, *Hanford Radiological Control Manual,* Rev. 2, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Hanford Site Procedures, CH2M HILL Hanford Group, Inc., Richland, Washington [RPP] and Fluor Hanford, Richland, Washington [HNF]:

- HNF-PRO-309, Rev. 0, 1999, Computer Software Quality Assurance Requirements
- RPP-PRO-097, Rev. 0, 1999, *Engineering Design and Evaluation*
- RPP-PRO-222, Rev. 0, 1999, *Quality Assurance Records Standards*
- RPP-PRO-224, Rev. 0, 1999, *Document Control Program Standards*
- RPP-PRO-709, Rev. 0, 1999, *Preparation and Control Standards For Engineering Drawings*
- RPP-PRO-1621, Rev. 0, 1999, *ALARA Decision Making Methods*
- RPP-PRO-1622, Rev. 0, 1999, *Radiological Design Review Process*
- RPP-PRO-1819, Rev. 0, 1999, *Engineering Requirements.*

HNF-1507, 2000, *Interface Document, Project W-211, Initial Tank Retrieval Systems*, Rev. 1, Numatec Hanford Corporation, Richland, Washington.

HNF-2004, 1999, *Estimated Dose to In-Tank Equipment and Ground-Level Transfer Equipment During Privatization*, Rev. 1, COGEMA Engineering Corporation for Lockheed Martin Hanford Corporation, Richland, Washington.

HNF-2937, 1999, *Estimated Maximum Concentration of Radionuclides and Chemical Analytes in Phase 1 and Phase 2 Transfers*, Rev. 0, COGEMA Engineering Corporation for Lockheed Martin Hanford Corporation, Richland, Washington.

HNF-2962, 1998, *A List of EMI/EMC Requirements*, Rev. 0, Numatec Hanford Corporation for Fluor Daniel Hanford, Inc., Richland, Washington.

HNF-3514, 1998, *Project W-211, Initial Tank Retrieval Systems, Description of Operations for 241-AP-104,* Rev. 0, Numatec Hanford Corporation for Fluor Daniel Hanford, Inc., Richland, Washington.

HNF-3695, 1999, *Project W-211, Initial Tank Retrieval Systems, Description of Operations for 241-AZ-102,* Rev. 0, Numatec Hanford Corporation for Fluor Daniel Hanford, Inc., Richland, Washington.

HNF-4160, 2000, *Double-Shell Tank Transfer Valving Subsystem Specification*, Rev. 0, Numatec Hanford Corporation for CH2M HILL Hanford Group, Inc., Richland, Washington.

HNF-4163, 2000, *Double-Shell Tank Diluent and Flush Subsystem Specification*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.

HNF-4553, 1999, *Operations and Maintenance Philosophy,* Rev. 0, Lockheed Martin Hanford Corporation for Fluor Daniel Hanford, Inc., Richland, Washington.

HNF-5183, 2000, *Tank Farms Radiological Control Manual (TFRCM)*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.

HNF-IP-0842, 1999, *RPP Administration*, Lockheed Martin Hanford Corporation, Richland, Washington.

HNF-IP-1266, 1999, *Tank Farms Operations Administrative Controls,* Rev. 2, DE&S Hanford, Incorporated, for Fluor Daniel Hanford, Inc., Richland, Washington.

HNF-SD-GN-ER-501, 1998, *Natural Phenomena Hazards, Hanford Site, Washington,* Rev. 1, Numatec Hanford Corporation for Fluor Daniel Hanford, Inc., Richland, Washington.

HNF-SD-W314-PDS-001, 1999, *Project Development Specification for Transfer Piping,* Rev. 2, Fluor Daniel Northwest, Inc., for Lockheed Martin Hanford Corporation, Richland, Washington.

HNF-SD-W314-PDS-003, 1998, *Project Development Specification – Pit Leak Detection,* Numatec Hanford Corporation, Richland, Washington.

HNF-SD-W314-PDS-004, 2000, *Project Development Specification - Master Pump Shutdown System*, Numatec Hanford Corporation, Richland, Washington.

HNF-SD-W314-TI-008, *Project Design Concept for Master Pump Shutdown System*, Rev. 3, Numatec Hanford Corporation, Richland, Washington.

HNF-SD-WM-SAR-067, 1999, *Tank Waste Remediation System Final Safety Analysis Report,* Rev. 1, Lockheed Martin Hanford Corporation for Fluor Daniel Hanford, Inc., Richland, Washington.

HNF-SD-WM-SP-012, 1999, *Tank Waste Remediation System Operation and Utilization Plan to Support Waste Feed Delivery,* Rev. 1, Numatec Hanford Corporation, Lockheed Martin Hanford Corporation, and COGEMA Engineering Corporation for Fluor Daniel Hanford, Inc., Richland, Washington.

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APPENDIX B

PRELIMINARY SAFETY CLASSIFICATIONS

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APPENDIX B

PRELIMINARY SAFETY CLASSIFICATIONS

The preliminary safety classifications for the Double-Shell Tank Monitor and Control Subsystem major components were derived from the *Tank Waste Remediation System Final Safety Analysis Report*, HNF-SD-WM-SAR-067. See Table B-1 below.

Table B-1. Safety Classification of Double-Shell Tank Monitor and Control Subsystem Components.

Component	GS	SS	SC
Piping Encasement Leak Detection Monitoring and Control Loops	✓		
Valve Position Monitoring and Control Loops	✓		
Service Water Backflow Detection Monitoring and Control Loops		✓	
Monitor and Control Loops for Transfer System Flow, Pressure, Density and Temperature	✓		
Transfer Pump Monitor and Control Loops Including Suction Level	✓		
Diluent and Flush System Monitoring and Control Loops	✓		
Ventilation System Monitoring Loops	✓		
Tank Waste and Structure Thermocouples and Tank Level Monitoring and Control Loops		✓	
Annulus Leak Detection Pit Monitoring			✓
Pit Leak Detection Monitoring and Control Loops			✓

GS = general service.
SC = safety class.
SS = safety significant.

REFERENCES

HNF-SD-WM-SAR-067, 1999, *Tank Waste Remediation System Final Safety Analysis Report*, Rev. 1, Lockheed Martin Hanford Corporation for Fluor Daniel Hanford, Inc., Richland, Washington.

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APPENDIX C

DOUBLE-SHELL TANK MONITOR AND CONTROL UNRESOLVED ISSUES

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APPENDIX C

DOUBLE-SHELL TANK MONITOR AND CONTROL UNRESOLVED ISSUES

a. Waste flow rate provides information about waste slurry properties such as solids loading, density, viscosity and potential transfer line plugging. However, at this time there is no definitive guidance for each tank for operational limits for flow rate (other than for minimum flow velocity). Some transfer pumps will automatically control waste flow to a setpoint but there is not a basis for a response to abnormal flow or flow velocity.

b. Waste density measurements of waste as it is being transferred through a transfer line provide important data for monitoring slurry properties. However, investigation is continuing on how to use the data. Currently, there is no definitive guidance for each tank for operational limits of density or density control, nor are there requirements for the correlation of density with other waste parameters such as flow rate, pressure drop, solids loading, and transfer line plugging potential that could be monitored and controlled by the DST Monitor and Control Subsystem.

APPENDIX D

INTERIM GUIDANCE FOR WASTE FEED DELIVERY MONITOR AND CONTROL SUBSYSTEM

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MEMORANDUM **CH2MHILL**

74B50-00-040

INTERIM GUIDANCE FOR WASTE FEED DELIVERY MONITOR & CONTROL SUBSYSTEM LEVEL II SPECIFICATION

TO:	R. R. Bafus	R3-73
COPIES:	P. J. Certa	R3-73
	T. J. Conrads	R3-73
	N. W. Kirch	R2-11 WBB for
	SDE LB/File	
FROM:	Process Control	
DATE:	April 5, 2000	
REPLY BY:	Not applicable	

This memo transmits the subject interim guidance.

S. D. Estey
Engineer

sde/mjg

Attachment

74B50-00-040.DOC

Waste Feed Delivery
Monitor & Control Subsystem Specification

Performance Requirements

General Guidelines:

A) If an AB process measurement is required, but no requirement is placed upon the specific type of instrumentation to be used (and its accuracy), then any device capable of measuring the parameter will suffice (Reference HNF-SD-WM-SAR-067 Chapter 5 Section 5.5.33.2).
B) Use interlocks only where absolutely necessary. If alarms will satisfy the function, they are preferred over an interlock.
C) Any Monitor & Control parameter listed with a justification of " *No AB requirement?* " is considered **NOT RECOMMENDED** by Process Engineering.

Notes:

(1) During waste transfers, the minimum performance requirement is to record values at start of transfer, +0.5 hrs, +1.0 hrs; every 2 hrs thereafter and upon termination of transfer.
(2) The desired performance requirement is to continuously record the parameter.
(3) Take immediate action to verify that the transfer is not being misrouted or system is not leaking. Terminate transfer if verification cannot be performed.
(4) No requirement is placed upon accuracy of the parameter measurement.
(5) If not required by the AB, include instrumentation only where Engineering has reasonable confidence that the instrumentation will produce value-added information, or where the equipment manufacturer recommends parameter monitoring. RPP Project history has shown that excess instrumentation almost always results in adverse cost and schedule impacts, and little, if any, useful additional information.

Control	Criteria	Requirements	Justification
Transfer Line Operational Parameters	Flow Rate: +/- 5% of process range	(1) (2)	HNF-IP-1266 Section 5.12 HNF-SD-WM-SEL-040
	Flow Volume: +/- 5% of process range	(1) (2)	HNF-IP-1266 Section 5.12 HNF-SD-WM-SEL-040
	Density: +/-5% of process range	(1) (2)	(5)
	Pressure: +/-5% of process range	(1) (2)	(5)
	Pressure Drop: +/-5% of process range	(1) (2)	(5)
	Temperature: +/-5 °F	(1) (2)	HNF-SD-WM-SAR-067 Chapter 4 Section 4.4.10

Material Balance Discrepancy Criteria	$^1/_4$ inch in sending tank + $^1/_4$ inch in receiving tank + transfer line volume as determined by any means (tank level to tank level; tank level to totalized flow)	(1) (2) (3)	HNF-SD-WM-SAR-067 Chapter 5 Section 5.5.26 (5)
Service Water Totalized Flow	+/- 5% of totalized flow	Monitor once every 24 hrs hrs when not in use (1) (3) (2)	HNF-IP-1266 Section 5.21 HNF-SD-WM-SAR-067 Chapter 4 Section 4.4.8 (5)
DST Waste Temperature	+/-5.0 °F	Monitor once per week in a static tank During a waste transfer (1) (2)	HNF-SD-WM-SAR-067 Chapter 4 Section 4.4.10 HNF-IP-1266 Section 5.12
DST Waste Level (liquids and solids to avoid mixer pump intake blockage)	+/-0.5 inches	(1) (2)	HNF-SD-WM-SAR-067 Chapter 4 Section 4.4.9 (5)
DST Headspace Pressure	Verify < 0 kPa relative to ambient atmosphere (4)	Once every 24 hrs	HNF-SD-WM-SAR-067 Chapter 4 Section 4.3.2
DST Annulus Leak Detection	+/-1.0 inches	Audible alarm signal and annunciator panel light upon real-time detection	HNF-SD-WM-SAR-067 Chapter 4 Section 4.3.7 HNF-SD-WM-TSR-006 Appendix A Primary Tank Leak Detection Systems B 3.2.6

DST Annulus Air Leak Detection	Annulus Air CAM alarm (setpoint?) (4)	Audible alarm signal and annunciator panel light upon real-time detection	HNF-SD-WM-SAR-067 Chapter 4 Section 4.3.7 HNF-SD-WM-TSR-006 Appendix A Primary Tank Leak Detection Systems B 3.2.6
DST Ventilation System Operation	HEPA filter/prefilter housing radiation level of >200 mr/hr (4)	DST Ventilation System exhaust fans shut down upon alarm	HNF-SD-WM-SAR-067 Chapter 5 Section 5.5.6 & 5.5.32
	Ventilation System CAM interlock at 10000 cpm (4)	DST Ventilation System exhaust fans interlocked to shut down upon alarm	HNF-SD-WM-TSR-006 Appendix A Ventilation Stack CAM Interlock Systems B 3.1.4
Waste Backflow Detection	+/-2.0 psi	Protective action must occur upon real-time detection of this amount of back-pressure	HNF-SD-WM-SAR-067 Chapter 4 Section 4.4.4
Leak Detected in Transfer-Associated Structure	The volume defined by the floor area of the structure multiplied by the level at which the leak detector actuates must be < 1520 gallons. (this level is typically about 2 inches)	Terminate waste transfer upon actuation of leak detection alarm	HNF-SD-WM-SAR-067 Chapter 4 Section 4.4.11
Leak Detected in Primary Confinement	The volume defined by the floor area of the structure multiplied by the level at which the leak detector actuates must be < 1520 gallons. (this level is typically about 2 inches)	Terminate waste intrusive activity upon actuation of leak detection alarm	HNF-SD-WM-SAR-067 Chapter 4 Section 4.4.11
Transfer Pump Operating Parameters	Motor power consumption (4)	(1) (2)	(5)
	Pump speed (4)	(1) (2)	(5)
	Bearing temperature (4)		*No AB requirement?*
	Winding temperature (4)		*No AB requirement?*
	Seal water flow (4)		*No AB requirement?*
	Pump vibration (4)		*No AB requirement?*
	Nozzle pressure (4)		*No AB requirement?*
Mixer Pump Operating Parameters	Motor power consumption (4)	(1) (2)	(5)
	Pump speed (4)	(1) (2)	(5)
	Bearing temperature (4)		*No AB requirement?*
	Winding temperature (4)		*No AB requirement?*
	Seal water flow (4)		*No AB requirement?*
	Pump vibration (4)		*No AB requirement?*
	Nozzle pressure (4)		*No AB requirement?*
	Nozzle position (4)		*No AB requirement?*
	Nozzle rotational speed (4)		*No AB requirement?*
Mixer Pump Control Signal	on/off?		*No AB requirement?*

DST Structure Temperature (to determine sludge distribution in tank)	(4)		*No AB requirement?*
DST Waste Density and Viscosity vs. Depth	(4)		*No AB requirement?*
DST Hydrostatic Loads	(4)		*No AB requirement?*
MOV Actuation Signal	(4)		*No AB requirement?*
MOV Position	(4)		*No AB requirement?*
Transfer Pump Control Signal	(4)		*No AB requirement?*
Transfer Pump Intake Position	(4)		*No AB requirement?*

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