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Low-Activity Waste Feed Process Control Strategy

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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Abstract:

The primary purpose of this document is to describe the overall process control strategy for monitoring and controlling the functions associated with the Phase 1B low-activity waste feed delivery. This document provides the basis for process monitoring and control functions and requirements needed throughout the double-shell tank system during Phase 1 low-activity waste feed delivery.

This document is intended to be used by (1) the developers of the future Process Control Plan and (2) the developers of the monitoring and control system.

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Revision 0

Low-Activity Waste Feed Process Control Strategy

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Date Published
May 2000

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FIGURES

Figure 2-1. Level 1 Functional Flow Diagram. 2-2

ACRONYMS AND ABBREVIATIONS

CAM	continuous air monitor
CFR	Code of Federal Regulations
COB	clean-out box
DCRT	double-contained receiver tank
DOE	U.S. Department of Energy
DST	double-shell tank
ft	feet
gal	gallon
GRE	gas release event
HEPA	high-efficiency particulate air
HLW	high-level waste
hp	horsepower
ICD	interface control document
kW	kilowatt
LAW	low-activity waste
LCO	limiting condition of operation
LFL	lower flammability limit
m	meter
PC	Privatization Contractor
SHMS	Standard Hydrogen Monitoring System
SpG	specific gravity
SST	single-shell tank
VFD	variable-frequency drive
WCA	waste compatibility assessment
WFD	waste feed delivery
w.g.	water gauge

DEFINITIONS

Certified	The waste has been sampled and meets the criteria of BNFL-5193-ID-19, *Interface Control Document for Low-Activity Waste Feed*, for the given transfer.
Diluent	Raw water, or water with added caustic and/or nitrite compounds, which may be temperature adjusted.
Homogenized	The waste has been sufficiently mixed to meet the requirements for qualification and certification.
LAW	Low-activity waste as defined in *DOE Contract DE-AC06-96RL13308, Waste Treatment Plant*, Specification 7, "Low-Activity Waste Envelopes Definition" (BNFL 1996).

LAW/HLW Plant	The vitrification facility to be built by the Privatization Contractor.
Mobilize	The process of resuspending settled sludge from the bottom of the tank.
Multimoded	A function performed concurrently with several other functions.
Qualified	The waste has been determined to be pumpable.
Transfer	The process of moving waste from one tank to another or from one tank to the LAW/HLW Plant.
Waste Envelope	Waste defined per *DOE Contract DE-AC06-96RL13308, Waste Treatment Plant*, Specification 7, "Low-Activity Waste Envelopes Definition" (BNFL 1996).
Waste Feed	Waste slurry to be transferred to the LAW/HLW Plant; it contains a mixture of solids and liquids.
Watch List Tanks	With respect to LAW, tanks 241-AN-103, -104, -105, 241-AW-101, and 241-SY-103.

LOW-ACTIVITY WASTE PROCESS CONTROL STRATEGY

1.0 INTRODUCTION

Low-activity radioactive wastes stored in underground storage tanks at the U.S. Department of Energy (DOE) Hanford Site are scheduled to undergo vitrification before final disposal. The initial phase (Phase 1B) of the low-activity waste (LAW) feed delivery process includes retrieval of wastes from tanks at the 241-AN, 241-AP, 241-AW, and 241-SY Tank Farms. The waste contained in the LAW source tanks typically is made up of a settled sludge layer covered by a layer of liquid supernatant. The sludge layer has a tendency to retain gases, some of which are flammable, that are constantly being generated by the waste. Some of the gas escapes from this sludge layer on a relatively constant basis; however, a portion of the gas builds up and can result in relatively large releases over a relatively short period of time. These large rapid releases are referred to as gas release events (GRE). In addition, there may be a partially dried layer of solids, commonly called the crust, floating on top of the waste. Not all layers exist in every tank. In general, the waste retrieval process includes transferring supernatant to staging tanks, dissolving salts, transferring dissolate to the LAW/high-level waste (HLW) Plant, homogenizing the supernatant, and transferring supernatant to the LAW/HLW Plant. Transfers will be via underground pipelines.

Although incidental insoluble solids will be transferred with the supernatants and salt solutions, most insoluble solids are expected to settle and remain in the source tanks.

1.1 SCOPE

The primary purpose of this document is to describe the overall process control strategy for monitoring and controlling the functions associated with the Phase 1B LAW feed delivery. This document provides the basis for process monitoring and control functions and requirements needed throughout the Double-Shell Tank (DST) System during Phase 1B LAW feed delivery.

This document is intended to be used by (1) the developers of the future Process Control Plan and (2) the developers of the monitoring and control system.

This document is based on the Case 3, Project Planning, DST use scenario, which was the applicable baseline when this document was first prepared. 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 River Protection Project 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 the DOE Office of River Protection (ORP). Preliminary quantitative and qualitative assessments were performed to determine the effect of these changes to this document. Generally, the requirements developed in this document 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., Case 3 included retrieval of single-shell tank (SST) waste as a part of the extended order, and Case 3S6D includes retrieval of SST waste as a part of minimum-order and extended-order quantities). In instances where

quantitative assessments were performed, the enveloping case was selected to develop the requirements.

Performance requirements for the DSTs, which include the available storage and staging capacities, waste sources and volumes, physical, chemical, and radiological waste properties for storage/preparation/transfer, utility requirements, and transfer rates, are given in HNF-2168, *Performance Requirements for the Double-Shell Tank System: Phase 1*.

Requirements for monitoring and control instrumentation, including performance requirements, physical characteristics, environmental conditions, reliability, maintainability, and transportability are given in HNF-4155, *Double-Shell Tank Monitor and Control Subsystem Specification*.

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 use of the DSTs during Phase 1 Waste Feed Delivery is detailed in HNF-SD-WM-SP-012, *Tank Waste Remediation System Operation and Utilization Plan to Support Waste Feed Delivery*.

1.2 DOCUMENT ORGANIZATION

This document is organized as outlined below.

- Section 1.0, "Introduction," includes a brief description of the scope of the process control strategy, the document organization, and the general assumptions used in developing the process control strategy.

- Section 2.0, "Process Overview," breaks the DST System functions down according to the functional decomposition presented in HNF-5136, *Functional Analysis for Double-Shell Tank Subsystems*, and describes existing retrieval systems at the tank farms.

- Section 3.0, "Process Control," describes the general objectives of the process control strategy, with reference to the matrices in Appendix A and the logic diagram in Appendix B. The specific process control strategy requirements for each of the functional decompositions in Section 2.0 are discussed. The general requirements of the instruments and equipment are also described.

- Section 4.0, "References," provides full reference citations for references used in the document.

- Appendix A, "Process Control Strategy Matrices," contains the breakdown of storage, preparation, and transfer functions, with associated process concerns, potential control variables, choice of controlling variables (monitored or controlled), and the basis for

control variable selection. Two sets of matrices are provided, "Existing Process Concerns," and "Control Variable Consideration for Future Development."

- Appendix B, "Process Control Strategy Logic Diagram," contains the logic train associated with requirements developed in Section 3.0 and Appendix A. The logic diagrams indicate the types of decisions required (administrative or control logic) to operate each function (storage, preparation, or transfer).

- Appendix C, "Low-Activity Waste Process Control Strategy Task Team Decisions Meetings Minutes," provides documentation of decisions regarding the HLW and LAW process control strategy. Some decisions are on an interim basis, pending formal resolution.

- Appendix D, "Low-Activity Waste Process Control Strategy Unresolved Issues," contains a list of issues that need to be resolved to document fully the selection of the specific controlling variables as detailed in the matrices (Appendix A) and logic diagram (Appendix B).

1.3 ASSUMPTIONS

The following assumptions were made in the preparation of this document.

- LAW feed staging Case 3 (HNF-SD-WM-SP-012) is used as the basis for this document.

- Mixer pumps, if required, will be able to mobilize the required quantity of waste feed in LAW source and staging tanks. Per Case 3S6D, LAW in SSTs may be mobilized by means other than mixer pumps.

- Instrumentation to measure solids mobilization, blending, and suspension parameters, including the suspended solids profiler, gamma profiler, and ultrasonic interface level detector, will be tested in conjunction with mixer pump testing (HNF-SD-WM-PTP-027, *Mixer Pump Test Plan for Double-Shell Tank 241-AZ-101*). Successful testing of these instruments may justify monitoring additional process control parameters.

- Only parameters that have been monitored or measured previously or can be proven to be measurable will be used for monitoring and control of LAW feed delivery.

- New transfer pumps, if installed in tanks with solids layers, will have adjustable suction.

- The waste retrieval and delivery process for Phase 1B LAW feed is as described in Section 2.2.

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2.0 PROCESS OVERVIEW

2.1 DOUBLE-SHELL TANK SYSTEM FUNCTIONS

The LAW feed process has been broken down into three separate system-level functions, as described in HNF-SD-WM-TRD-007, *System Specification for the Double-Shell Tank System*: Store Waste in DSTs, Prepare Waste in DSTs, and Transfer Waste. Waste storage includes those functions required for monitoring and controlling the stored waste in DSTs and for receiving wastes from other tanks. Waste preparation includes those functions required for sampling, dissolving, and homogenizing the waste for transfer. Waste transfer functions are those required for transferring the waste contained in source or staging tanks to other tanks and to the LAW/HLW Plant. The waste storage function is multimoded, i.e., performed simultaneously with the waste preparation and waste transfer functions; therefore, waste storage monitor and control functions must account for differing performance levels, depending on the activity being performed in the tank.

The Level 1 functional flow diagram is shown in Figure 2-1. It provides the framework within which the process control strategy is performed and documented. The functions depicted in Figure 2-1 that pertain to the LAW process control strategy are as follows:

- Store Waste in East/West Area DSTs
- Prepare Waste in East/West Area DSTs
- Transfer Waste to LAW Staging Tanks
- Transfer LAW Cross-Site
- Prepare LAW in LAW Staging Tanks
- Transfer LAW Supernatant to LAW/HLW Plant.

The majority of the LAW feed delivery activities will take place in the 200 East Area; however, the 200 West Area DST System Activities are included, because 200 West Area Tank 241-SY-101 is a Phase 1B LAW source tank. Existing supernatant stored in source tanks is sent to staging tanks via the Transfer Waste to LAW Staging Tanks function. Supernatant is homogenized via the Prepare LAW in LAW Staging Tanks function and sent to the LAW/HLW Plant via the Transfer LAW Supernatant to LAW/HLW Plant function. Salt dissolution is accomplished via the Prepare Waste in East/West Area DSTs function and sent to the LAW/HLW Plant via the Transfer LAW Supernatant to LAW/HLW Plant function. Waste is transferred from the 200 West Area to the 200 East Area via the Transfer LAW Cross-Site function.

Figure 2-1. Level 1 Functional Flow Diagram. (Sheet 1 of 2)

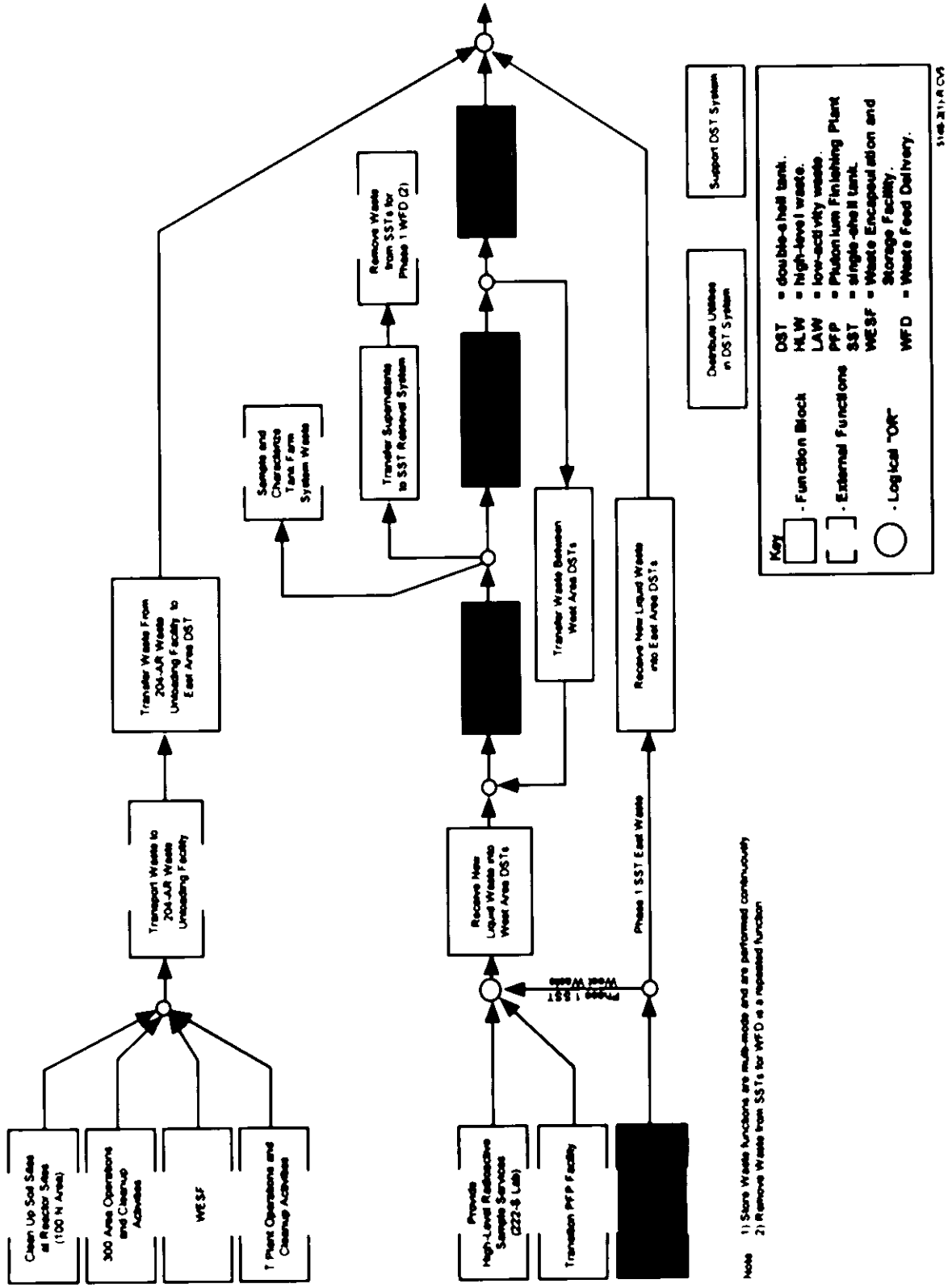
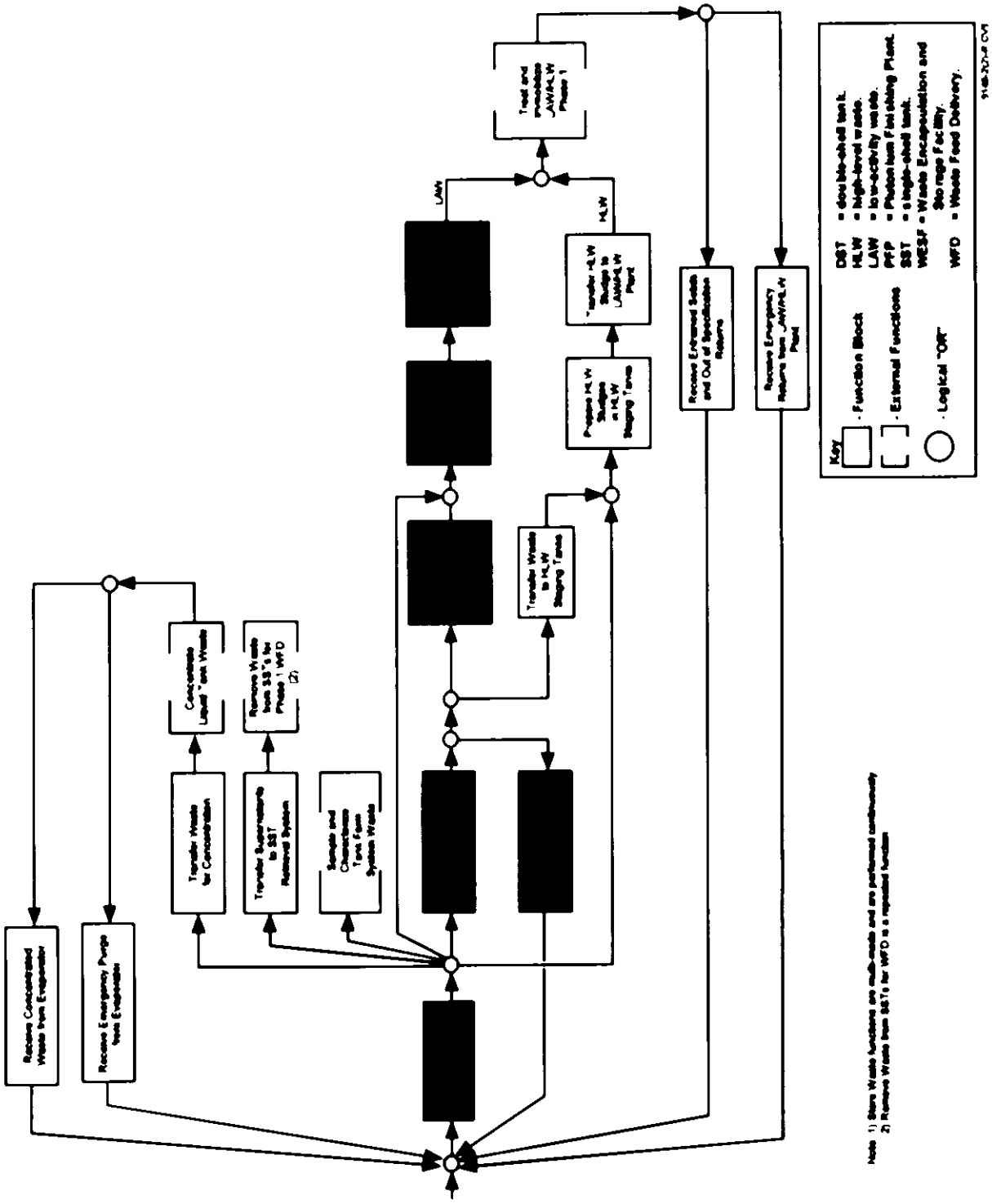


Figure 2-1. Level 1 Functional Flow Diagram. (Sheet 2 of 2)



2.2 PROCESS DESCRIPTION

A typical process flowsheet that describes the process for retrieval and delivery of waste feed is given in HNF-1939, *Waste Feed Delivery Technical Basis*, Vol. II, "Waste Feed Delivery Flowsheet for Tank 241-AN-104," Rev. 0c. Flowsheets describing transfer of additional HLW feeds from other source and staging tanks are also available. Recent interim guidance was provided in Letter 73600-99-006, *Interim Guidance on LAW Retrieval Strategy* (Treat 1999).

In general, the overall process for Phase 1B LAW feed delivery is as follows. Not all process steps are required for each LAW tank.

- Store Waste in East/West Area DSTs.

  Tank parameters are monitored and controlled to ensure containment and safe storage during waste retrieval activities.

- Prepare Waste in East/West Area DSTs.

  Diluent is added, and the majority of the precipitated salts in the source tanks are mobilized and dissolved. When the salt-dissolution step is complete, undissolved solids are allowed to settle.

- Transfer Waste to LAW Staging Tanks.

  LAW supernatants are decanted to LAW staging tanks. Selected source tanks are monitored for gas releases during transfers. Supernatants being transferred to the staging tanks must be sampled and qualified first.

- Transfer LAW Cross-Site.

  Waste is transferred from the 200 West Area tank to the 200 East Area tank.

- Prepare LAW in LAW Staging Tanks.

  Supernatants in staging tanks are homogenized, then sampled, qualified, and certified before transfer to the LAW/HLW Plant.

- Transfer LAW Supernatant to LAW/HLW Plant.

  Supernatant in some source tanks is decanted directly to the LAW/HLW Plant. Supernatant in staging tanks is homogenized, sampled, qualified, and certified before transfer to the LAW/HLW Plant. Salt dissolates to be transferred are sampled, qualified, and certified before transfer to the LAW/HLW Plant. The salt dissolates are decanted directly to the LAW/HLW Plant.

The process description for each of the LAW feed delivery functions is described below.

2.2.1 Store Waste in East/West Area Double-Shell Tanks

The process activities included in the Store Waste in East/West Area DSTs function are primarily monitoring and control of tank parameters to ensure containment and safe storage of the waste during retrieval activities, such as waste transfers, waste preparation, and blending. Waste confinement is evaluated by monitoring for waste leakage in the tank annulus and monitoring for contamination in the ventilation exhaust stacks. Parameters monitored include waste volume, waste temperature, tank-structure temperature, and dome vacuum. Where provided, vapor space hydrogen concentration will be monitored and in-tank, closed-circuit television cameras will provide views of the in-tank environment.

2.2.2 Prepare Waste in East/West Area Double-Shell Tanks

The major process steps of the Prepare Waste in East/West Area DSTs function are an optional crust-softening step, salt dissolution, and solids settling. If crust softening is required, the floating solids will be softened and dissolved partially by adding diluent or by using the transfer pump to recirculate diluted supernatant to the top of the waste. "Diluent" refers to water supplied by the Diluent and Flush Subsystem. Diluent may consist of raw water or chemically adjusted water, depending on the requirement, and also may be temperature-adjusted. The diluent may be chemically adjusted, as necessary, with sodium hydroxide and sodium nitrite for corrosion inhibition. The Diluent and Flush Subsystem also supplies flush solution for flushing transfer lines after waste transfers. Transfer lines are flushed to prevent accumulation of solids and to provide corrosion protection.

Depending on the total volume of waste in a tank, an initial transfer of a portion of the supernatant may be necessary to allow sufficient water or diluent addition for the salt-dissolution step. In the salt-dissolution step, most of the settled, undissolved salts in the sludge layer are dissolved by diluting, mobilizing, and mixing with submerged jet mixer pumps. As the liquid level of the tank is reduced, incremental lowering of the mixer pump will allow startup of the pump by placing the pump suction in liquid. Diluent can be added directly on top of the waste and at the suction of the transfer pump. With the pump off, the diluent flows into the tank, dissolving and diluting the waste at or near the point of entry. The mixer pumps can be operated with the nozzles in a fixed position or in the oscillating mode. In the oscillating mode, the two diametrically opposed nozzles are rotated back and forth through 180 degree arcs. Tanks with the potential for production of flammable gas will be monitored for lower flammability limit (LFL). If necessary, flammable gas concentration will be monitored by sampling. If flammable gas concentrations in the tank headspace exceed 25 percent of the LFL during the mixing process, the mixer pump will be shut off and not restarted until the Ventilation Subsystem reduces the concentrations of flammable gases. A GRE may result in mixer pump shutdown, if permissible operating parameters are exceeded, per Sections 3.2.2.2 through 3.2.2.5.

Alternative methods for salt dissolution include (1) water jetting, in which the dilution water is introduced near the bottom of the tank with horizontal jets pointed circumferentially, resulting in thorough mixing of the tank contents, and (2) recirculation of the tank contents by the transfer

pump, in which the recirculated transfer pump discharge is introduced at a location that establishes a wide mixing zone.

After the waste is diluted and mixed, the mixer pump is turned off and the undissolved solids are allowed to settle. In situ solids distribution and settled-solids level data are collected, and samples are analyzed to verify adequate dissolution of the waste. Additional mixing time and/or diluent addition may be provided if necessary. After verification that the waste has been adequately diluted and mixed and the solids have settled, preparations are initiated for waste transfers to the LAW/HLW Plant. Preparation for transfer includes determining the settled-solids level in the tank so the transfer pump suction can be positioned to avoid drawing in undissolved solids that could plug transfer lines or exceed feed specifications.

2.2.3 Transfer Waste to Low-Activity Waste Staging Tanks

Before transferring any waste to tanks containing residual heels, consideration will be given to the effects of combining different types of waste envelopes. Additionally, for retrieval operations involving transfers, CPS-T-149-00010, *Criticality Prevention Specification*, requires that a criticality safety evaluation be performed per WHC-SD-SQA-CSA-20368, *CSER 94-004: Criticality Safety of Double-Shell Waste Storage Tanks*.

If the crust is sufficiently thick, as in Watch List Tanks 241-AN-103, -104, and -105, 241-AW-101, and 241-SY-103, consideration must be given to potential structural damage resulting from (1) moments caused by crust remaining on the tank walls, (2) crust falling to the tank bottom, and (3) floating crust damaging in-tank components after removal of the liquid below the crust. Hold-points should be a part of the process control strategy during supernatant removal. The movement of crust would be observed with closed-circuit television. In-tank washing of the crust may be required to preclude damage resulting from crust movement. The crust-softening step is discussed in Section 3.2.3.

Before waste transfers begin, the transfer plan is prepared and the transfer route is established. If adjustable suction transfer pumps are installed, the transfer pump suction is positioned at an elevation above the settled-solids layer as determined in the Prepare Waste in East/West Area DSTs function (Section 2.2.2). Existing transfer pumps, if functional, may be used to transfer waste. The transfer valve positioning is confirmed by a walkdown and is monitored during waste transfers. The transfer pump suction elevation is verified by the operator during the transfer process. The transfer route may be preheated with diluent to reduce the possibility of solids precipitating during transfer. The requirement for preheating of the transfer line has been studied, and conservative judgment will be applied to determine whether preheating is required for any given transfer.

Transfers to LAW staging tanks comprise portions of the source tank supernatant and/or the salt dissolate solutions resulting from dilution and mixing steps. During the transfer of supernatants, diluent is added at the pump suction to desaturate the liquid, dissolve incidental solids drawn into the pump suction, and maintain the sodium concentration below the contract feed limit. Although diluent is not required for transfers of salt dissolate, diluent may be used during transfer pump startup to ensure that solutions do not approach their saturation point or to recover

from off-normal conditions. Diluent flow to the transfer pump suction begins before the pump is started, then is reduced until it is equal to the planned transfer pump flow rate. With the pump off, diluent flows in the reverse direction to flush solids from the suction line and intake screen.

When the diluent flow rate is equal to the planned transfer pump flow rate, the transfer pump is started at a relatively low rotational speed. With the pump on, the diluent can be either recirculated to the top of the waste or directed through the transfer lines. During the recirculation mode, critical transfer instrumentation will be checked. Transfer pump parameters are monitored to ensure proper operation and alert operators to potential problems. To initiate the transfer, diluent flow is reduced in steps while the pump outlet flow is held constant. As diluent flow is reduced, waste is drawn into the pump suction to make up the difference. A minimum ratio of diluent to total pump flow will be determined to maintain the solids content of the transfer stream below the allowable limit and to prevent transfer line plugging. Waste composition and solids content data collected during the Prepare Waste in East/West Area DSTs function are used to determine the minimum ratio of diluent to total pump flow rate. This ratio is correlated to transfer stream density.

In some tanks, removal of waste will reduce the pressure on flammable gases that are trapped in the settled solids, thereby increasing the likelihood of GREs. Flammable gas concentrations in tank headspaces will be monitored. If monitoring is provided during the decanting process and if flammable gas concentrations exceed 25 percent of the LFL, then the waste transfer will be stopped and not restarted until the flammable gas concentration is less than 25 percent of the LFL. A GRE may result in transfer pump shutdown if permissible operating parameters are exceeded.

Primary control of the transfer process is at the source tank. The operator approves start of the transfer and monitors in-tank and transfer stream conditions during the transfer. The transfer system is monitored for waste leakage and misrouting by the Master Pump Shutdown System, which will terminate a transfer if leakage or misrouting is detected. The operator may also interrupt the transfer if necessary. Material balance information is collected, and periodic material balances are performed. The transfer is continued until the predetermined tank level is achieved. The transfer may be limited by the possibility of drawing either floating solids or settled solids into the pump suction, increasing solids content above the allowable limit, and/or increasing the risk of transfer line plugging. When the transfer is complete, the transfer pump is shut down, and flush solution is delivered to the transfer line by the diluent pump. When the transfer system is flushed sufficiently, the diluent pump is shut off and the flow of flush solution is stopped. The flush solution in the transfer line partially drains to the staging tank, and the remainder drains back to the source tank through the pump and pump inlet line. The transfer route is reconfigured by returning the transfer valves, Diluent and Flush Subsystem, and pump and monitoring systems to their offline positions and settings. The final waste transfer material balance then is completed. The many factors that must be considered in material balance are discussed in Section 3.2.17.

2.2.4 Transfer Low-Activity Waste Cross-Site

The LAW contained in the West Area tanks will be transferred cross-site to East Area intermediate or staging tanks before being sent to the LAW/HLW Plant for immobilization. The

transfers will originate from one of the 241-SY Tank Farm DSTs and will be sent either to Tank 241-AN-101 or Tank 241-AN-104 located in the 200 East Area. A high-point vent is located approximately half way between the 200 East and 200 West Areas to facilitate filling and draining the pipeline. The transfers will be performed in 5 steps.

1. Valves are configured for proper transfer routing.
2. Line is preheated with diluent if necessary.
3. Transfer is performed.
4. Pipeline is flushed and drained.
5. Valves are reconfigured to a non-transfer condition.

During the transfer, system operating parameters including transfer pump pressures, fluid temperature, primary pipe leaks, and leaks through isolation valves will be monitored. Material balance information is collected and periodic material balances are performed. The many factors that must be considered in material balance are discussed in Section 3.2.17.

2.2.5 Prepare Low-Activity Waste in Low-Activity Waste Staging Tanks

The overall waste feed delivery (WFD) plan assigns staging tanks that are used to prepare waste batches for transfer to the LAW/HLW Plant. The waste that is prepared in the staging tanks is either the waste that is currently contained in the tanks or waste that has been transferred from another tank (source tank). The primary process steps included in the Prepare LAW in LAW Staging Tanks function are the receipt of waste transfers from LAW source tanks, homogenization of waste batches, settling of undissolved solids, and qualification of waste for transfer to the LAW/HLW Plant. The residual heel material from previous batches is left in the staging tank and blended with incoming waste from source tanks. The amount of residual heel material is estimated for use in planning transfers.

The waste is homogenized by (1) mixer pump(s) operated for short periods of time or (2) recirculation of the waste by transfer pumps. Homogenization requirements are described in Section 3.2.6.1(3) of the interface control document (ICD), BNFL-5193-ID-19, *Interface Control Document for Low-Activity Waste Feed*. The control concept for mixer pump operation during homogenization is the same as for the salt-dissolution step presented under the Prepare Waste in East/West Area DSTs function in Section 2.2.2. The mixer pump(s) is shut off to allow undissolved solids to settle and to reduce the suspended solids concentration below the contract feed limit. In preparation for transfers of these batches, the waste is sampled and analyzed to verify that it meets contract requirements for certification and to reach agreement with the Privatization Contractor (PC) that the waste batch is acceptable. Subsequent batches of waste are transferred from staging tanks directly to the LAW/HLW Plant.

2.2.6 Transfer Low-Activity Waste Supernatant to Low-Activity Waste/High-Level Waste Plant

The LAW contained in the 200 East Area source and staging tanks is transferred to the LAW/HLW Plant for processing. Before the waste transfer begins, the transfer plan is prepared

and the transfer route is established. Existing transfer pumps, if functional, may be used to transfer waste. The transfer valve positioning is confirmed by an independent verification and by electronic monitoring of valve position (where available) during waste transfers. The specific procedure of verifying valve configuration between DOE and the LAW/HLW Plant facilities will be elaborated upon in the future Process Control Plan (see Unresolved Issue 10). In addition, the transfer line may be preheated to reduce the possibility of solids precipitating during transfer by transferring heated diluent. The diluent transfer also is used to verify the transfer line routing before tank waste is admitted to the line. A flush pump at the Diluent and Flush System is used to pump the diluent through the transfer line. Valving at the transfer pit jumper is configured to allow the diluent transfer to be routed so that it bypasses the transfer pump.

The waste transfer is initiated by transferring the waste through a recirculation loop in the transfer pit jumper. Instrumentation contained in the jumper is monitored to verify waste transfer parameters such as flow, mass flow, pressure, and, tentatively, density. Once parameters have been verified, valves in the transfer pit jumper are realigned to allow the waste to proceed to its destination.

In-line dilution also may be required during the transfer. In this case, diluent flow to the transfer pump suction is initiated before the pump is started, then reduced until it is equal to the planned transfer pump flow rate. When the diluent flow rate is equal to the planned transfer pump flow rate, the transfer pump is started at a relatively low rotational speed. With the pump on, the diluent is recirculated through the recirculation loop. Transfer pump operation and instrumentation contained in the jumper are monitored as described above to ensure proper operation and to alert operators to potential problems. To initiate the transfer, diluent flow is reduced in steps while the pump outlet flow is held constant. As diluent flow is reduced, waste is drawn into the pump suction to make up the difference. A minimum ratio of diluent to total pump flow will be determined to maintain the solids content of the transfer stream below the allowable limit and prevent transfer line plugging. Waste composition and solids content data collected during the tank characterization process are used to determine the minimum diluent to total pump flow rate ratio, and this ratio is correlated to transfer stream density.

Transfer stream parameters are monitored to ensure compliance with pumpability requirements and maintain the solids content within allowable limits. If the transfer pump and transfer stream parameters are as expected, diluent flow rate reductions continue until the minimum ratio of total flow to diluent is reached.

Primary control of the transfer process is at the source tank. The operator approves start of transfer and monitors in-tank and transfer stream conditions during the transfer. The transfer system is monitored for waste leakage and misrouting, and the operator may interrupt the transfer if necessary. Material balance information is collected, and periodic material balances are performed. The transfer continues until the predetermined tank level is achieved.

When the transfer is complete, flush solution is delivered to the pump suction at a flow rate slightly more than the pumping rate to flush waste from the transfer pump and transfer line. When the transfer system is flushed sufficiently, the transfer pump is shut off and valves are reconfigured to allow diluent flow in the reverse direction to flush solids from the suction line and intake screen. Part of the flush solution remaining in the transfer line drains to the

LAW/HLW Plant tank, and the remainder drains back to the source or staging tank through the pump.

On completion of the transfer, the transfer route is reconfigured by returning the transfer valves, diluent and flush solution supply equipment, and pump and monitoring systems to their off-line positions and settings. A final material balance calculation then is completed for the waste transfer. The many factors that must be considered in material balance are discussed in Section 3.2.17.

2.2.7 Changes in Process with New Baseline Case 3S6D

The process steps described above apply to Case 3S6D DSTs. Specific process steps for sluicing have yet to be developed for SST retrieval.

2.3 RETRIEVAL SYSTEM DESCRIPTION

Existing systems and equipment at the LAW feed tanks are primarily for maintaining the waste in a safe storage condition. The overall LAW retrieval system is in various stages of planning, design, and construction and will be installed by various projects. The waste transfer system and other upgrades also will be installed by these projects. Existing and planned equipment are discussed in the following sections. Discussion of the 241-AZ Tank Farm is not included in this section, as HLW from these tanks will be delivered to the LAW/HLW Plant with supernatant processed there as LAW.

A detailed description of the retrieval system appears in HNF-1939, Vol. III, "Waste Feed Delivery System Description," which will be updated during fiscal year 2000.

2.3.1 AN Tank Farm

The 241-AN Tank Farm, located in the 200 East Area at the Hanford Site, is made up of seven DSTs (241-AN-101, -102, -103, -104, -105, -106, and -107), each with a capacity of 4,390 m^3 (1.16 Mgal). Waste will be delivered to the LAW/HLW Plant as LAW feed during Phase 1B privatization. The supernatant and/or soluble solids will be retrieved from certain tanks, and the solids will be left behind. Tank 241-AN-104 will be used as an HLW receiving tank after removal of LAW.

Mixer Pumps – Mixer pumps will be required in Tanks 241-AN-102, -103, -104, and -105 for dissolution of soluble solids. An experimental approach, in which one mixer pump at a time is installed and evaluated for solids dissolution effectiveness, may be utilized. Two 224 kW (300-hp) mixer pumps will be installed in Tank 241-AN-104 under a current project.

Transfer Pumps – New transfer pumps and jumpers, if required, will be installed by current projects. Existing transfer pumps, if functional, will be used to transfer waste. The new pumps will be controlled through variable-frequency drive (VFD) units. New transfer pumps will have the capability to provide in-line dilution at the pump suction. Piping jumpers will transfer the

waste from the pump discharge to the transfer lines and will contain a recirculation line to return waste to the tank, if required.

Diluent and Flush Subsystem – A new system will be provided by a current project and located at the 241-AN Tank Farm. The additional system will consist of a storage/makeup tank, heaters, chemical-metering pumps, and a piping system. The diluent added to the tanks is introduced either at the transfer pump intake or directly to the tank. The system also will be used for providing diluent and flush water for the 241-AZ and 241-AY Tank Farms.

Ventilation Subsystem – The primary ventilation system draws outside air into the tank through inlet filters, pit cover blocks, and risers as a result of the vacuum created by the primary exhaust blowers. Air is drawn out of the tank through a duct and into a belowgrade exhaust header that is routed to a ventilation pit. After leaving the ventilation pits, the exhaust ducts combine into one larger duct, which is routed to the primary exhauster unit. The exhaust stream passes through a demister, an electric heater, and a set of filters consisting of a prefilter and two high-efficiency particulate air (HEPA) filters mounted in series, before being exhausted out the stack.
A continuous air monitor (CAM) monitors effluent radioactivity levels, and a record sampler collects representative samples before the air is discharged to the atmosphere.

The annulus ventilation system consists of two exhausters that provide annulus ventilation for the annuli of the seven 241-AN Tank Farm tanks. Each tank has an air intake station that contains a prefilter and a HEPA filter. The airflow exhausted from the annulus of each tank is combined and then routed through the two exhaust trains before being exhausted from a stack to the atmosphere. Each exhaust train consists of a demister, an electric heater, two HEPA filter housings (one for tanks 241-AN-104, -105, -106, and -107 and the other for tanks 241-AN-101, -102, and -103) and a blower.

Instrumentation, Monitoring, and Control System – Instrumentation is in place to measure storage parameters including tank liquid level, tank waste temperature, tank structure temperature, tank headspace pressure, flammable gas concentration (not all tanks), primary tank and annulus leak detection, and Ventilation Subsystem parameters. If a crust is present, level measurement may determine only the location of the top of the crust. A standard hydrogen monitoring system (SHMS) cabinet is in place to monitor hydrogen gas concentration in the tank headspace, except for Tanks 241-AN-102 and -106. Hydrogen concentration will be monitored by sampling in tanks without a SHMS, if required. The diluent-addition system to be provided by a future project will consist of caustic-metering pumps, pH-monitoring capability, pressure monitoring, flow-totalizer capability, and temperature monitoring. This project also will provide instruments for monitoring mixer pump operation, transfer pump operation, flow, mass flow, and pump outlet pressure in pit piping jumpers.

2.3.2 AP Tank Farm

The 241-AP Tank Farm, located in the 200 East Area at the Hanford Site, is made up of eight DSTs (241-AP-101, -102, -103, -104, -105, -106, -107, and -108), each with a capacity of 4,390 m^3 (1.16 Mgal). Salt-well liquor waste from certain tanks will be delivered to the LAW/HLW Plant as LAW feed during Phase 1 privatization.

Mixer Pumps – Single mixer pumps will be required in certain tanks to mix the LAW thoroughly before certification sampling and delivery to the LAW/HLW Plant. One 224 kW (300-hp) mixer pump will be installed in each of these tanks by a current project.

Transfer Pumps – New transfer pumps and jumpers, if required, may be installed by plant forces. Existing transfer pumps, if functional, may be used to transfer waste. The new pumps will be controlled through VFD units. New transfer pumps will have the capability to provide in-line dilution at the pump suction. Piping jumpers will transfer the waste from the pump discharge to the transfer lines and will contain a recirculation line to return waste to the tank if required.

Diluent and Flush Subsystem – A new system to be provided by a current project will be located at the 241-AW Tank Farm and will serve both the 241-AP and 241-AW Tank Farms. The additional system will consist of a storage/makeup tank, heaters, chemical-metering pumps, and a piping system. The diluent added to the tanks is introduced either at the transfer pump intake or directly to the tank.

Ventilation Subsystem – The existing primary tank ventilation system provides a common ventilation off-gas exhaust for the eight AP tanks. There are no dedicated air inlet stations for the AP tanks; the air inlet consists of in-leakage though gaps such as those between cover blocks or pits. The combined exhaust stream from the eight tanks flows through a demister to eliminate any waste droplet carryover into the filter system. On exiting the demister, the gas stream is heated by electric heaters to protect the downstream HEPA filter banks. Each bank consists of two HEPA filters. After passing though one of the two filter banks, the ventilation gas stream is exhausted up the exhaust stack to the atmosphere by one of two exhaust fans. One fan is in standby while the operating fan maintains a vacuum in the vapor space for the tanks.

The annulus exhaust system is a combined system for AP tanks. Inlet air enters the system through one of four air intake stations, two tanks per station. The exhaust air is routed through one of two belowgrade ventilation pits, each of which contains an air-cleaning unit. The units consist of a heating coil, two banks of HEPA filters, and an exhaust fan. The exhaust stream is discharged to the atmosphere through the annulus exhaust stack.

Instrumentation, Monitoring, and Control System – Instrumentation is in place to measure storage parameters including tank liquid level, tank waste temperature, tank structure temperature, tank headspace pressure, primary tank and annulus leak detection, and Ventilation Subsystem parameters. If necessary, flammable gas concentration will be monitored by sampling. The diluent-addition system to be provided by a current project will include caustic-metering pumps, pH-monitoring capability, pressure monitoring, flow-totalizer capability, and temperature monitoring. Instrumentation also will be in place to monitor mixer pump operation, transfer pump operation, flow, mass flow, and pump outlet pressure in pit piping jumpers.

2.3.3 AW Tank Farm

The 241-AW Tank Farm, located in the 200 East Area at the Hanford Site, is made up of six DSTs (241-AW-101, -102, -103, -104, -105, and -106), each with a capacity of 4,390 m^3 (1.16 Mgal). Supernatant from certain tanks will be retrieved and delivered as LAW feed.

Mixer Pumps – Two 224 kW (300-hp) mixer pumps will be required in Tanks 241-AW-101 and -104 to mix the waste thoroughly. Two mixer pumps will be provided in each tank as part of a current project.

Transfer Pumps – A transfer pump and jumper assembly will be required in the central pump pit to transfer the waste from Tanks 241-AW-101 and -104. A current project will install transfer pumps and jumpers for each tank. The new pumps will be controlled through VFD units. Existing transfer pumps, if functional, will be used to transfer waste out of other tanks.

Diluent and Flush Subsystem – A new system to be provided by a current project will be located at the 241-AW Tank Farm. The system will be used for dilution and flushing of transfers from Tank 241-AW-101. The additional system will be similar to that proposed by another project for the 241-AZ Tank Farm.

Ventilation Subsystem – The primary ventilation system serves the six 241-AW Tank Farm tanks. Air infiltration through pit cover blocks is conveyed through ductwork to an exhaust fan, and is discharged through an exhaust stack. The exhaust train contains a de-entrainer, heater, prefilter, and a first- and second-stage HEPA filter. The exhaust stack is equipped with radiation monitors and alarms. The system design is such that one primary fan operates while another fan remains in standby as a backup.

The annulus exhaust system consists of two exhaust fans, each of which provides ventilation for three tanks. Outside air enters through intake stations at each tank that contain a pre-filter and HEPA filter. The air is drawn from the annulus and conveyed through a demister, heater, pre-filter, and first- and second-stage HEPA filters before being discharged through the exhaust stack. Should either exhaust fan assembly fail or require maintenance, partial airflow from the tanks can be maintained by manually switching the valve arrangement to allow the operating fan to draw from the tanks.

Instrumentation, Monitoring, and Control System – Instrumentation is in place to measure storage parameters including tank liquid level, tank waste temperature, tank structure temperature, tank headspace pressure and flammable gas concentration, and primary tank and annulus leak detection. A SHMS cabinet is in place for Tank 241-AW-101 and may be removed. A current project will install instruments for monitoring mixer pump operation, transfer pump operation, flow, mass flow, and pump outlet pressure instrumentation contained in pit piping jumpers.

2.3.4 SY Tank Farm

The 241-SY Tank Farm, located in the 200 West Area at the Hanford Site, is made up of three DSTs (241-SY-101, -102, and -103), each with a capacity of 4,390 m^3 (1.16 Mgal). The liquid supernatant from Tank 241-SY-101 will be removed and delivered to the LAW/HLW Plant as LAW feed during Phase 1B privatization.

Mixer Pumps – Mixer pumps may be required in Tank 241-SY-101 for salt dissolution. An experimental approach, in which one mixer pump at a time is installed and evaluated for solids dissolution effectiveness, may be utilized. The mixer pumps would be provided as part of a

future project. The existing mixer pump, which has been used for GRE mitigation, may be used for solids dissolution.

Transfer Pumps – A transfer pump and jumper assembly are required in the central pump pit to transfer the waste from Tank 241-SY-101. A recent project designed and installed the retrieval equipment. New transfer pumps will be required in all tanks. The new pumps will be controlled through VFD units.

Diluent and Flush Subsystem – The existing system will be used for dilution and flushing of transfers from Tank 241-SY-101.

Ventilation Subsystem – The primary ventilation system serves the three 241-SY Tank Farm tanks. Air is directed through the tank and ductwork to a moisture separator, steam heater, and first- and second-stage HEPA filters before being exhausted through the stack. The exhaust stack is equipped with radiation monitors and alarms. System controls include pressure switches to control tank overpressurization or failure of the second HEPA filter. A trailer-mounted portable exhauster is being used as a backup to the primary fan.

An exhaust fan provides annulus ventilation for the three tanks. Outside air is drawn into the annulus through HEPA-filtered intake stations at each tank. The exhaust is conveyed through ductwork to a moisture separator, steam heater, and first- and second-stage HEPA filters before being discharged through the exhaust stack. No backup system is available for the annulus exhaust system.

Instrumentation, Monitoring, and Control System – Instrumentation is in place to measure storage parameters including tank liquid level, tank waste temperature, tank structure temperature, tank headspace pressure and flammable gas concentration, and primary tank and annulus leak detection. A current project will install instruments for monitoring mixer pump operation, transfer pump operation, flow, mass flow, and pump outlet pressure in pit piping jumpers.

2.3.5 Cross-Site Transfer System

The cross-site transfer system will be used to transfer wastes from the 241-SY Tank Farm in the 200 West Area to the 241-AN Tank Farm in the 200 East Area. The transfer system contains two separate double-encased transfer lines, one for transferring supernatant and the other for transferring slurry. Each line has a continuous leak detection cable located in the annulus space between the primary and secondary pipes. The LAW will be routed through the supernatant line, which passes through one of two existing valve pits (241-SY-A and 241-SY-B), a diversion box, and a vent station before arriving at the 241-AN Tank Farm. The vent station contains a vent line that is supplied with a HEPA filter and two isolation valves.

Instrumentation is provided to monitor and control transfer system operation. Existing instrumentation includes pressure and temperature indication at the vent station, continuous leak detection, remote vent system valve position indication, and vent line pressure indication.

2.3.6 200 East Area Tank Farms Transfer System

The existing 200 East Area Tank farms transfer system consists of a network of underground pipelines that are routed between various diversion boxes and pits and terminate at nozzles inside the pits. Routing jumpers can be attached to the nozzles to connect numerous transfer lines. The transfer lines are typically 5.1 or 7.6 cm- (2- or 3-in.-) diameter carbon or stainless steel and provided with a carbon steel or concrete encasement that is twice the diameter of the primary pipe. The pipe-in-pipe transfer lines are generally compliant except in some cases where the secondary containment does not extend through the pit walls. The concrete encased lines do not meet current secondary containment requirements. The transfer lines are sloped toward a pit on one end to allow waste left in the line to drain back and to allow waste leakage in the secondary containment to drain to the low point where a leak detection system is located. Leak detection consists of a conductivity probe located in the pit and/or a conductivity probe located in the transfer line secondary containment drain. The existing transfer lines need to be upgraded to meet waste feed delivery system requirements.

Valve pits provide a method to establish and change waste routings, through jumper changes, between the waste storage tanks and/or treatment facilities. Tank process pits (pump pits, drain pits, sluice pits, leak detection pits, annulus pump pits, etc.) provide tank access either to receive or remove waste. The existing valve and process pits need to be upgraded to minimize the number of components (e.g., valves and jumpers) to reduce the risk of transfer system upset.

In addition to the valve and process pits, the existing transfer system also contains certain ancillary components, including the following:

- Double-contained receiver tanks (DCRT), which provide small-capacity, short-term waste accumulation points
- Clean-out boxes (COB), which house nozzles to clean out waste transfer lines in the event of line pluggage (The use of COBs has been discontinued.)
- Seal pots, which receive condensate drained from tank ventilation systems and return the condensate to the tanks via a dedicated drain line.

Current projects will replace the existing 200 East Area tank farm transfer system. Modification to the existing systems is required to

- Provide cross-site transfers directly from the 241-SY Tank Farm to the 241-AN Tank Farm
- Provide compliant transfer lines in the 200 East Area for waste feed delivery between the 241-AN, -AP, -AW, -AY, and -AZ Tank Farms and the LAW/HLW Plant interface point
- Provide instrumentation and controls for performing waste transfers, including leak detection and valve indication
- Replace the existing Master Pump Shutdown System to provide transfer flexibility, increased reliability, and expandability to accommodate future system needs.

2.3.7 Changes In Retrieval Systems with the New Baseline Case 3S6D

The systems described above for DST farms are essentially unchanged from Case 3 to Case 3S6D. The SST farm involved in Case 3S6D (241-C Tank Farm) will be equipped with a different retrieval system. These systems (not yet defined) are to be installed by a current project and will undergo conceptual design in fiscal year 2001.

3.0 PROCESS CONTROL

3.1 DEVELOPMENT OF PROCESS CONTROL STRATEGY

The process control strategy was developed with the following tools:

- Existing references related to tank farm safety and operations (Section 4.0)
- A matrix indicating the selection of control variables related to each process concern (Appendix A)
- A logic diagram detailing the logic sequence required to operate the system functions (Appendix B)
- A task team that provided key decisions regarding process control strategy logic.

The references are provided at the end of each text section following " *Basis: ...*" in Section 4.0, and in Appendix A at the end of Tables A-1a, A-2a, and A-3a.

3.1.1 General Process Control Strategy Requirements

The general process control strategy requirements relating to safe storage, preparation, and transfer of waste were developed on the basis of HNF-SD-WM-TSR-006, *Tank Waste Remediation System Technical Safety Requirements*; OSD-T-151-00007, *Operating Specifications for the 241-AN, AP, AW, AY, AZ, and SY Tank Farms*; HNF-SD-WM-OCD-015, *Tank Farm Waste Transfer Compatibility Program*; and ICDs requiring that certified waste be delivered to the LAW/HLW Plant. These objectives, listed under the appropriate functional decomposition in HNF-5136 are as follows:

Store Waste in East/West Area DSTs

- Receive waste
- Direct waste additions within DSTs
- Perform material balance
- Control DST hydrostatic loads
- Control DST primary confinement leaks
- Control DST tank and waste temperature
- Control DST chemical composition
- Control DST gaseous discharge

Prepare Waste in East/West Area DSTs

- Soften crust layer in source tanks (optional)
- Dissolve salts in source tanks

- Add diluent to source tanks
- Mobilize solids in source tanks
- Settle undissolved solids
- Monitor mixer pump operating parameters and control mixer pump operation
- Sample waste
- Perform waste-compatibility assessment

Transfer Waste to LAW Staging Tanks

- Establish transfer route
- Verify transfer route
- Verify transfer component status
- Convey waste
- Evaluate for line plugging
- Monitor transfer pump operation
- Monitor transfer jumper operation
- Confine waste leakage along transfer route
- Confine waste leakage within secondary confinement piping
- Confine waste leakage within transfer-associated structures
- Monitor for leaks in transfer-associated structures
- Transfer-associated structure leak detection
- Monitor for DST transfer pipe leakage
- Pipeline leak-detection monitoring
- Compare transfer structure leak detection data to process limit
- Compare transfer pipe leak detection data to process limit
- Shut down transfer pump through interface with the Master Pump Shutdown System
- Perform material balance
- Flush transfer system
- Control transfer line flushes
- Deliver flush water to transfer-associated structures
- Monitor flush water supply to transfer structures
- Confine flush water within manifolds and jumpers
- Confine flush water within DST transfer piping
- Monitor transfer valve position
- Carry flush water to transfer pump suction
- Drain transfer piping
- Reconfigure transfer route
- Position valves for off-line service
- Monitor valve position

Transfer LAW Cross-Site

Same functions as Transfer Waste to LAW Staging Tanks <u>except</u> include the following:

- Provide diluent during transfers
- Control in-line additions

~~4~~ Prepare LAW in LAW Staging Tanks

- Homogenize waste
- Monitor mixer pump operating parameters and control mixer pump operation
- Settle undissolved solids (optional)
- Sample waste
- Perform waste-compatibility assessment

~~4~~ Transfer LAW Supernatant to LAW/HLW Plant

Same functions as Transfer Waste to LAW Staging Tanks, including:

- Provide diluent during transfers
- Control in-line additions.

3.1.2 Process Control Strategy Matrices

The process control strategy matrices (Appendix A) were developed from the breakdown of storage, preparation, and transfer functions presented in HNF-5136 with associated process concerns, potential control variables, choice of controlling variables (monitored or controlled), and the basis for control variable selection. The first set of matrices, "Existing Process Concerns" (Tables A1a, A2a, and A3a), defines existing process concerns and the basis for those concerns. The second set of matrices, "Control Variable Consideration for Future Development" (Tables A1b, A2b, and A3b), provides existing and potential future control variables. The matrices present a compact, quick reference for determining the basis for the selection of control variables, with traceability to the functional breakdown per HNF-5136.

The goal of the matrices is to develop the existing and future process control requirements. The matrices are set up as follows:

"Existing Process Concerns" (Tables A1a, A2a, and A3a):

- Column 1, "Flowsheet Process Step," is derived from the process flowsheets in the waste feed technical requirements, HNF-1939, Vol. II, Rev. 0c.

- Columns 2, 3, and 4, "DST 2nd Tier Function," "DST 3rd Tier Function," and "DST 4th Tier Function," are structured according to the HNF-5136.

- Column 5, "Associated Process Concerns," displays the process concerns that arise during operations indicated by the fourth-tier functions.

- Column 6, "Basis for Concerns," displays the bases for concerns. The bases for concerns include existing document requirements.

"Control Variable Consideration for Future Development" (Tables A1b, A2b, and A3b):

- Column 1, "Flowsheet Process Step," is derived from the process flowsheets in the waste feed technical requirements, HNF-1939, Vol. II, Rev. 0c.

- Columns 2, 3, and 4, "DST 2nd Tier Function," "DST 3rd Tier Function," and "DST 4th Tier Function," are structured according to the HNF-5136.
- Column 5, "Associated Process Concerns," displays the process concerns that arise during operations indicated by the fourth-tier functions.
- Column 6, "Potential Control Variables," displays examples of possible choices for control variables that meet the concerns indicated in Column 5.
- Column 7, "Choice Variables to be Controlled," displays the selected control variables, based on historical usage, directness of measurement, and acceptable operability and maintainability.
- Column 8, "Monitor/Control," displays the use of the variable, whether it is monitored and/or controlled.

3.1.3 Process Control Strategy Logic Diagram

The process control strategy logic diagram (Appendix B) contains the logic sequence associated with requirements developed in the process control strategy matrices and in Section 3.2. The logic diagram indicates the types of decisions required (administrative or control logic) to operate each type of function (storage, preparation, or transfer). Additionally, the logic diagram shows the dependence of operations on enabling functions. Thus, a satisfactory Store Waste enabling function must be maintained to prepare or transfer waste. Additionally, a satisfactory Prepare Waste enabling function must be maintained to transfer waste, and a satisfactory Transfer Waste enabling function must be maintained to continue waste transfer. The dependence of storage, preparation, and transfer process steps on satisfactory waste sampling results are shown on the diagram.

The process control strategy logic diagram contains symbols that indicate predefined processes (per HNF-5136), manual operations, administrative decisions, control-logic decisions, and enabling functions. The process control strategy logic diagram also indicates which functions occur in parallel during system operation. Thus, Store Waste functions are occurring continuously while Prepare Waste and Transfer Waste functions are proceeding. Similarly, the Prepare Waste function occurs continuously while Transfer Waste functions are proceeding, and the Transfer Waste function occurs continuously while waste transfer is proceeding.

The decision blocks that have three lines indicate that the succeeding functions are continuously checked, while satisfactory conditions provide input to enabling functions and unsatisfactory conditions produce alarms to the operator. While inputs to an enabling function exist, the function is enabled.

3.1.4 Task Team Decisions

Several key decisions regarding the process control strategy logic were developed as a task team effort. These decisions are documented in Appendix C.

3.2 PROCESS CONTROL STRATEGY

The process control monitoring and control functions typically include the subfunctions of measuring parameters, comparing data measurements to operational limits, maintaining the parameters within limits, and responding to off-normal conditions. This document does not address the subfunction specifics of recovering from off-normal conditions. The specified operational limits are to be provided in the future process control plan. Prediction and mitigation of impending pipe plugging is included in the process control strategy.

3.2.1 Receive Waste

The DST System receives waste from external sources. This section discusses the process control strategy and requirements for receiving waste. This function is limited to those requirements that pertain only to the actual receipt of waste in the tank. The process control strategy for receiving waste is to monitor the waste storage parameters specified in Section 3.2.2 and to monitor the parameters specific to waste receipt activities. Existing in-tank, closed-circuit television cameras, where available, may be used to verify waste receipt and provide views of the in-tank environment.

For retrieval operations involving transfers, CPS-T-149-00010 requires that a criticality safety evaluation be performed per WHC-SD-SQA-CSA-20368.

Basis: HNF-SD-WM-TRD-007, Section 3.2.1.1.5.

3.2.1.1 Direct Waste Additions Within Double-Shell Tanks. Waste will be transferred into DSTs at a point directly below the dome or through a drop leg or slurry distributor.

3.2.1.2 Perform Material Balance. A final material balance is required to be performed after transfers have been completed to verify that no leakage or misrouting has occurred. Verification of the volume of waste received will be determined by obtaining the waste level before and after the waste has been received, calculating the volume received, and comparing that value with the volume of waste transferred.

Basis: A material balance calculation is required during each waste transfer per HNF-SD-WM-TSR-006, Section 5.12.2.b.

3.2.2 Store Waste

Mixed wastes are stored in DSTs on an interim basis until they can be prepared and transferred to the LAW/HLW Plant for final treatment and disposal. The waste storage process control strategy pertains to the containment of waste stored in source or staging tanks during WFD operations. The process control strategy for monitoring and controlling waste storage also applies during the waste preparation and waste transfer stages. Requirements to perform operations during waste storage and transfer appear in HNF-SD-WM-TSR-006, OSD-T-151-00007, and HNF-SD-WM-OCD-015.

The basic process control strategy for containing waste in DSTs is to monitor and control various parameters specific to tank integrity and waste containment.

The process requirements for monitoring these parameters are described in the following sections.

3.2.2.1 Control Double-Shell Tank Hydrostatic Loads. The hydrostatic head allowable on the primary tank wall is measured as the sum of the primary tank pressure and the tank liquid level, assuming a specific gravity (SpG) of 2.0. The maximum hydrostatic head is limited to meet seismic design criteria. In the event of an earthquake, a larger hydrostatic head could damage the tank because of hydrodynamic loading of the waste sloshing in the vessel. The minimum hydrostatic load is limited to prevent high stress to and possible uplifting of the tank bottom.

Liquid-level measurements are taken with the ENRAF liquid-level-monitoring instrument. As a backup to the ENRAF instrument, tank liquid level also can be measured with a manual tape instrument. If waste levels fall below the minimum limit, addition of dilution water or waste is required to bring the level back into compliance.

Basis: OSD-T-151-00007, Sections 7.2.2 and 7.2.3.

3.2.2.2 Control Double-Shell Tank Primary Confinement Leaks. Primary tank liner leak-detection instrumentation must be monitored throughout phases of the LAW feed delivery process to alert operators of the presence of a leak. Primary tank leak detection relies on a CAM in the annulus Ventilation Subsystem, on conductivity probes mounted in the tank annulus, or on changes in tank annulus level as detected by ENRAF. The CAM is used to detect increases in radioactivity, indicating a potential leak into the annulus. Air samples are extracted continuously from the annulus exhaust flow upstream of the HEPA filter and routed through the CAM, which monitors the sample flow stream for radionuclide particles. An increase in radioactive particle activity above the CAM setpoint will activate an alarm signifying a potential leak. The conductivity probe has electrodes at different electrical potentials that are short-circuited by the conductivity of the waste leakage. The establishment of the short-circuit generates an alarm signifying a leak. The State of Washington has approved the use of the ENRAF as a primary leak-detection method.

Waste leakage from the bottom of waste tanks is collected in slots cut into the insulating concrete below the tanks; these slots have been designed to drain to a leak-detection pit. A leak from the primary tank will be contained in the annulus between the primary and secondary tanks. The annulus is designed to collect leaked waste at the annulus leak-detection pit within the annulus for detection and transfer.

Basis: Requirements for control of DST primary confinement leaks are specified in WAC 173-303, "Dangerous Waste Regulations; 40 CFR 264, "Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities;" DOE Order 5820.2A, Radioactive Waste Management; *and HNF-SD-WM-TSR-006, LCO 3.1.4, OSD-T-151-00031,* Operation Specifications for Tank Leak Detection and Single-Shell Tank Intrusion Detection.

3.2.2.3 Control Double-Shell Tank and Waste Temperature. Tank waste temperatures will be monitored to ensure that temperatures necessary for potential tank bumps and organic salt-nitrate reactions to occur are not exceeded. If either of these limits is exceeded, action shall be taken to mitigate the cause of the temperature increase and to restore waste temperatures to within allowable limits. High tank-waste temperatures will be mitigated by (1) operation of the primary Ventilation Subsystem, (2) operation of the annulus Ventilation Subsystem, and/or (3) shutdown of the mixer pumps. Areas of high heat that have developed in the sludge may be mitigated by brief operation of the mixer pump.

The waste temperatures also are limited to prevent excessive stresses to the primary tank and structural degradation of the primary shell. High temperatures, rapid temperature cycling, and extreme temperature gradients can cause concrete temperature transients that can cause concrete damage.

Basis: HNF-SD-WM-TSR-006, SL 2.1 and LCO 3.3.2; and OSD-T-151-00007, Sections 7.2.6 and 7.2.7.

3.2.2.4 Control Double-Shell Tank Waste Chemical Composition. The chemical composition of stored waste will be monitored through periodic waste sampling and analysis, as applicable; the analysis may include measuring for chemical composition for control of tank bumps, temperature excursions, and tank corrosion. The chemical composition of DST waste is controlled to inhibit corrosion and stress-corrosion cracking of the primary tank. Control of the chemical composition includes administratively controlling tank inputs, sampling waste periodically, comparing DST chemical composition to operational limits, and maintaining DST waste chemical composition.

Basis: OSD-T-151-00007, Section 7.2.1, "Basis for Limit" paragraph cites SD-WM-TI-150, Technical Basis for Waste Tank Corrosion Specifications, *and TWRS-PP-94-025,* Sludge Washing Materials Study: The Behavior of Carbon Steel in a Dilute Waste Environment, *which establish the technical basis for corrosion specifications to prevent corrosion and stress-corrosion cracking.*

3.2.2.5 Control Double-Shell Tank Gaseous Discharge. Operation of the primary tank Ventilation Subsystem is required to remove flammable gases from the tank vapor space and to control tank vapors and radionuclides exhausted from the tanks. The Ventilation Subsystem also will provide cooling of the waste. The primary process control strategy for verifying Ventilation Subsystem operation is to monitor tank vapor pressure to ensure that it is <0 kPa (<0 in. water gauge [w.g.]). The requirement to maintain negative pressure in the primary tank ventilation system is given by HNF-SD-WM-TSR-006, Section 3.2.1, which indicates that the ventilation system must be operable and verified by primary tank vapor space as being <0 in. w.g. Additionally, DOE Order 6430.1A, *General Design Criteria*, Section 1300, indicates that radiological enclosures maintain at least –0.3 in. w.g. Output from a tank vapor pressure transmitter can be monitored continually by a control room computer, recorded on a strip chart, or read from a local gauge. Ventilation Subsystem operation also can be verified by monitoring the airflow rate. Monitoring frequency shall be a minimum of once every 24 hours. This frequency was conservatively based upon the determination that the worst-case tank required 7 days to reach an LFL of 25 percent.

A CAM system is required on the primary and annulus Ventilation Subsystem exhaust stack to monitor and control the release of radionuclides in the tank exhaust. The exhaust stream will be monitored through isokinetic sampling. The CAM must measure the radiation level in the sampled flow stream and detect levels in excess of a preset value. The CAM shall activate an interlock to shut down the exhauster fan when preset radiation levels are exceeded. On CAM failure, the monitors must actuate an alarm and/or interlock to shut down the exhaust system.

After being mobilized and suspended, if the waste is allowed to settle for a period of time such that gas is generated and accumulated within the waste, the gas could be released by operation of the mixer pumps. Various instruments contained in the Ventilation Subsystem will monitor increases in air emissions resulting from mixer pump operation. Radiation readings also can be taken at these locations with hand-held instruments.

During the recent sluicing operation of Tank 241-C-106, the State of Washington approved the use of administrative controls if the ventilation system was inoperable. Thus, if the ventilation system was inoperable or tank vapor pressure was > 0 kPa (0 in. w.g.), personnel were evacuated. Personnel with respiratory personal protective equipment then would enter the area and reestablish the vacuum. Once vacuum was reestablished, the area would be monitored for the presence of organics and ammonia before personnel reentry. This administrative procedure may be applicable to future operations that involve the potential for gaseous discharges.

Basis: WAC 173-400, "General Regulations for Air Pollution Sources;" WAC 173-460, "Control for New Sources of Toxic Pollutants;" and 29 CFR 1910, Subpart Z, "Occupational Safety and Health Standards, Toxic and Hazardous Substances;" Requirements for the CAM interlock that shuts down the Ventilation Subsystem when high radionuclide particulate activity is detected are specified in HNF-SD-WM-TSR-006, LCO 3.1.4, and WAC 246-247, "Radiation Protection – Air Emissions."

3.2.3 Soften Crust Layer in Source Tanks (Optional)

As discussed in Section 2.2.3, consideration must be given to potential structural damage resulting from (1) moments caused by crust remaining on the tank walls, (2) crust falling to the tank bottom, and (3) floating crust damaging in-tank components (such as thermocouple trees, air lances, and riser pipes) after removal of the liquid below the crust. Hold-points should be a part of the process control strategy during supernatant removal. The movement and dissolution of crust would be observed with closed-circuit television.

Crust softening is an optional step according to the LAW feed delivery basis. If this step is required, the crust layer in LAW source tanks would be softened and partially dissolved by adding diluent on top of the waste or by using the transfer pump to recirculate diluted supernatant to the top of the waste. The crust-softening step could be used to prevent damage to in-tank equipment from movement of large pieces of the crust during mixer pump operation.

Basis: HNF-1939, Vol. II, Rev. 0c, Table 2-1, and the text in Section 2, indicate an optional crust-softening step that, if added, would be accomplished with bulk additions of diluent augmented by mixer pump agitation. HNF-5136 also provides for optional crust softening

3.2.3.1 Add Diluent to Source Tanks. Diluent additions from the Diluent and Flush Subsystem are controlled to maintain transfer volumes within material balance criteria and to prevent overfilling of tanks. Control of diluent additions shall include monitoring diluent additions to LAW source tanks, comparing data to process limits, and maintaining diluent additions within process limits. If the process uses the transfer pump to recirculate diluted supernatant to the top of the waste, this function also includes establishing the recirculation route.

Basis: HNF-1939, Vol. II, Rev. 0c, Section 2 and Table 2-1, indicates an optional crust-softening step that, if added, would be accomplished with bulk additions of diluent augmented by mixer pump agitation and it establishes the basis for bulk diluent additions for crust softening. The diluent additions must be controlled to prevent exceeding the maximum tank capacities given in HNF-SD-WM-SAR-067, Tank Waste Remediation System Final Safety Analysis Report.

3.2.3.2 Monitor Diluent Additions to Source Tanks. Diluent supply is monitored to obtain data that are compared with predetermined or preset process limits or used to complete material balances. The monitoring system shall provide data for the following parameters:

- Diluent flow rate
- Total diluent addition.

The diluent chemistry is determined before addition and must meet compatibility requirements per HNF-SD-WM-TSR-006.

Basis: The diluent additions are monitored to prevent exceeding the maximum tank capacities given in HNF-SD-WM-SAR-067 and to obtain data for material balances required by HNF-SD-WM-TSR-006, Section 5.12.2.c.

3.2.3.3 Recirculate Diluted Supernatant in Source Tank. The diluted supernatant is recirculated using the transfer pump. The operator positions the valves to recirculate diluted supernatant to the top of the waste. The valve positions are monitored by the operator or by electronic valve-position indicators.

Basis: HNF-4553, Operations and Maintenance Philosophy, *indicates manual and electronic valve position indicators, but the explicit requirements for electronic displays and valve positions will be defined in the future Process Control Plan.*

3.2.3.4 Compare Diluent Supply System Data to Process Limits. Data from the Monitor Diluent Additions to Source Tanks function (Section 3.2.3.2) are compared to process limits, and the proper actions are initiated. The data comparison and required actions are operator functions that will continue diluent supply, stop the diluent supply, or redirect the diluent supply.

Basis: Diluent additions are limited by the maximum tank capacities given in HNF-SD-WM-SAR-067 and to allow space for miscellaneous water or diluent additions as indicated in HNF-1939, Vol. II, Rev. 0c, Section 3.1 and Figure 2-1.

3.2.3.5 Maintain Diluent Additions Within Process Limits. Total diluent additions are maintained within process limits specified in the appropriate diluent addition plan.

Basis: A specific diluent addition plan is developed for each addition to prevent exceeding the maximum tank capacities given in HNF-SD-WM-SAR-067 and to allow space for miscellaneous water or diluent additions as indicated in HNF-1939, Vol. II, Rev. 0c, Section 3.1 and Figure 2-1.

3.2.4 Dissolve Salts in Source Tanks

Precipitated salts in the sludge layer are dissolved by dilution, mobilization, and mixing. Diluent is supplied by the Diluent and Flush Subsystem.

Basis: HNF-1939, Vol. II, Rev. 0c, Sections 2, 3.1.9, and 3.1.10; Letter 73600-99-006 (Treat 1999).

3.2.4.1 Add Diluent to Source Tanks. Diluent additions during salt dissolution are controlled to prevent overfilling tanks, to update material balances, to verify waste-level changes in tanks, and to complete salt dissolution without producing excess waste volume.

Basis: HNF-1939, Vol. II, Rev. 0c, Sections 2, 3.1.9, and 3.1.10.

3.2.4.2 Control In-Tank Additions. Dilution water is made up at the Diluent and Flush Subsystem. Caustic is delivered to the Diluent and Flush Subsystem by truck and pumped or unloaded into a blending tank. Raw water will be heated and also sent to the blending tank to be blended with the caustic. The blended solution will be pumped to the waste retrieval system as needed for in-tank dilution, pump intake dilution, line flushing, or transfer-line preheating. The Diluent and Flush Subsystem will supply hot water additions, chemical additions, or combinations of both.

The diluent or caustic solution will be supplied to the tank pump pit via a supply pipe. The supply pipe will connect to the piping jumper, which will allow the distribution of diluent directly into the tank, through a diluent injection line that will transfer the diluent to the transfer pump inlet, or directly to the transfer line for preheating or flushing. In-tank dilution additions can be made either by routing the diluent directly into the tank or by routing it through the transfer pump and recirculating the discharge back into the tank.

Process control of the in-tank diluent additions will be provided by equipment and instrumentation at the Diluent and Flush Subsystem as well as at the pump pit. Diluent flow will be monitored and controlled as required, as well as diluent temperature and line pressure. The caustic addition supply line pressure will be monitored and compared with the pump discharge line to prevent any backflow through the supply line. Detection of high pressure in the supply line is required to actuate an alarm and/or provide an interlock to shut down the transfer pump.

Valve position indicators of the pit jumpers also will be monitored to verify the correct line configuration. The tank liquid level will be monitored during in-tank addition, per waste storage requirements (Section 3.2.2.1).

Basis: Requirements for control of in-tank additions are specified in OSD-T-151-00007, Sections 7.2.1, 7.2.2, and 7.2.3, and OSD-T-151-00017, Sections 17.2.1.1, 17.4.1.1.2, 17.4.1.1.3 and 17.4.1.1.4. Fill limits for diluent are specified in SD-RE-TI-008, 241-AW Tank Farm Process Specifications, *Section 3.a.*

3.2.4.3 Mobilize Solids in Source Tanks. Precipitated salts are mobilized by mixer pump operation to facilitate the dissolution process. The mobilization process is controlled by monitoring mixer pump operation and process parameters, comparing data to process limits, and maintaining process parameters within limits.

Basis: HNF-1939, Vol. II, Rev. 0c, Sections 2 and 3.1.10.

3.2.4.4 Monitor Mixer Pump Operating Parameters and Control Mixer Pump Operation. Mixer pump operation is monitored to ensure proper operation and mechanical integrity of the pump, to prevent premature pump failure, and to limit impingement on other in-tank equipment. Measured parameters will be used to detect mixer pump cavitation, plugged outlet nozzles, pump drive problems, and low seal- or bearing-water supply. Pump-specific parameters will be monitored as applicable per the Basis.

As the waste is transferred out of the tank and the waste level is reduced, mixer pump operation may need to be altered to prevent unwanted conditions such as pump cavitation, the release of excessive aerosols into the tank headspace, and excessive waste temperatures.

Basis: WHC-SD-WM-DGS-006, Tank Farms Pump Critical Characteristics and Specification Guide, establishes the basis for controlling pump operations to maximize pump life and comply with safety requirements. WHC-SD-WM-DGS-006, Sections 4.2.2 and 4.6.5, establishes the bases for monitoring motor power draw and rotational speed. The basis for monitoring bearing temperature, motor winding temperature, seal-water flow, and pump vibration is developed in HNF-4553 and from vendor recommendations. The basis for monitoring, position, and rotation speed is WHC-SD-WM-DGS-006, Section 4.6.6.

3.2.4.5 Maintain Diluent Additions Within Process Limits. The system shall maintain the total diluent additions within the process limits specified in the appropriate salt-dissolution plan.

Basis: A specific salt dissolution plan is developed for each LAW source tank to dissolve the maximum amount of salts, prevent exceeding the maximum tank capacities given in HNF-SD-WM-SAR-067, and allow space for miscellaneous water or diluent additions as indicated in HNF-1939, Vol. II, Rev. 0c, Section 3.1, and Figure 2-1.

3.2.5 Settle Undissolved Solids

The undissolved salts and other insoluble solids are allowed to settle so that the suspended solids concentration in the LAW meets Site pumpability requirements. Portions of the waste that will be transferred directly to the LAW/HLW Plant also must meet the contract limits.

Basis: HNF-1939, Vol. II, Rev. 0c, Section 3.1.12, indicates a solid-settling period of up to 230 days. HNF-SD-WM-OCD-015 contains the Site pumpability requirements BNFL-5193-ID-19 contains the contract limits for transfers to the Privatization Contractor (PC)

3.2.6 Sample Prepared Waste

Once the waste contained in source or staging tanks has been prepared, it will be sampled to verify that the waste concentrations are within the contractor specification limits and within qualification for waste transfer. When specification requirements are confirmed, waste transfer can begin. Waste samples provide data to perform the following:

- Determine the waste chemical and radiological properties
- Determine the extent of waste solids dissolution and homogeneity
- Verify and calibrate operation of waste mobilization monitoring instruments
- Provide samples for the PC and archive.

Waste grab samples will be taken, as a minimum, before each feed envelope is transferred to the LAW/HLW Plant for feed certification.

The ICDs require that waste be certified only once. It is assumed that the waste characteristics will not change between sampling and transfer. Sampling is required only for staging tank certification.

Basis: HNF-1939, Vol. II, Rev. 0c, Sections 3.0 and 3.1.13, establishes that transfers are intended to meet the contract limit for suspended solids, and Section 3.1.14 states that transfers to the LAW/HLW Plant must be sampled and qualified as specified in BNFL-5193-ID-19 HNF-SD-WM-OCD-015 contains waste compatibility and pumpability requirements

3.2.6.1 Waste Sampling and Analysis. The LAW feed will be sampled and analyzed per the following.

1. If required, homogenize the waste using mixer pumps.

2. Immediately following the shutdown of the mixer pumps, if applicable, obtain grab samples from eight different depths from below a single riser. Identify tank waste conditions, such as waste temperature and tank volume, at the time of sampling. The sample volume will meet the sample volume needs for analysis of the tank waste to support feed certification, a sample for the PC, and archive sample material. Tank archive sample material will be stored until the tank waste has been immobilized and accepted by the DOE.

3. For dissolved waste, perform a homogeneity analysis to determine whether additional mixing and sampling are required.

4. Prepare a tank waste composite by combining equal quantities, by weight, of the grab samples for analysis, transfer to the PC, and archive.

5. Use at least three subsamples of the composite sample for feed verification analysis. The arithmetic mean concentration for each analyte identified in the waste feed specification will be determined from the analysis of the three subsamples.

6. Certify the waste feed by combining information on the tank volume and tank waste composition. The mean composition of each of the analytes is determined by an analysis of the subsamples.

7. Determine the waste tank volume liquid level and calculate waste volume.

8. Measure and report the tank waste composition analytes to an accuracy identified in the contract documents.

9. Provide feed certification documentation to the PC that consists of a statement that the waste feed meets specification requirements and provides the waste composition in the staging tank. The estimate of the composition of the LAW feed will account for the addition of dilution and flush water.

Basis: Waste sampling requirements are specified in BNFL-5193-ID-19, Section 3.2.6.1

3.2.6.2 Waste Certification. The PC is responsible for notifying the ORP that it is ready to receive a LAW feed batch. Notification will confirm the following:

- The waste sample is within specification requirements
- The LAW/HLW Plant receiver tanks are empty and ready to receive waste
- The PC monitoring system, including connection to the Master Pump Shutdown System, is operational.

A number of steps must be performed before waste is transferred to the LAW/HLW Plant (BNFL-5193-ID-19). At least 30 days before any transfers occur, the ORP is required to provide representative waste samples to the PC. Certification and documentation that the LAW feed batch meets contract requirements must accompany the samples. Just before initiating the transfer, the PC will provide verification that the PC systems for receipt of the waste, including receipt vessels, transfer lines, and monitoring instrumentation, are operational.

Basis: Waste certification requirements are specified in BNFL-5193-ID-19, Section 4.3.1.

3.2.6.3 Perform Waste Compatibility Assessment. Before any waste transfer in the DST System (i.e., transfers from waste feed source tanks to other tanks for staging), the proposed transfer will be evaluated to ensure continued safe storage and handling of the wastes during and after the transfer. Rules for assessing these parameters are included in HNF-SD-WM-OCD-015. The waste compatibility assessment (WCA) will compare the compositions of the waste sources, the waste receivers, and the transfer conditions as applied to safety, operational, regulatory, and programmatic decision criteria. If the proposed transfer is determined to be acceptable, the decision is documented in the WCA with a recommendation for proceeding with the transfer. The documented WCA is signed by the DST Farms Engineering, Process Engineering, and

Environmental Permits/Policy organizations before it is issued. Assessment documentation shall include, as a minimum, the disposition of each applicable decision rule as listed in the Compatibility Compliance Table found in HNF-SD-WM-OCD-015, the transfer requirements, and the WCA expiration date.

Basis: A WCA is required per HNF-IP-1266, Tanks Farms Operations Administrative Controls, *Section 5.12, "Transfer Controls."*

3.2.7 Monitor Waste Receipt in Staging Tank

The receiving of waste in the staging tank is monitored to verify receipt of the waste, confinement of the waste, proper operation of the Ventilation Subsystem, and that tank design limits are not exceeded. Monitoring of waste receipt in the staging tank includes measuring tank Store Waste parameters, comparing data with operational limits, and maintaining parameters within limits (see Section 3.2).

Basis. OSD-T-151-00007 establishes the basis for safety-related control requirements. WAC 173-400, WAC 173-460, and WAC 246-247 establish the basis for monitoring DST emissions. HNF-SD-WM-TSR-006, Section 5.12.2.b, requires material balances during transfers for misrouting protection.

3.2.8 Homogenize Waste in Staging Tank

The waste received from LAW source tanks is blended to obtain more consistent waste composition and physical properties. The residual heel material from previous batches is left in the staging tank and blended with incoming waste from source tanks. Mixer pumps are operated for short periods to homogenize waste batches. The adequacy of homogenization will be evaluated per the ICD. Mixer pump operation is monitored to ensure proper operation and mechanical integrity of the pump. The bases for monitoring requirements for mixer pump operation are given in Section 3.2.4.3.

Basis: HNF-1939, Vol. II, Rev. 0c, Sections 3.1.6 and 3.1.14; BNFL-5193-ID-19, Section 3.2.4.1(3).

3.2.8.1 Monitor Diluent Additions During Homogenization (Optional). Diluent additions are not planned for the homogenization step. If diluent additions are necessary to compensate for evaporation or to recover from off-normal conditions, the step could be added. If used, the diluent additions are monitored to prevent overfilling tanks, minimize the total waste volume, adjust waste composition, and provide material balance data. Monitoring requirements for diluent additions during homogenization are given in Section 3.2.3.

Basis: A diluent supply is available for composition adjustments that may be necessary because of evaporation or to recover from off-normal conditions. Diluent additions are monitored to prevent exceeding the maximum tank capacities specified in HNF-SD-WM-SAR-067 and to obtain data for material balances required by BNFL-5193-ID-19, Section 4.1.3.

3.2.9 Settle Undissolved Solids in Staging Tank (Optional)

Solids settling is an optional step according to the LAW feed delivery basis. If solids concentrations are greater than expected or if recovery from off-normal conditions requires it, a solids-settling step could be added. If solids settling is used in the preparation of waste in LAW staging tanks, the process will be monitored by sampling to certify the LAW for transfers to the LAW/HLW Plant (see Section 3.2.10).

Basis: BNFL-5193-ID-19 requires that the suspended solids concentration be less than 2 wt percent for transfer from the staging tanks to the LAW/HLW Plant. HNF-1939, Vol. II, Rev. 0c, Sections 3.1.3 and 3.1.5, indicates that it is possible that the incidental solids in the transfer stream will exceed the limit. However, the basis for the monitoring instrumentation will depend on analysis that derives the performance requirements necessary for the intended function. The analysis is to include the potential for detecting off-normal events, such as a solids concentration that is higher than expected immediately after mixer pump operation and a settling rate that is slower than expected.

3.2.10 Sample Prepared Waste in Staging Tank

The LAW in the staging tanks is sampled to verify that it meets contract requirements and to reach agreement with the PC that the waste batch is acceptable. Waste sampling requirements are specified in BNFL-5193-ID-19. The waste sampling and analysis, waste certification, and WCA are described in Sections 3.2.6.1, 3.2.6.2, and 3.2.6.3.

Basis: HNF-1939, Vol. II, Rev. 0c, Section 3.1.11, and BNFL-5193-ID-19, Section 4.

3.2.11 Establish Transfer Route

3.2.11.1 Verify Transfer Route. Transfer route verification reduces the risk of an accident caused by misroutings, equipment out of position, or equipment failure. The facility manager has the overall responsibility to ensure that pre-transfer requirements are met. The transfer route will be designated and maintained on an official routing board. Waste transfer system as-built drawings and jumper configurations are maintained as part of configuration management.

- Independent field verification will be performed to include verification that the transfer route is appropriate for the intended transfer, that piping and jumpers are in place per the configuration status controls, that correct and operable pumps are specified, and that valves are properly aligned. Inspections will be performed to ensure that open nozzles connected to jumpers in transfer routes are sealed with caps, process blanks, or the equivalent to prevent misroutings. The shift manager shall verify that the appropriate jumpers are indicated on the official routing board. The specific procedure of verifying valve configuration between DOE and LAW/HLW Plant facilities will be elaborated upon in the future process control plan. This could include agreement from both parties as signatories to the verification of valve configuration at separate facilities.

Basis: Waste transfer paths shall be isolated where valves exist, and an independent verification of the waste transfer route and valve status shall be performed before transfer per HNF-SD-WM-TSR-006, Section 5.12.2.

3.2.11.2 Verify Transfer Component Status. The status of certain equipment and components related to the waste transfer is verified before the start of any waste transfers. Verification can be performed by data analysis or by confirmation of instrument readings or inspection records. The following conditions need to be verified.

- Newly installed jumpers have been leak tested before use.
- Sufficient space is available in the receiver tank for the waste to be transferred.
- Catch tanks that are physically connected to, but not in, the direct transfer route are less than 50 percent full before the waste transfer.
- The Primary Ventilation Subsystems of the affected receiving tanks are operable.
- Preventive maintenance and surveillance or functional checks of instruments that are necessary for the waste transfer are current.

Basis: Transfer system components shall be checked for operability and calibration before a transfer per HNF-IP-1266. HNF-4553 establishes the need to ensure that the flow is isolated during waste transfers. HNF-4553 is to be incorporated in the next revision of HNF-1939, Vol. IV, "Waste Feed Delivery Operations and Maintenance Concept."

3.2.12 Provide Diluent During Transfers

To initiate and sustain waste transfers, diluent is supplied by the Diluent and Flush Subsystem to flush the transfer pump suction line before pump startup, to desaturate salt solutions, to dissolve incidental solids drawn into the pump, and to maintain the sodium concentration within limits. If necessary, transfer lines may be preheated with heated diluent to prevent solids from precipitating during waste transfers.

Basis: HNF-1939, Vol. II, Rev. 0c, Sections 3.1.5 and 3.1.13, state that diluent is supplied for supernatant transfers and is available for salt liquor transfers even though dilution of salt solutions may not be necessary. HNF-5442, Preliminary Heat Transfer Studies for the Double-Shell Tank Transfer Piping, *examines transient and steady-state heat transfer properties for transfer piping with various thicknesses in insulation, various line lengths, and various waste temperatures, thus establishing a basis for determining the necessity for transfer line preheating.*

3.2.12.1 Control In-Line Additions. In-line dilution may be required for a variety of reasons, including heating of the transfer lines, dilution of waste to meet transfer requirements, or flushing. Each application of caustic or diluent additions will require a different configuration; however, the control strategy is similar. In-line additions may be particularly useful when the staging tank is full or where there is an upset condition involving the transfer pump or the transfer line. Either waste or diluent introduced at the pump suction may be used for the initial

startup of the pump. An advantage to using diluent is that it can be heated and used to heat the transfer line before the waste is transferred. The transfer pump speed will be controlled during startup and operations through a VFD unit.

The diluent or caustic solution will be supplied to the pump pit via a supply pipe. The supply pipe will connect to a piping jumper located in the pump or valve pit, where different routing configurations can be set for different applications. To preheat or flush the transfer line, valves will be configured to introduce the diluent directly into the transfer line, bypassing the transfer pump. The line will be heated by filling it with hot dilution and then closing the valves on either end to hold the solution in the line for a prescribed time. During filling of the line, flow will be controlled by a VFD on the Diluent and Flush Subsystem supply pump. Solution temperature, line pressure, and valve position also will be monitored.

In-line dilution will be accomplished by reconfiguring the valves so that diluent is introduced at the pump suction via a supply line originating in the pump pit. Various transfer parameters including pump amperage, flow, and in-line density will be monitored to determine the amount of dilution required. The transfer pump will be operated to pump the diluent to the pump discharge located in the pump pit, from which it will be discharged into a transfer jumper for recirculation back into the tank or for transfer. After completion of the transfer, valves also may be configured to backflush through the pump.

The transfer lines will be flushed in the same way that they are preheated. The only difference is that the flow will be open-ended and will continue until the line has been flushed with a flush solution, at a minimum of twice the transfer line capacity .

3.2.12.2 Deliver Diluent to Transfer-Associated Structures. Diluent delivery to transfer-associated structures is controlled to prevent accidental overfilling of tanks, to maintain the desired waste dilution ratio, and to provide data for cross-checking other in-line instruments and for completing material balances. If transfer lines are preheated, the control function also ensures adequate preheating of the transfer system. For diluent supply lines that are connected to the transfer system downstream of the transfer pump discharge, this function includes controls to prevent backflow of radioactive waste into diluent supply lines. Diluent delivery to transfer structures shall be controlled by monitoring the diluent supply, comparing the system parameters to limiting control values, and maintaining diluent additions within limits.

Basis: The process for initiating transfers with diluent only and then reducing diluent flow to obtain a predetermined dilution factor, described in HNF-1939, Vol. II, Rev. 0c, Section 3.1.5, establishes the basis for controlling diluent delivery to transfer-associated structures. *HNF-2938,* Evaluation of 241AN Tank Farm Supporting Phase 1 Privatization Waste Feed Delivery, *page 34, establishes the basis for temperature control for preheating the transfer line*

3.2.12.3 Monitor Diluent Supply to Transfer Structures. Diluent supply is monitored to obtain data that are compared with predetermined or preset process limits or used to complete material balances. The system shall monitor the following parameters:

- Diluent flow rate
- Total diluent addition
- Diluent temperature.

The diluent chemistry is determined before addition and must meet compatibility requirements per HNF-SD-WM-TSR-006.

Basis: HNF-1939, Vol. II, Rev. 0c, Sections 3.1.5 and 3.1.13, establishes the basis for diluent additions to control waste properties during transfers. HNF-2938, page 34, establishes the basis for temperature control for preconditioning the transfer line. HNF-SD-WM-TSR-006 establishes compatibility requirements.

3.2.12.4 Provide Backflow-Detection Pressure Switches and Isolation Valves. Two isolation valves and two pressure switches per line shall be provided for diluent flush supply lines that connect to the transfer piping upstream of the transfer pump. The valves and pressure switches isolate the Diluent and Flush Subsystem from the transfer piping for backflow prevention.

Basis: HNF-SD-WM-SAR-067, Section 4.3.6, establishes the basis for backflow prevention with pressure switches and isolation valves, and extends the concept to raw water systems in general.

3.2.12.5 Compare Diluent Supply System Monitorings to Process Limits. The system compares data from the Monitor Diluent Supply to Transfer Structures function (Section 3.2.12.3) with process limits and initiates responses as follows.

- The Diluent and Flush Subsystem shall maintain the supply system temperature to be greater than or equal to the temperature of the waste to be transferred.

  Basis: HNF-1939, Vol. II, Rev. 0c, Section 3.1.5, states that the heating duty on dilution water is set so that diluted waste discharges from the transfer pump at no less than the decanted waste temperature.

- The backflow-detection pressure switches shall provide an alarm signal to the Master Pump Shutdown Operator Station and actuate an interlock to shut down associated transfer pump operations.

  Basis: HNF-SD-WM-SAR-067, Section 4.3.6.3, indicates that the pressure switch interlock system shall provide an alarm or actuate an interlock to prevent or stop operation of the associated pump when the pressure in the service water piping reaches a preset limit.

3.2.12.6 Confine Diluent Within Valve Manifolds and Jumpers. Diluent is confined within valve manifolds and jumpers to provide primary confinement for diluent flow through diversion boxes, valve pits, and pump pits. The diluent is confined along the supply route to ensure that the waste is sufficiently diluted for transfers.

Basis: DOE Order 6430.1A and the Standard Design Code requirements in ASME B31.3, Process Piping.

3.2.12.7 Confine Diluent Water Within Double-Shell Tank Transfer Piping. Diluent is confined within the double-confinement system along the transfer route to prevent any leaks of radioactive diluent or waste that could increase the radiation dose to the operators and spread contamination.

Basis: WAC 173-303-640, "Tank Systems;" DOE Order 6430.1A, Sections 1300-7.4 and 1323-5.2; and ASME B31.3.

3.2.12.8 Carry Diluent Water to Transfer Pump Suction. Diluent is supplied to the transfer pump suction to flush the transfer pump suction line before pump startup, desaturate salt solutions, dissolve incidental solids, and maintain the desired dilution ratio.

Basis: HNF-1939, Vol. II, Rev. 0c, Section 3.1.5, states that waste transfers are initiated with diluent flow equal to the transfer pump rate of 530 L/min and then the diluent flow is reduced to a specified dilution factor. HNF-1939, Vol. II, Rev. 0c, Section 3.1.3, states that diluent volumes may be revised to compensate for higher-than-expected levels of solids in the supernatants.

3.2.13 Convey Waste

Transfer system conditions and parameters will be monitored during the transfer to ensure that the LAW feed is delivered to the LAW/HLW Plant and to determine whether there are any upset conditions. The process control strategy will include monitoring for transfer-line leak detection, line pluggage, and other transfer parameters such as temperature, in-line density (tentative), and pressure. This section establishes how the transfer of wastes will be controlled to accomplish the processing goals and comply with technical operating requirements.

Communications are maintained between the tank farm operators and the PC during the waste transfer process. The PC facility manager will provide notification if a leak detector alarm is received at the LAW/HLW Plant that was initiated from the waste transfer pipeline or from within the LAW feed receipt process cell. Additionally, the LAW/HLW Plant manager will provide notification of monitoring instrumentation or Ventilation Subsystem malfunctions and will request that the transfer be halted should such malfunctions occur.

After receiving the LAW feed batch and transfer-pipeline flush, the LAW/HLW Plant manager will provide notification of the volume of waste received so that material balance calculations can be performed. Waste temperature changes and waste dissolution will be accounted for in material balance calculations.

The tank liquid level is measured during waste storage operations to establish a volume baseline before transfer operations begin. Mixer pumps will be shut down while liquid-level readings are taken.

The transfer pump suction will be located close to the tank floor, resulting in a waste heel of approximately 125 m^3 (33,032 gal) remaining in the tank after the final batch has been transferred. The transfer line may need to be preheated to prevent the precipitation of gibbsite in the transfer lines. After each batch transfer, the transfer line will be flushed with a volume of flush water, at a minimum of twice the transfer line capacity. After the flushing operation has been completed, the flush solution remaining in the line will be allowed to drain back to the source or staging tank and the receiver tank.

A waste transfer system will be used for transferring LAW feeds within the tank farms for staging and for transferring to the LAW/HLW Plant for processing. The transfer system is made

up of an 7.6 cm (3-in.-) nominal diameter stainless steel and carbon steel primary pipe encased in a 15 cm (6-in.-) nominal diameter carbon steel pipe, which serves as secondary confinement along straight runs. At expansion loops, the encasement diameter increases to 30 cm (12 in.) Leakage from the primary transfer piping is detected and contained in the encasement piping. The pipeline is sloped downward toward the pump pit or valve pits, and a leak-detection element is located at the lower end of the secondary encasement pipe. The leak-detection elements in the pits will actuate an alarm and an annunciator light in the control room if a leak is detected, and the transfer will be terminated. Any leak in the transfer line will drain into the pump pit or valve pit, from which it subsequently will drain into the source tank, staging tank, or LAW/HLW Plant tank.

Consideration should be given to providing closed-circuit television observation of the crust in Watch List Tanks as a monitoring and administratively controlled function during waste transfer (see Sections 2.2.3 and 3.2.3).

Basis: HNF-SD-WM-SP-012, Section 3.4.3.1.

3.2.13.1 Position Transfer Pump Suction Intake. Transfer pump suction intake is positioned to keep it submerged in fluid to prevent cavitation of the pump, help achieve as homogeneous an output stream as possible, and prevent solids from being drawn into the pump and potentially plugging transfer lines.

Basis: HNF-SD-WM-SP-012, Section 3.4.3.1, states that transfer pumps will have adjustable suctions. HNF-1939, Vol. II, Rev. 0a, Section 3.1.2, states that transfer pumps will be installed at specific locations above the tank bottom. HNF-1939, Vol. II, Rev. 0c, Section 3.1.13, states that transfer pump suction will be positioned to decant diluted sludge liquors that meet the BNFL-5193-ID-19 contract limit of 2 wt percent suspended solids.

3.2.13.2 Monitor Position of Transfer Pump Suction Intake. The transfer pump suction position is compared with the predetermined elevation and readjusted, if necessary.

Basis: HNF-1939, Vol. II, Rev. 0a, Section 3.1.2, states that transfer pumps will be installed at specific locations above the tank bottom.

3.2.13.3 Pump Waste or Diluent. Transfer pumps provide the motive force for conveying liquid waste or diluent from source tanks to staging tanks or to the LAW/HLW Plant.

Basis: HNF-SD-WM-SP-012, Section 3.4.3.1, establishes that transfers of LAW involve pumps with adjustable suctions.

3.2.13.4 Confine Waste in Transfer Pump. The waste is confined within the transfer pump case and boundary connections.

Basis: WHC-SD-WM-DGS-006, Section 4.1.6.

3.2.13.5 Monitor Transfer Pump Operation. Transfer pump parameters are monitored to detect mechanical problems and alert operators to problems that could lead to pump failure. Pump speed and motor amperage will be used in conjunction with other data such as flow to

verify that the pump is operating properly and to evaluate whether the transfer is proceeding satisfactorily. Pump-specific parameters will be monitored as applicable per the Basis.

A process transfer jumper will be installed in the pump pit to direct the pump discharge flow to the transfer line or to recirculate it into the tank. The jumper will have a connection for receiving diluent from the caustic addition system for in-tank or in-line dilution and flushing. Switching between the various modes, such as between transfer and recirculation modes, is accomplished through three-way, electric-motor-operated valves. The following parameters are monitored to control the operation of the transfer jumper.

- A pressure relief system may be required to protect transfer system piping from overpressurization. The relief system will be located downstream of the pump outlet and will include a rupture disc, high-pressure switch with alarm, and pressure-relief valve. Fluid that passes through the rupture disc and pressure-relief valve is returned to the tank.

- The volumetric flow rate of waste discharged form the pump outlet must be measured as a basis for setting pump speed and the diluent flow setpoint. It also provides material-balance data and flow-rate data to verify that the system is operating as expected and data for troubleshooting.

- Line pressure is monitored to detect pressure readings higher than expected for the measured flow rate, which may indicate that solids or other debris have accumulated in the line, that valves are not open all the way, that waste is more viscous than expected (for example in the transfer of high solids content when not planned), or that there is an error in flow rate measurement. Pressure that is lower than expected may have one of several causes. If flow cannot be maintained at the rate indicated by the pump curve, this generally indicates pump cavitation if the pump power draw is low. Low outlet pressure also could indicate low pump suction pressure (high suction line pressure drop), restriction between pump and pressure tap, or other pump problems. Pressure measurement also may provide useful information during line flushing or attempts to remove solids accumulations or other line blockages.

- Discharge flow must be monitored to compare pump operating parameters and pump curves. This parameter will be monitored in both the recirculation and the transfer modes.

- Volumetric flow rate and density must be monitored to set transfer flow rate and provide the basis for establishing the diluent addition setpoint. Density measurement provides verification that the waste is being drawn in and that the diluent addition is reasonably close to what is expected. Higher-than-expected density may indicate that solids are being drawn in or that correct diluent flow is not entering the pump suction (for example, because of diluent misrouting, erroneous diluent flow-rate measurement, or a diluent line broken or leaking at the pump). Lower-than-expected density indicates that the diluent-to-waste ratio is excessive (several possible causes) or that liquid waste is being drawn in when solids slurry is planned.

- Valve position indications are required to verify valve configuration.

Basis: WHC-SD-WM-DGS-006, Sections 4.2.2 and 4.6.5, establishes the bases for monitoring motor power draw and rotational speed. The basis for monitoring bearing and motor winding temperature is established in HNF-4553 and will be incorporated in the next revision of HNF-1939, Vol. IV. The need to control dilution ratio, as specified in HNF-1939, Vol. II, Rev. 0c, Sections 3.1.5 and 3.1.13, establishes the basis for monitoring pump output.

3.2.13.6 Monitor Process Parameters for Waste Transfer. Process parameters for waste transfer are monitored to prevent overpressurization of the lines, maintain the flow rate within specified limits, avoid solids buildup in the transfer lines, and ensure that sufficient diluent and/or flush water is supplied to maintain the rheological properties of the fluid within specified limits. Waste being delivered to the PC also must meet the contract specifications. Control of the process parameters for waste transfers includes measuring transfer stream parameters, comparing data with process limits, and maintaining transfer stream parameters within process limits.

Basis: WHC-SD-WM-DGS-006, Table 4-1, establishes waste property limits after dilution at the pump suction. HNF-SD-WM-OCD-015 establishes waste compatibility and pumpability requirements.

3.2.13.7 Measure Transfer Stream Parameters. Transfer stream parameters are measured to detect impending transfer line plugging, a plugged pump inlet, higher-than-expected waste viscosity, or stream density that is outside the acceptable range. The system shall monitor the following parameters:

- Transfer stream flow rate
- Transfer line pressure
- Transfer stream density (tentative)
- Transfer stream temperature (as part of densitometer functionality).

The tentative requirement to measure transfer stream density was determined during the task team discussions.

Basis: HNF-SD-WM-OCD-015 establishes waste compatibility and pumpability requirements. BNFL-5193-ID-19 establishes requirements for LAW transferred to the LAW/HLW Plant.

3.2.13.8 Compare Transfer Stream Data to Process Limits. The system compares data from the Measure Transfer Stream Parameters function (Section 3.2.14.7) with process limits and initiates the appropriate alarms. The responses shall include the appropriate alarms.

Basis: The basis for process limits and alarms will be developed from analysis of the requirements specified in WHC-SD-WM-DGS-006; HNF-SD-WM-OCD-015; and HNF-SD-WM-SEL-040, Tank Waste Remediation System Facility Safety Equipment List. *The analysis includes demonstrating the correlation between a requirement and the controlled parameter.*

3.2.13.9 Evaluate for Line Plugging. Reasonable assurance must be obtained that transfer lines will not become plugged during waste transfers from source tanks to staging tanks and, particularly, from staging tanks to the LAW/HLW Plant. If it is planned or suspected that solids

will be entrained or formed in a waste stream during transfer, the system flow conditions must be analyzed to assess the probability that line plugging can be avoided. For waste streams with <5 percent solids by volume and a SpG $\leq$1.35, no evaluation is required. The evaluation will be accomplished by obtaining and/or analyzing the following parameters:

- The carrier liquid density
- The particulate solids density
- The slurry density during transfer
- The system flow rate
- The particle size volume distribution from which unhindered settling velocity can be determined
- The carrier liquid viscosity or some other analytical measure such as the maximum expected slurry temperature during transfer from which the carrier viscosity can be determined
- Volume percent solids.

The indicated parameters may not all be measurable and may be determined or obtained from past practice.

Basis: Evaluation for line plugging shall be performed per HNF-SD-WM-OCD-015, Section 6.4., and per RPP-5346, Waste Feed Delivery Transfer System Analysis.

3.2.13.10 Confine Waste Along Transfer Route. The waste is confined in a double-confinement system along the transfer route to prevent any leaks of the radioactive waste that could increase the radiation dose to the operators and spread contamination and to ensure that adequate waste is transported to the PC to meet contractual quantities. Leakage from the primary piping will drain to low points where leak detection is provided. Transfer-associated structures will have dedicated leak detectors. Confinement of waste includes monitoring for leakage, comparing the leak-detection data to the operational limit, initiating the appropriate alarm, and automatically shutting down transfer pump operation.

Basis: WAC 173-303-640; DOE Order 6430.1A, Sections 1300-7.4 and 1323-5.2; and ASME B31.3.

3.2.13.11 Confine Waste Within Valve Manifolds and Jumpers. Waste is confined in valve manifolds and jumpers to provide the primary containment for waste routed through diversion boxes, pump pits, and valve pits.

Basis: HNF-SD-WM-SAR-067 and ASME B31.3.

3.2.13.12 Confine Waste Within Double-Shell Tank Transfer Piping. Waste is confined in the double-containment DST transfer piping subsystem.

Basis: HNF-SD-WM-SAR-067; WAC 173-303; ASME B31.3; and DOE Order 6430.1A, Section 1323.

3.2.14 Confine Waste Leakage Along Transfer Route

Waste leakage from the primary transfer piping is confined in the secondary containment system along the transfer route. Transfer pipes and pits have leak-detection capability to determine a pipe or jumper leak. Leakage from the primary transfer piping (inner pipe) is contained in the secondary containment (outer pipe). The transfer lines are sloped so that any leakage will drain down to a low point, typically at the pump pit, which contains encasement leak-detection instrumentation. Pump pits also contain leak detectors with alarm functions in addition to a high capacity pit drain. The leak detector is designed to detect any leak in the pit from a variety of sources, including the transfer lines, transfer pump, and transfer pit jumper manifolds. If the leak detector alarms, the retrieval operation will enter a controlled shutdown. Transfer leak-detection systems are required to detect a 5.1-cm (2.0 in.) (maximum) accumulation of liquid waste in the bottom of the pit and shall provide an alarm when such an accumulation is detected.

Basis: Transfer system leak detection is required per HNF-SD-WM-TSR-006, Section 3.1.3; WAC 173-303; and DOE 6430.1A. The basis for the 2.0-in. detection limit is per HNF-SD-WM-SAR-067, Section 3.4.2.7.

3.2.14.1 Confine Waste Leakage Within Secondary Confinement Piping. Waste leakage from the primary piping is confined in the encasement piping that directs the flow to a waste transfer-associated structure.

Basis: HNF-SD-WM-SAR-067, Section 4.3.5; and DOE Order 6430.1A, Section 1323-5.1.

3.2.14.2 Confine Waste Leakage Within Transfer-Associated Structures. Waste leakage from valve manifolds and jumpers in transfer-associated structures is confined within the structure boundaries.

Basis: HNF-SD-WM-SAR-067 and WAC 173-303-640, (4).f.

3.2.14.3 Monitor for Leaks in Transfer-Associated Structures. The monitoring system shall detect leaks from the primary piping that flows into waste transfer-associated structures.

Basis: WAC 173-303-640, (4).f, and (4).b.i, and ii.

3.2.14.4 Transfer-Associated Structure Leak Detection. The transfer-associated leak detection system shall be capable of detecting a 5-cm (2-in.) maximum-deep accumulation at the bottom of the pit and shall provide an alarm when such accumulation is detected.

Basis: HNF-SD-WM-SEL-040, Section 6.8.1.4.

3.2.14.5 Monitor for Double-Shell Tank Transfer Pipe Leakage. The transfer piping is monitored for leakage from the primary confinement pipe into the secondary piping.

Basis: WAC 173-303-640, (4).b.ii.

3.2.14.6 Pipeline Leak-Detection Monitoring. The pipeline leak-detection system shall be capable of detecting a primary confinement boundary leak within 24 hours. An encasement-type leak detector will be provided. Specific instrument requirements will be provided in the future Process Control Plan.

Basis: WAC 173-303-640, (4).c.iii.

3.2.14.7 Compare Transfer Structure Leak-Detection Data with Process Limit. The system shall detect waste leaks in waste transfer-associated structures and provide either an alarm to alert operators to take mitigative actions or an interlock to shut down the transfer pump.

Basis: HNF-SD-WM-SAR-067, Section 4.3.17, establishes the basis for the alarm signal or transfer pump interlock to shut down pump operation on leak detection.

3.2.14.8 Compare Transfer Pipe Leak-Detection Data with Process Limit. The system shall compare the leak-detection data with the limit specified, initiate the appropriate alarm signal, and shut down the associated transfer pump operation by means of an automatic interlock.

Basis: WAC 173-303-640, (4).c.iii.

3.2.15 Flush Transfer System

When the transfer is complete, flush solution is supplied by the Diluent and Flush Subsystem to flush the transfer line. Flushing of the system will be required when the transfer has been interrupted because of an upset condition or when a transfer has been completed. Flush solution flow rate and total volume are monitored. When the desired quantity of flush solution has been transferred, the diluent pump is shut off. This function includes monitoring and delivering the flush solution to transfer-associated structures and confining the flush solution along the transfer route.

Basis: HNF-1939, Vol. II, Rev. 0c, Section 3.1.5, and HNF-2938, Appendix F.1.3, establish that transfer lines are to be flushed after transfers. WAC 173-303-640(3) and DOE Order 5820.2A establish the basis for corrosion protection and control parameters. BNFL-5193-ID-19, Section 4.2, states that the maximum flush volume is twice the transfer line capacity.

3.2.15.1 Control Transfer-Line Flushes. After each batch transfer, the transfer line will be flushed with a volume of flush water, at a minimum of twice the transfer line capacity. The flush will (1) prevent the potential buildup of unacceptable flammable gas concentrations in the transfer pipeline, (2) reduce personnel exposure during jumper changes, and (3) displace slurry from the transfer line.

Basis: Flushing of the transfer system is required after a transfer per HNF-1939-Vol. II, Rev. 0c, Addendum 1, Section 3.1.3.

3.2.15.2 Deliver Flush Water to Transfer-Associated Structures. The routing of the flush water is controlled to ensure that the lines are adequately cleaned after waste transfer is complete, to minimize use of flush water to clean the lines, and to ensure that the pump receives

flush water when the process is in the flush mode. Delivery of the flush water to transfer-associated structures includes monitoring flush water supply, comparing flush water data to process limits and initiating the appropriate action, and confining the flush solution along the transfer route. The total quantity of flush water added needs to be tracked for material balance calculations and to ensure that the waste meets the contractual specifications. Because flush water can be supplied to the transfer pump suction or downstream of the transfer pump discharge, this function includes controls to prevent backflow of radioactive waste into flush water supply lines.

Basis: HNF-1939, Vol. II, Rev. 0c, Section 3.1.5, establishes that the transfer lines are flushed before the transfer is terminated. BNFL-5193-ID-19, Sections 4.1.3 and 4.2, requires documentation of the flush solution volume and composition and limits the maximum flush volume to twice the transfer line capacity.

3.2.15.3 Monitor Flush Water Supply to Transfer Structures. Flush water supply is monitored to obtain data that are compared with predetermined or preset process limits or used to complete material balances. The monitoring system requirements for flush water supply are the same as those for the Monitor Diluent Supply to Transfer Structures function (Section 3.2.12.3) except that the temperature requirements do not apply to flush water.

Basis: BNFL-5193-ID-19, Sections 4.1.3 and 4.2, requires documentation of the flush solution volume and composition and limits the maximum flush volume to twice the transfer line capacity. HNF-1939, Vol. II, Rev. 0c, Section 2, states that the diluent is temperature-adjusted and the flush solution is composition-adjusted only.

3.2.15.4 Confine Flush Water Within Valve Manifolds and Jumpers. Flush water is confined in valve manifolds and jumpers to provide the primary containment for flush water or waste routed through diversion boxes, pump pits, and valve pits. Sections 3.2.14.3 and 3.2.14.7 contain the flush water leak-detection requirements for leakage from valve manifolds and jumpers into transfer-associated structures.

Basis: HNF-SD-WM-SAR-067 and ASME B31.3.

3.2.15.5 Confine Flush Water within Double-Shell Tank Transfer Piping. Flush water is confined within the double-confinement piping system along the transfer route to prevent any leaks of radioactive flush water or waste that could increase the radiation dose to the operators and spread contamination. Section 3.2.15 contains the flush water leak-detection requirements for leakage from primary piping into secondary piping.

Basis: HNF-SD-WM-SAR-067; WAC 173-303-640; DOE Order 6430.1A, Sections 1300-7.4 and 1323-5.2; and ASME B31.3.

3.2.15.6 Position Valves for Flushing. The flushing route is established by positioning valves to ensure that the transfer route is flushed and to prevent any misroutings. The required valves and positions will be identified and controlled through the applicable transfer procedure.

Basis: HNF-IP-1266, Chapter 5.12, "Transfer Controls," Section C.4.

3.2.15.7 Carry Flush Water to Transfer Pump Suction. Flush water is supplied to the transfer pump suction at a flow rate equal to that of the transfer pump, and the flush solution is pumped through the transfer piping.

Basis: HNF-1939, Vol. II, Rev. 0c, Section 3.1.5, establishes that the transfer lines are flushed before terminating the transfer.

3.2.16 Drain Transfer Piping

When the transfer line has been flushed sufficiently, the flush pump is shut off and the transfer lines are allowed to drain. A portion of the flush solution in the transfer line will drain to the staging tank, with the remainder draining to the LAW/HLW Plant receiver tank. This function is controlled by administrative procedures. No monitoring and control functions are associated with this function.

Basis: Flushwater will be allowed to drain back to the tank per HNF-1939, Vol. II, Rev. 0c, Addendum 1, Section 3.0, "Process Description." WHC-SD-GN-DGS-30011, Radiological Design Guides, *Section 3.4.2, establishes the basis for draining transfer lines.*

3.2.17 Perform Material Balance

Material balance calculations are performed during transfer to provide early leak detection and avoid filling tanks above safe levels. The volume of waste transferred is monitored by comparing the waste volumes in the source tank and destination tank to the flow rate at the pump discharge. Waste volume measurements should account for any dilution addition before or during transfer and for any flushing performed after batch transfers.

Tank liquid levels are read and monitored before the transfer, at 30 minutes, 60 minutes, every 2 hours after starting the transfer pump, and after the transfer has been completed as required per HNF-IP-1266, Chapter 5.12. Flow readings are measured, recorded, and used to calculate material balance. Waste transferred from the source tank will be estimated on the basis of level drop, with adjustments for diluent addition at the pump suction, other water additions to the tank, trapped gas released during the transfer, and gas expansion as pressure on the retained gas is reduced. Waste temperature changes and waste dissolution also can have large impacts on material balance and therefore must be accounted for in calculations. A more complete material balance is calculated after each transfer. Final volume and sample analyses of waste in the destination tank are included to allow calculation of selected waste components delivered to the destination tank and the quantity remaining in the source or staging tank. The existing requirement for source or staging tank level agreement with destination tank level is likely to be inaccurate because of these factors. Consideration should be given to changing the requirement to transfer pump volumetric flowmeter/totalizer agreement with destination tank level changes, thus eliminating several uncertainties.

The requirement for liquid-level measurements during mixer pump operation may not be met with current instrumentation. The 241-AZ-101 mixer pump test may determine whether such measurement is possible. For material balance during mixer pump operation, it may be possible

to use the transfer pump discharge volumetric flow rate (including the in-line dilution volumetric flow rate). This method was accepted and was successful in recent transfers.

If periodic material balance calculations indicate a variance that exceeds the criteria, the transfer shall be stopped.

Analysis will model the temperature profile when source tank waste streams are added to staging tanks. Waste transfers will be controlled to ensure that waste temperatures remain below established temperature limits. Temperature will be controlled by operating the primary and annulus ventilation systems and by retrieving waste in increments.

Tank waste temperatures and tank bottom temperatures are monitored correlated with heat-balance data provided by the Ventilation Subsystem airflow rates, temperatures, and humidities. From these measurements, steady-state temperatures can be predicted and compared with the temperature limits and the expected thermal behavior as the retrieval progresses. If, at any time during retrieval operations, the sludge temperature profile indicates a significant departure from the estimates, retrieval operations will be suspended to allow for further analysis of the tank conditions and to restore waste temperatures to allowable limits.

Basis: A material balance calculation is required during each waste transfer per HNF-SD-WM-TSR-006, Section 5.12.2.b.

3.2.18 Reconfigure Transfer Route

After completion of the transfer, line flush, and transfer line drain, the transfer route will be configured safely to prevent inadvertent operation of the transfer pump resulting in transfer of waste to an unwanted location. The pump intake position and the valve positions in the transfer line and flush water supply line are reconfigured also.

Basis: Transfer system configuration management requires that transfer paths be isolated from active waste transfer pumps per HNF-SD-WM-TSR-006, Section 5.12.2.

3.2.18.1 Position Valves for Off-line Service. Transfer valves are controlled to ensure that they are in their predetermined off-line positions to prevent any misrouting of waste from inadvertent startup of the transfer pump. Control of the transfer valve positioning shall include maintaining an official routing board, independent field verification, and electronic monitoring of the transfer valve positioning.

3.2.18.2 Monitor Valve Position. Transfer valves are monitored to ensure that they are in their predetermined off-line positions to prevent any misrouting of waste from inadvertent startup of the transfer pump.

3.3 INSTRUMENT AND EQUIPMENT REQUIREMENTS

Instrumentation and equipment will be required to ensure efficient and reliable waste feed delivery operations. Existing equipment can be used for monitoring and control of several of the

waste feed delivery functions, particularly for waste storage functions. The control of waste preparation and waste transfer functions may require the development and use of new equipment and instrumentation. This new equipment may be required because there are new parameters that need to be monitored for control of waste feed delivery functions and because other parameters may have to be controlled more closely than was done in the past. For example, instrumentation and equipment may be helpful to

- Ensure that there will be no line plugging during lengthy transfers to the LAW/HLW Plant
- Determine in-tank waste concentrations
- Sample waste during mixer pump operation.

Several prototype instruments are being developed and commercially available instruments are being tested for use during waste feed delivery. Several of these instruments are being tested as part of the Tank 241-AZ-101 mixer pump testing. Mixer pump testing potentially may determine whether waste sampling during mixer pump operation will be required.

This process control strategy assumes that existing and proven instrumentation and equipment will be used for the monitoring and control of LAW feed delivery. The plan will be revised as applicable to incorporate new equipment that has been developed and proven to be reliable.

3.4 CHANGES IN PROCESS CONTROL STRATEGY FROM CASE 3 TO CASE 3S6D

Section 3.0 is not tank-specific. Therefore, it applies equally to Case 3S6D DSTs and Case 3 DSTs. For Case 3S6D SST retrieval, specific process controls will have to be developed.

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4.0 REFERENCES

29 CFR 1910, Subpart Z, "Occupational Safety and Health Standards, Toxic and Hazardous Substances," *Code of Federal Regulations*, as amended.

40 CFR 264, "Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," *Code of Federal Regulations*, as amended.

ASME B31.3, 1999, *Process Piping*, American Society of Mechanical Engineers, New York, New York.

BNFL, 1996, *DOE Contract DE-AC06-96RL13308, Waste Treatment Plant*, as amended by Modification A012, Specification 7, "Low-Activity Waste Envelopes Definition," January 2000, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

BNFL-5193-ID-19, 2000, *Interface Control Document for Low Activity Waste Feed*, Rev. 4e, BNFL Inc., Richland, Washington.

CPS-T-149-00010, 1998, *Criticality Prevention Specification*, Rev. 1-0, Lockheed Martin Hanford Corporation, Richland, Washington.

DOE Order 5820.2A, *Radioactive Waste Management*, U.S. Department of Energy, Washington, D.C.

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

HNF-1939, 1998, *Waste Feed Delivery Technical Basis*, Volume II, "Waste Feed Delivery Flowsheet," Rev. 0, Lockheed Martin Hanford Corporation, Richland, Washington.

HNF-1939, 1999, *Waste Feed Delivery Technical Basis*, Volume II, "Waste Feed Delivery Flowsheet for Tank 241-AN-104," Rev. 0c, Numatec Hanford Corporation, Richland, Washington.

HNF-1939, 1999, *Waste Feed Delivery Technical Basis*, Volume III, "Waste Feed Delivery System Description," Rev. 0, Lockheed Martin Hanford Corporation, Richland, Washington.

HNF-1939, 1999, *Waste Feed Delivery Technical Basis*, Volume IV, "Waste Feed Delivery Operations and Maintenance Concept," Rev. 0, Lockheed Martin Hanford Corporation, Richland, Washington.

HNF-2168, 2000, *Performance Requirements for the Double-Shell Tank Systems: Phase 1*, Rev. 1, CH2M HILL Hanford Group, Inc., Richland, Washington.

HNF-2938, 1998, *Evaluation of 241AN Tank Farm Supporting Phase 1 Privatization Waste Feed Delivery*, Rev. 0, Numatec Hanford Corporation and COGEMA Engineering Corporation for Fluor Daniel Hanford, Inc., Richland, Washington.

HNF-4155, 2000, *Double-Shell Tank Monitor and Control Subsystem Specification*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.

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

HNF-5136, 2000, *Functional Analysis for Double-Shell Tank Subsystems*, Rev. 0, Lockheed Martin Hanford Corporation, Richland, Washington.

HNF-5442, 2000, *Preliminary Heat Transfer Studies for the Double-Shell Tank Transfer Piping*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.

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

HNF-SD-WM-OCD-015, 1999, *Tank Farm Waste Transfer Compatibility Program*, Rev. 2, Lockheed Martin Hanford Corporation, Richland, Washington.

HNF-SD-WM-PTP-027, 2000, *Mixer Pump Test Plan for Double-Shell Tank 241-AZ-101*, Rev. 4, COGEMA Engineering Corporation for CH2M HILL Hanford Group, Inc., 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-SEL-040, 1998, *Tank Waste Remediation System Facility Safety Equipment List*, 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.

HNF-SD-WM-TRD-007, 1998, *System Specification for the Double-Shell Tank System*, Rev. E, COGEMA Engineering Corporation, Numatec Hanford Corporation, and TRW Systems Integration Group for Fluor Daniel Hanford, Inc., Richland, Washington.

HNF-SD-WM-TSR-006, 1999, *Tank Waste Remediation System Technical Safety Requirements*, Rev. 1, Fluor Daniel Hanford, Inc., Richland, Washington.

OSD-T-151-00007, 1998, *Operating Specifications for the 241-AN, AP, AW, AY, AZ, and SY Tank Farms*, Rev. H-21, Lockheed Martin Hanford Corporation, Richland, Washington.

OSD-T-151-00031, 1999, *Operation Specifications for Tank Leak Detection and Single-Shell Tank Intrusion Detection*, Rev. D-0, Lockheed Martin Hanford Corporation, Richland, Washington.

RPP-5346, 2000, *Waste Feed Delivery Transfer System Analysis*, Rev. 0, L. J. Julyk and T. C. Oten, CH2M HILL Hanford Group, Inc., and W. L. Willis, Numatec Hanford Corporation, Richland, Washington.

SD-RE-TI-008, 1980, *241-AW Tank Farm Process Specifications*, Rockwell Hanford Operations, Richland, Washington.

SD-WM-TI-150, 1984, *Technical Basis for Waste Tank Corrosion Specifications*, Rev. 0, Rockwell Hanford Operations, Richland, Washington.

Treat, R. L., 1999, *Interim Guidance on LAW Retrieval Strategy*, (Letter 73600-99-006 to A. F. Choho, June 22), Numatec Hanford Corporation, Richland, Washington.

TWRS-PP-94-025, 1994, *Sludge Washing Materials Study: The Behavior of Carbon Steel in a Dilute Waste Environment*, Westinghouse Hanford Company, Richland, Washington.

WAC 173-303, "Dangerous Waste Regulations," *Washington Administrative Code*, as amended.

WAC 173-400, "General Regulations for Air Pollution Sources," *Washington Administrative Code*, as amended.

WAC 173-460, "Control for New Sources of Toxic Pollutants," *Washington Administrative Code*, as amended.

WAC 246-247, "Radiation Protection—Air Emissions," *Washington Administrative Code*, as amended.

WHC-SD-GN-DGS-30011, 1994, *Radiological Design Guides*, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

WHC-SD-SQA-CSA-20368, 1994, *CSER 94-004: Criticality Safety of Double-Shell Waste Storage Tanks*, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

WHC-SD-WM-DGS-006, 1997, *Tank Farms Pump Critical Characteristics and Specification Guide*, Rev. 0, Lockheed Martin Hanford Corporation, Richland, Washington.

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APPENDIX A

PROCESS CONTROL STRATEGY MATRICES

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Table A-1a. Low-Activity Waste Process Control Strategy Store Waste Function Existing Process Concerns. (5 Sheets)

Flowsheet/Process Step	DST 2nd Tier Function	DST 3rd Tier Function	DST 4th Tier Function	Associated Process Concerns	Basis for Concerns
Waste is initially stored in DSTs. Store supernate in staging tank Store sludge dissolate in staging tank	Store waste in East/West Area DSTs	Direct waste additions within DSTs		Material balance	Ref. D, Section 7.2.2 minimum level for protection against tank bottom uplifting. Ref. E, Section to control waste accounting, leaks, hydrostatic load, and overflow of tank Ref. E, Verify waste receipt routing Ref. F Ref. H
				Compatibility	Ref. D, Section 7.2.1 nitrate, nitrite, and hydroxide concentrations Ref. G
				Tank thermal cycle	Ref. C, Sections 2.1.1 and 3.3.2 DST waste temperature. Ref. D, Sections 7.2.6 waste temperature limits, rate of change, and gradients Ref. D, Sections 7.2.7.a and 7.2.7.b temperature limits and gradients applied to concrete to prevent structure degradation Ref. D, Sections 7.3.3 and 7.3.4 used to help control waste and structure temperatures
				Tank ventilation overwhelmed	Ref. B, Section 4.3.2.1 to prevent the accumulation of flammable gases due to steady-state releases
				Criticality	Rev. 0, Criticality evaluation required for waste transfer Ref. P

Table A-1a. Low-Activity Waste Process Control Strategy Store Waste Function Existing Process Concerns. (5 Sheets)

Flowsheet/Process Step	DST 2nd Tier Function	DST 3rd Tier Function	DST 4th Tier Function	Associated Process Concerns	Basis for Concerns
Store sludge dissolate in staging tank	Store waste in East/West Area DSTs	Control DST waste chemical composition	Monitor waste chemical composition Compare waste chemical composition to operating limits Maintain waste chemical composition	Tank corrosion	Ref. D, Section 7.2.1 nitrate, nitrite, and hydroxide concentrations
				Flammable gas	Ref. E, Section C.6 insoluble solids limit Ref. D Ref. C, Section 3.2.1 ventilation system operability to prevent accumulation of flammable gas in the tank headspace
Waste is initially stored in DSTs. Store supernate in staging tank Store sludge dissolate in staging tank	Store waste in East/West Area DSTs			Temperature excursions	Ref. D, Section 7.2.1 nitrate, nitrite, and hydroxide concentrations Ref. C, Section 3.2.1 ventilation system operability to prevent accumulation of flammable gas in the tank headspace
				Vapor bubble	Ref. E, Section C.6 insoluble solids limit Ref. C, Section 3.2.1 ventilation system operability to prevent accumulation of flammable gas in the tank headspace
		Control DST and waste temperature	Compare DST and waste temperature to operating limits Maintain DST and waste temperature	Structural damage of primary tank structure	Ref. C, Sections 2.1.1 and 3.3.2 DST waste temperature, Ref. D, Sections 7.2.6 waste temperature limits, rate of change, and gradients Ref. D, Sections 7.3.3 and 7.3.4 used to help control waste and structure temperatures
				Structural damage to concrete shell	Ref. D, Sections 7.2.7.a and 7.2.7.b temperature limits and gradients applied to concrete to prevent structure degradation
				Pressurization of tank	Ref. C, Sections 2.1.1 and 3.3.2 DST waste temperature, Ref. D, Section 7.2.6 waste temperature limits, rate of change, and gradients

Table A-1a. Low-Activity Waste Process Control Strategy Store Waste Function Existing Process Concerns. (5 Sheets)

Flowsheet/Process Step	DST 2nd Tier Function	DST 3rd Tier Function	DST 4th Tier Function	Associated Process Concerns	Basis for Concerns
				Deflagration (org/nitrate)	Ref. D, Section 7.2.1 nitrate, nitrite, and hydroxide concentrations Ref. E, Section 4.3 mixer pump used in staging tank to produce homogeneous mixture as feed
Waste is initially stored in DSTs. Store supernate in staging tank Store sludge dissolate in staging tank	Store waste in East/West Area DSTs	Control DST hydrostatic loads	Monitor DST waste level Monitor DST vapor space pressure Monitor DST annulus pressure Compare DST hydrostatic loads to operating Limits Maintain DST waste level Maintain DST vapor space pressure Maintain DST annulus pressure	Structural tank damage due to:	
				High waste level	Ref. D, Section 7.2.2 minimum level for protection against tank bottom uplifting, Ref D, Reduce tank liquid level below leak level Ref. E, Section C.6 insoluble solids limit Ref. E, Section C.6, Prevent waste pile up
				Tank over/under pressurization	Ref. C, Sections 2.1.1 and 3.3.2 DST waste temperature, Ref. D, Sections 7.2.6 waste temperature limits, rate of change, and gradients Ref. B, Section 4.3.2.3 to maintain vapor space pressure of all tanks < 0 KPa (< 0 in. w.g.)
				High/low annulus pressure	Ref. D, Sections 7.3.3 and 7.3.4 used to help control waste and structure temperatures Ref D, Section 17.4.7 Recovery actions may include reduction of air flow rate to ALC, manipulating the vent system flow rates, or using a portable exhauster Ref. B, Maintain annulus pressure greater than or equal to primary tank pressure and less than or equal to atmospheric to prevent radioactivity release
Waste is initially stored in DSTs. Store supernate in staging tank Store sludge dissolate in staging tank	Store waste in East/West Area DSTs			Low liquid level (<10")	Ref. D, Reduce tank liquid level below leak level Ref. D, Section 7.2.2.b. Detection pit liquid level limits to prevent structure damage to primary and secondary tanks and to allow responsive monitoring of a radioactive material leak

Table A-1a. Low-Activity Waste Process Control Strategy Store Waste Function Existing Process Concerns. (5 Sheets)

Flowsheet/Process Step	DST 2nd Tier Function	DST 3rd Tier Function	DST 4th Tier Function	Associated Process Concerns	Basis for Concerns
		Control DST primary confinement leaks	Monitor DST annulus for primary leaks Compare DST annulus leak detection data to operating limits	Undetected liquid leak from primary tank containment	Ref. B, Section 4.3.7.3 to detect primary tank leak Ref. B, Section 4.3.7.2 requires liquid level monitoring in annulus leak detection pit Ref. D, Reduce tank liquid level below leak level Ref. M Ref. H Ref. I
			Monitor DST vapor space pressure Monitor DST annulus pressure Compare DST vapor space pressure to operating limits Compare DST annulus pressure to operating limits Maintain DST vapor space pressure Maintain DST annulus pressure	Release to environment due to HEPA failure	Ref. B, Section 4.3.2.3 to maintain vapor space pressures of all tanks < 0 KPa (< 0 in. w.g.) Ref. C, Section 3.2.1 flammable gas level limits Ref. B, Section 4.3.19.1 CAM interlock system to shut down exhaust fan when high radionuclide activity is detected Ref. D, Section 7.3.1 E design constraints limiting airborne emissions Ref. C, Section 3.2.1 Ref. D, Section 7.3.1.A gaseous discharge limits for primary and annulus Ref. J Ref. D, Section 7.3.1. A to prevent exhaust filter damage Ref. D, Section 7.3.1.B Air inlet air temperature limit to protect HEPA Ref. H

Table A-1a. Low-Activity Waste Process Control Strategy Store Waste Function Existing Process Concerns. (5 Sheets)

Flowsheet/Process Step	DST 2nd Tier Function	DST 3rd Tier Function	DST 4th Tier Function	Associated Process Concerns	Basis for Concerns
		Control DST gaseous discharge	Monitor DST gaseous discharge Monitor DST flammable gas concentration Compare DST gaseous discharge to operating limits Compare DST flammable gas concentration to operating limits Maintain DST gaseous discharge within limits	Gaseous release due to loss of vacuum	Ref. B, Section 4.3.2.3 to maintain vapor space pressures of all tanks < 0 KPa (< 0 in. w.g.) Ref. C, Section 3.2.1 flammable gas level limits Ref. N, Maintain <0.3 in. w.g. Ref. D, Section 7.3.1.E design constraints limiting airborne emissions Ref. H Ref. K Ref. C, Section 3.2.1 Ref. D, Section 7.3.1.A gaseous discharge limits for primary and annulus Ref. J Ref. D, Section 7.3.1. A to prevent exhaust filter damage

References:

A. Deleted

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

C. HNF-SD-WM-TSR-006, 1999, *Tank Waste Remediation System Technical Safety Requirements*, Rev. 1, Lockheed Martin Hanford Corporation, Richland, Washington.

D. OSD-T-151-00007, 1998, *Unclassified Operating Specifications for the 241-AN, AP, AW, AY, AZ, & SY Tanks Farm*, Rev. H-21, Fluor Daniel Hanford, Inc., Richland, Washington.

E. BNFL-5193-ID-19, 2000, *Tank Waste Remediation System Privatization Project, Interface Control Document ICD-19 Between DOE and BNFL, Inc. for Low-Activity Waste Feed*, Rev. 4e, BNFL, Inc., Richland, Washington.

F. HNF-SD-WM-TRD-007, 1998, *System Specification of the Double-Shell Tank System*, Rev. 0-E, Cogema/Numatec/TRW Corporation, Richland, Washington.

G. HNF-SD-WM-OCD-015, 1999, *Tank Farm Waste Compatibility Program*, Rev. 2, Lockheed Martin Hanford Corporation, Richland, Washington.

H. WAC-173-303, "Dangerous Waste Regulations," *Washington Administrative Code*, Olympia, Washington.

I. 40 CFR 264, "Standard for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," *Code of Federal Regulations*, as amended.

J. WAC-173-400, 1997, "General Regulations for Air Pollutions Sources," *Washington Administrative Code*, Olympia, Washington.

K. WHC-SD-WM-DGS-006, 1997, *Tank Farms Pump Characteristic and Specification Guide*, Rev. 0, ARES Corporation and Lockheed Martin Hanford Corporation, Richland, Washington.

L. WAC 246-247, "Radiation Protection - Air Emissions," *Washington Administrative Code*, Olympia, Washington.

M. DOE Order 5820.2A, *Radioactive Waste Management*, U.S. Department of Energy, Washington, D.C.

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

O. CPS-T-149-00010, 1998, *Criticality Prevention Specification*, Rev. I-0, Lockheed Martin Hanford Corporation, Richland, Washington.

P. WHC-SD-SQA-CSA-20368, 1994, *CSER 94-004: Criticality Safety of Double-Shell Waste Storage Tanks*, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Table A-2a. Low-Activity Waste Process Control Strategy Prepare Waste Function Existing Process Concerns. (3 Sheets)

Flowsheet/Process Step	DST 2nd Tier Function	DST 3rd Tier Function	DST 4th Tier Function	Associated Process Concerns	Basis for Concern
Prepare LAW waste	Prepare waste in West/East Area source DSTs	Dissolve soluble waste in source DSTs - Soften crust layer (optional)	Soften crust layer in source tanks Add diluent to LAW source tank Recirculate diluent in LAW source tank	Diluent temperature too low/high	HNF-1939
				Diluent supply pressure too low/high	HNF-1939
				Overfilling of DSTs with diluent	SD-RE-TI-008
				Equipment damage due to insufficient crust removal	HNF-1939
				Diluent leak or misrouting	HNF-SD-WM-TSR-006
				Diluent addition content incorrect	HNF-1939
		Dissolve soluble waste - Dissolve salts	Dissolve salts in source tank Add diluent to LAW source tank Mobilize solids in LAW source tanks with mixer pump	Overfilling tank with diluent	SD-RE-TI-008
				Mixer pump insufficient	WHC-SD-WM-DGS-006
				Time of mixer pump operation	BNFL-5139-ID-19 HNF-SD-WM-OCD-015
		Dissolve soluble waste - Settle undissolved solids	Settle undissolved solids	Solids do not settle out	HNF-1939 BNFL-5193-ID-19
		Dissolve soluble waste - Sample prepared LAW	Sample prepared LAW	Waste is not sampled at representative location	HNF-1939 BNFL-5193-ID-19
				Sample crystallizes enroute to lab	BNFL-5193-ID-19

Table A-2a. Low-Activity Waste Process Control Strategy Prepare Waste Function Existing Process Concerns. (3 Sheets)

Flowsheet/Process Step	DST 2nd Tier Function	DST 3rd Tier Function	DST 4th Tier Function	Associated Process Concerns	Basis for Concern
Prepare LAW waste	Prepare waste in LAW staging tanks	Prepare LAW in LAW staging tanks - Homogenize waste	Homogenize waste	Non-homogeneous mixture of waste	HNF-1939
				Salt does not dissolve	BNFL-5193-ID-19
				Solids content too high	BNFL-5193-ID-19
		Prepare LAW in LAW staging tanks - Soften waste	Soften crust layer in source tanks	Overfilling of tank with diluent	SD-RE-TI-006
			Add diluent to LAW source tank		
			Recirculate diluent in LAW source tank	Equipment damage due to insufficient crust removal	HNF-1939
		Prepare LAW in LAW staging tanks - Settle undissolved solids	Settle undissolved solids	Solids do not settle out	HNF-1939 BNFL-5193-ID-19
		Prepare LAW in LAW staging tanks - Dissolve salts in LAW tanks	Dissolve salts in source tank	Overfilling of tank with diluent	SD-RE-TI-006
			Add diluent to LAW source tank		
			Mobilize solids in LAW source tanks with mixer pump	Equipment damage due to insufficient crust removal	HNF-1939

Table A-2a. Low-Activity Waste Process Control Strategy Prepare Waste Function Existing Process Concerns. (3 Sheets)

Flowsheet/Process Step	DST 2nd Tier Function	DST 3rd Tier Function	DST 4th Tier Function	Associated Process Concerns	Basis for Concern
		Prepare LAW in LAW staging tanks - Sample prepared LAW	Sample prepared LAW	Waste is not sampled at representative location	HNF-1939 BNFL-5193-ID-19
				Diluent flow rate for transfer	BNFL-5193-ID-19
				Special distribution of solids	BNFL-5193-ID-19

References:

A. HNF-1939, 1999, *Waste Feed Delivery Technical Basis, Waste Feed Delivery Flowsheet for Tank AN-104*, Volume II, Rev. 0c, Numatec Hanford Corporation, Richland, Washington.

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

C. HNF-SD-WM-TSR-006, 1999, *Tank Waste Remediation System Technical Safety Requirements*, Rev. 1, Fluor Daniel Hanford, Inc., Richland, Washington.

D. BNFL-5193-ID-19, 2000, *Interface Control Document for Low-Activity Waste Feed*, Rev. 4e, BNFL Inc., Richland, Washington.

E. WHC-SD-WM-DGS-006, 1997, *Tank Farms Pump Characteristic and Specification Guide*, Rev. 0, ARES and Lockheed Martin Hanford Corporation, Richland, Washington.

F. HNF-SD-WM-OCD-015, 1999, *Tank Farms Waste Transfer Compatibility Program*, Rev. 2, Lockheed Martin Hanford Corporation, Richland, Washington.

G. SD-RE-TI-008, 1980, *241-AW Tank Farm Process Specifications*, Vollert, F. R., Rockwell Hanford Operations, Richland, Washington.

H. OSD-T-151-00007, 1991, *Unclassified Operating Specifications for the 241-AN, AP, AW, AY, AZ, and SY Tank Farms*, Rev. H-21, Lockheed Martin Hanford Corporation, Richland, Washington.

Table A-3a. Low-Activity Waste Process Control Strategy Transfer Waste Function Existing Process Concerns. (4 Sheets)

Flowsheet/Process Step	DST 2nd Tier Function	DST 3rd Tier Function	DST 4th Tier Function	Associated Process Concerns	Basis for Concerns
Transfer LAW	Transfer LAW cross site/transfer waste to intermediate/LAW staging tanks and to LAW/HLW plant	Establish transfer route for waste transfer	Position valves for transfer Monitor valve position	Assure valves are in the proper alignment for transfer	HNF-SD-WM-TSR-006 HNF-IP-1266
				Assure connecting piping is isolated by 2 closed valves	HNF-1939-Vol IV
				Assure valve position remains correct during transfer	HNF-SD-WM-TSR-006 HNF-1939-Vol IV HNF-IP-1266
		Confine waste along transfer route	Confine waste within DST transfer piping Continue waste within valve manifolds and jumpers	Assure there are no leaks in the primary piping	WAC-173-303-640 DOE Order 6430.1A ASME B31.3
				Assure there are no leaks in valve manifolds or jumpers	WAC 173-303-640 DOE Order 6430.1A ASME B31.3
		Provide diluent during transfers	Deliver caustic/diluent to transfer associated structures Deliver diluent/flush water to transfer pump suction Confine caustic/diluent within valve manifolds and jumpers Confine diluent/flush water within DST transfer piping	Assure that the correct amount of diluent is delivered	HNF-1939 HNF-SD-WM-OCD-015
				Assure that the correct amount of diluent is delivered to the transfer pump suction	HNF-SD-WM-OCD-015
				Assure there are no leaks in valve manifolds or jumpers	HNF-IP-1266 HNF-SD-WM-TSR-006 DOE Order 6430 1A
				Assure there are no leaks in the primary piping	HNF-IP-1266 WAC-173-303-640 HNF-SD-WM-TSR-006 DOE Order 6430.1A

Table A-3a. Low-Activity Waste Process Control Strategy Transfer Waste Function Existing Process Concerns. (4 Sheets)

Flowsheet/Process Step	DST 2nd Tier Function	DST 3rd Tier Function	DST 4th Tier Function	Associated Process Concerns	Basis for Concerns
Transfer LAW	Transfer LAW cross site/transfer waste to intermediate/LAW staging tanks and to LAW/HLW plant	Convey waste	Position transfer pump suction intake Pump waste/diluent	Assure waste concentration is within transfer and specification parameters	BNFL-5193-ID-19
			Confine waste in transfer pump Monitor transfer pump operation Monitor position of transfer pump suction Monitor process parameters for waste transfers	Assure waste concentration is within transfer and specification parameters	BNFL-5193-ID-19
				Pump failure	WHC-SD-WM-DGS-006
				Avoid gelling, salt precipitation, and solids settling	HNF-1939
				Assure there are no leaks in transfer pump or jumpers	WAC 173-303
				Assure transfer pumps will operate during transfers	HNF-1939 WHC-SD-WM-DGS-006
				Assure transfer pump will not cavitate	HNF-1939 WHC-SD-WM-DGS-006
				Pump Failure	HNF-1939 WHC-SD-WM-DGS-006
				Assure that transfer lines will not get plugged during transfer	HNF-SD-WM-OCD-015

Table A-3a. Low-Activity Waste Process Control Strategy Transfer Waste Function Existing Process Concerns. (4 Sheets)

Flowsheet/Process Step	DST 2nd Tier Function	DST 3rd Tier Function	DST 4th Tier Function	Associated Process Concerns	Basis for Concerns
		Confine waste leakage along transfer route	Confine waste leakage within secondary containment piping Monitor for DST transfer pipe leakage	Assure no waste leaks from transfer pipe into the environment	HNF-IP-1266 DOE Order 6430.1A WAC 173-303
Transfer LAW	Transfer LAW cross site/transfer waste to intermediate/LAW staging tanks and to LAW/HLW plant		Confine waste leakage within transfer associated structures Monitor for leaks in transfer associated structures	Assure no waste leaks from transfer associated structures into the environment	WAC 173-303 DOE Order 6430.1A
		Flush transfer system	Deliver flush waste to transfer associated structures Confine flush water within valve manifolds and jumpers Confine flush water within DST transfer piping Deliver flush water to transfer pump suction	Leak of contaminated flush water	BNFL-5193-ID-19 DOE Order 6430.1A HNF-1939 BNFL-5193-ID-19
				Flush water misrouted	HNF-IP-1266
				Via transfer pump, waste mixed with flush water	HNF-1939
		Drain transfer piping		Misrouting of residual waste	HNF-1939
		Perform material balance for DST transfers		Material balance discrepancy	HNF-SD-WM-TSR-006

Table A-3a. Low-Activity Waste Process Control Strategy Transfer Waste Function Existing Process Concerns. (4 Sheets)

Flowsheet/Process Step	DST 2nd Tier Function	DST 3rd Tier Function	DST 4th Tier Function	Associated Process Concerns	Basis for Concerns
		Reconfigure transfer route	Position valves for offline service	Assure no accidental startup of the transfer pump will result in a waste misrouting	HNF-SD-WM-TSR-006
			Monitor valve position	Assure that all waste transferred has been received	HNF-SD-WM-TSR-006

References:

A. HNF-IP-1266, *Tank Farms Operations Administrative Controls*, Rev. 1, Fluor Daniel Hanford, Inc., Richland, Washington.

B. HNF-SD-WM-TSR-006, Rev. 1, 1999, Tank Waste Remediation System Technical Safety Requirements, Lockheed Martin Hanford Corporation, Richland, Washington.

C. HNF-1939, Volume II, Rev. 0c, 1999, Waste Feed Delivery Technical Basis, Waste Feed Delivery Flowsheet for Tank AN-104.

D. WAC-173-303, "Dangerous Waste Regulations," *Washington Administrative Code*, Olympia, Washington.

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

F. ASME B31.3, 1999, *Process Piping*, American Society of Mechanical Engineers, New York, New York.

G. BNFL-5193-ID-19, 2000, *Tank Waste Remediation System Privatization Project, Interface Control Document for Low Activity Waste Feed*, BNFL, Inc., Richland, Washington.

H. WHC-SD-WM-DGS-006, 1997, *Tank Farms Pump Characteristic and Specification Guide*, Rev. 0, ARES Corporation and Lockheed Martin Hanford Corporation, Richland, Washington.

I. HNF-SD-WM-OCD-015, 1999, *Tank Farm Waste Transfer Compatibility Program*, Rev. 2, Lockheed Martin Hanford Corporation, Richland, Washington.

Table A-1b. Low-Activity Waste Process Control Strategy Store Waste Function Control Variable Consideration for Future Development. (5 Sheets)

Flowsheet/Process Step	DST 2nd Tier Function	DST 3rd Tier Function	DST 4th Tier Function	Associated Process Concerns	Potential Control Variables (examples)	Choice of Variable(s) to be Controlled	Monitor/ Control
Waste is initially stored in DSTs. Store supernate in staging tank Store sludge dissolate in staging tank	Store waste in East/West Area DSTs	Direct waste additions within DSTs		Material balance	Liquid/sludge level and specific gravity	Liquid/sludge level and specific gravity	M
					Leak detection	Leak detection	M, C
					Flowmeter totalizers	Flowmeter totalizers	M
					CCTV		
				Compatibility	Samples for chemical composition prior to receipt		
					pH monitoring		
					Waste analysis		
					Process knowledge	Process knowledge	M, C
					Electrochemical monitoring		
				Tank thermal cycle	Temperature of the waste	Temperature of the waste	M
					Temperature of the concrete	Temperature of the concrete	M
					Temperature of the headspace		
					Rate of waste additions		
					Temperature of the annulus		
					Waste analysis (BTU load)	Waste analysis (BTU load)	C
					HVAC flow rate	HVAC flow rate	M, C
					ALCs		

Table A-1b. Low-Activity Waste Process Control Strategy Store Waste Function Control Variable Consideration for Future Development. (5 Sheets)

Flowsheet/Process Step	DST 2nd Tier Function	DST 3rd Tier Function	DST 4th Tier Function	Associated Process Concerns	Potential Control Variables (examples)	Choice of Variable(s) to be Controlled	Monitor/ Control
				Tank ventilation overwhelmed	Head space pressure	Head space pressure	M, C
					HVAC fan sizing	HVAC fan sizing	C
					Evacuation flow rate		
					HEPA, HEMA, HEGA differential pressure	HEPA, HEMA, HEGA differential pressure	M
					CAM monitoring system	CAM monitoring system	M
					Moisture removal system	Moisture removal system	M
					Ventilation balance	Ventilation balance	C
					Waste flow rate		
					Volatile monitoring/control		
					Head space H2		
					Radiation monitoring		
					Off gas VOC by FID		
Store sludge dissolate in staging tank	Store waste in East/West Area DSTs	Control DST waste chemical composition	Monitor waste chemical composition Compare waste chemical composition to operating limits Maintain waste chemical composition	Tank corrosion	Nitrate/nitrite concentrations	All monitored via chemical analysis/process knowledge	M
					Hydroxide concentrations	NaOH additions	C
					Diluent addition		
				Flammable gas	Organics	Nitrite additions	C
					Nitrate concentration	Waste transfer	C
					Radionuclides		
					Insoluble salts		

Table A-1b. Low-Activity Waste Process Control Strategy Store Waste Function Control Variable Consideration for Future Development. (5 Sheets)

Flowsheet/Process Step	DST 2nd Tier Function	DST 3rd Tier Function	DST 4th Tier Function	Associated Process Concerns	Potential Control Variables (examples)	Choice of Variable(s) to be Controlled	Monitor/ Control
				Temperature excursions	Ammonia		
					Ventilation balance	Ventilation balance	M, C
					Organics		
					Radionuclides		
				Vapor bubble	Organics		M
					Ventilation balance	Ventilation balance	M, C
					Radionuclides/fissile material		
					Insoluble salts		
					Sodium concentration		
		Control DST and waste temperature	Compare DST and waste temperature to operating limits Maintain DST and waste temperature	Structural damage of primary tank structure	Primary structure HVAC flow	Primary structure HVAC flow	M, C
					Annulus HVAC flow	Annulus HVAC flow	M, C
					Waste temperature	Waste temperature	M
					Waste transfer	Waste transfer	C
				Structural Damage to concrete shell	Concrete temperature	Concrete temperature	M
					Waste temp rate of rise	Waste temp rate of rise	M
					Headspace temperature		
				Pressurization of tank	Waste temperature	Waste temperature	M
					Primary structure HVAC flow	Primary structure HVAC flow	M, C
					Chemical/radionuclide composition	Chemical/radionuclide composition	C

Table A-1b. Low-Activity Waste Process Control Strategy Store Waste Function Control Variable Consideration for Future Development. (5 Sheets)

Flowsheet/Process Step	DST 2nd Tier Function	DST 3rd Tier Function	DST 4th Tier Function	Associated Process Concerns	Potential Control Variables (examples)	Choice of Variable(s) to be Controlled	Monitor/ Control
Waste is initially stored in DSTs Store supernate in staging tank Store sludge dissolate in staging tank	Store waste in East/West Area DSTs			Deflagration (org/nitrate)	Sludge temperature	Sludge temperature	M
					Mixer pump	Mixer pump	C
					ALCs		
					Chemical/radionuclide composition	Chemical/radionuclide composition	C
		Control DST hydrostatic loads	Monitor DST waste level Monitor DST vapor space pressure Monitor DST annulus pressure Compare DST hydrostatic loads to operating limits Maintain DST waste level Maintain DST vapor space pressure Maintain DST annulus pressure	Structural tank damage due to:			
				High waste level	Liquid level	Liquid level	M
					SpG	SpG	M
					Solids level	Solids level	M
					Waste transfer	Waste transfer	C
				Tank over/under pressurization	Head space pressure	Head space pressure	M
					Primary HVAC rate	Primary HVAC rate	M, C
				High/low annulus pressure	Annulus pressure	Annulus pressure	M
					Annulus HVAC rate	Annulus HVAC rate	M, C
				Low liquid level (<10")	Liquid level	Liquid level	M
					Waste transfer	Waste transfer	C
Waste is initially stored in DSTs. Store supernate in staging tank Store sludge dissolate in staging tank	Direct waste additions within DSTs	Control DST primary confinement leaks	Monitor DST annulus for primary leaks Compare DST annulus leak detection data to operating limits	Undetected liquid leak from primary tank containment	Pit liquid level leak detection	Pit liquid level leak detection	M, C
					Annulus exhaust CAM radiation detection	Annulus exhaust CAM radiation detection	M
					Tank liquid level	Tank liquid level	M
					Waste transfer	Waste transfer	C
					Other leak monitors		

Table A-1b. Low-Activity Waste Process Control Strategy Store Waste Function Control Variable Consideration for Future Development. (5 Sheets)

Flowsheet/Process Step	DST 2nd Tier Function	DST 3rd Tier Function	DST 4th Tier Function	Associated Process Concerns	Potential Control Variables (examples)	Choice of Variable(s) to be Controlled	Monitor/ Control
			Monitor DST vapor space pressure	Release to environment due to HEPA failure	Primary ventilation stack monitoring	Primary ventilation stack monitoring	M
			Monitor DST annulus pressure		Relative humidity of gaseous effluent stream	Relative humidity of gaseous effluent stream	M
			Compare DST vapor space pressure to operating limits		HEPA differential pressure	HEPA differential pressure	M
			Compare DST annulus pressure to operating limits		Primary HVAC flow	Primary HVAC flow	M, C
			Maintain DST vapor space pressure		Toxic vapor concentrations	Toxic vapor concentrations	M
			Maintain DST annulus pressure				
		Control DST gaseous discharge	Monitor DST gaseous discharge	Gaseous release due to loss of vacuum or GRE	Primary headspace pressure	Primary headspace pressure	M
			Monitor DST flammable gas concentration		Primary HVAC flow rate	Primary HVAC flow rate	M, C
			Compare DST gaseous discharge to operating limits		HEPA differential pressure	HEPA differential pressure	M
			Compare DST flammable gas concentration to operating limits		Mixer pump operation	Mixer pump operation	M, C
			Maintain DST gaseous discharge within limits		Solids content	Solids content	C
					Flammable gas concentrations	Flammable gas concentrations	M

Table A-2b. Low-Activity Waste Process Control Strategy Prepare Waste Function Control Variable Consideration for Future Development. (4 Sheets)

Flowsheet/Process Step	DST 2nd Tier Function	DST 3rd Tier Function	DST 4th Tier Function	Associated Process Concerns	Potential Control Variables (examples)	Choice of Variable(s) to be Controlled	Monitor/ Control
Prepare LAW waste	Prepare waste in West/East Area source DSTs	Dissolve soluble waste in source DSTs - Soften crust layer (optional)	Soften crust layer in source tanks Add diluent to LAW source tank Recirculate diluent in LAW source tank	Diluent temperature too low/high	Diluent temperature	Diluent temperature	M
				Diluent supply pressure too low/high	Diluent supply pressure	Diluent supply pressure	M
				Overfilling of DSTs with diluent	Tank liquid level	Tank liquid level	M
					Material balance	Material balance	M
					Diluent volume	Diluent volume	M
					Leak detection		
				Equipment damage due to insufficient crust removal	Diluent volume	Diluent volume	M, C
					Mixing time	Mixing Time	M, C
				Diluent leak or misrouting	Leak detection - line		
					Leak detection - tank		
					Valve position	Valve position	M, C
					Tank liquid level	Tank liquid level	M
					Diluent flow rate		
				Diluent addition content incorrect	pH/ORP of diluent	pH/ORP of diluent	M
					Flow rate of metering pump	Flow rate of metering pump	M
		Dissolve soluble waste - Dissolve salts	Dissolve salts in source tank Add diluent to LAW source tank Mobilize solids in LAW source tanks with mixer pump	Overfilling tank with diluent	Tank liquid level	Tank liquid level	M
					Material balance	Material balance	M
					Diluent volume	Diluent volume	M, C
					Leak detection		

Table A-2b. Low-Activity Waste Process Control Strategy Prepare Waste Function Control Variable Consideration for Future Development. (4 Sheets)

Flowsheet/Process Step	DST 2nd Tier Function	DST 3rd Tier Function	DST 4th Tier Function	Associated Process Concerns	Potential Control Variables (examples)	Choice of Variable(s) to be Controlled	Monitor/ Control
				Mixer pump insufficient performance	Pump flow rate	Pump flow rate	C
					Pump motor amperage	Pump motor amperage	M
					Pump rotational speed		
					Pump bearing temperature		
					Pump discharge pressure		
					Pump specific monitoring parameters	Pump specific monitoring parameters	M
					Sampling	Sampling	M
				Time of mixer pump operation	Mixing time	Mixing time	M, C
		Dissolve soluble waste - Settle undissolved solids	Settle undissolved solids	Solids do not settle out	Settling time	Settling time	M
					Temperature of waste		
					Waste density		
					Waste viscosity		
					Sampling	Sampling	M
					Waste characterization		
					Solids level		
		Dissolve soluble waste - Sample prepared LAW	Sample prepared LAW	Waste is not sampled at representative location	Sample locations	Sample locations	M, C
					Lateral distribution of risers	Lateral distribution of risers	M
				Sample crystallizes enroute to lab	Sample temperature enroute to lab	Sample temperature enroute to lab	M

Table A-2b. Low-Activity Waste Process Control Strategy Prepare Waste Function Control Variable Consideration for Future Development. (4 Sheets)

Flowsheet/Process Step	DST 2nd Tier Function	DST 3rd Tier Function	DST 4th Tier Function	Associated Process Concerns	Potential Control Variables (examples)	Choice of Variable(s) to be Controlled	Monitor/ Control
Prepare LAW waste	Prepare waste in LAW staging tanks	Prepare LAW in LAW staging tanks - Homogenize waste	Homogenize waste	Non-homogeneous mixture of waste	Mixing time	Mixing time	M, C
					Mixer pump UoD	Mixer pump UoD	M, C
					Sampling	Sampling	M
				Salt does not dissolve	Diluent make-up concentration		
					Mixing time	Mixing time	M, C
					Sampling	Sampling	M
					Mixing temperature		
				Solids content too high	Sampling	Sampling	M
				Assure mixer pumps are operated efficiently	Pump flow rate	Pump flow rate	M, C
					Pump motor amperage	Pump motor amperage	M
					Pump rotational speed		
					Pump bearing temperature		
					Pump discharge pressure		
					Sampling		
					Pump specific operating parameters	Pump specific operating parameters	M
		Prepare LAW in LAW staging tanks - Settle undissolved solids (optional)	Settle undissolved solids	Solids do not settle out	Settling time	Settling time	M, C
					Temperature of waste		
					Waste density		
					Waste viscosity		
					Sampling	Sampling	M
					Waste characterization		
					Solids level	Solids level	M

Table A-2b. Low-Activity Waste Process Control Strategy Prepare Waste Function Control Variable Consideration for Future Development. (4 Sheets)

Flowsheet/Process Step	DST 2nd Tier Function	DST 3rd Tier Function	DST 4th Tier Function	Associated Process Concerns	Potential Control Variables (examples)	Choice of Variable(s) to be Controlled	Monitor/ Control
		Prepare LAW in LAW staging tanks - Sample prepared LAW	Sample prepared LAW	Waste is not sampled at representative location	Sample locations	Sample locations	M, C
					Lateral distribution of risers	Lateral distribution of risers	M
				Diluent flow rate for transfer	Diluent flow rate	Diluent flow rate	M, C
					Flow rate of metering pump	Flow rate of metering pump	M, C
				Special distribution of solids	Sampling	Sampling	M, C

Table A-3b. Low-Activity Waste Process Control Strategy Transfer Waste Function Control Variable Consideration for Future Development. (5 Sheets)

Flowsheet/Process Step	DST 2nd Tier Function	DST 3rd Tier Function	DST 4th Tier Function	Associated Process Concerns	Potential Control Variables (examples)	Choice of Variable(s) to be Controlled	Monitor/ Control
Transfer LAW	Transfer LAW cross site/transfer waste to intermediate/LAW staging tanks and to LAW/HLW plant	Establish transfer route for waste transfer	Position valves for transfer Monitor valve position	Assure valves are in the proper alignment for transfer	Leak detection	Leak detection	M, C
					Valve positioning	Valve positioning	M, C
				Assure connecting piping is isolated by 2 closed valves	Valve positioning	Valve positioning	M, C
				Assure valve position remains correct during transfer	Leak detection	Leak detection	M, C
					Valve positioning	Valve positioning	M, C
					Tank liquid level	Tank liquid level	M
					Waste flow rate		
					Material balance		
					Line pressure	Line pressure	M
		Confine waste along transfer route	Confine waste within DST transfer piping Continue waste within valve manifolds and jumpers	Assure there are no leaks in the primary piping	Leak detection	Leak detection	M, C
					Valve positioning		
					Tank liquid level	Tank liquid level	M
					Waste flow rate		
					Material balance	Material balance	M
					Line pressure	Line pressure	M
					Encasement leak detection	Encasement leak detection	
				Assure there are no leaks in valve manifolds or jumpers	Leak detection	Leak detection	M, C
					Valve positioning		
					Tank liquid level	Tank liquid level	M
					Waste flow rate	Waste flow rate	M, C
					Material balance	Material balance	M

Table A-3b. Low-Activity Waste Process Control Strategy Transfer Waste Function Control Variable Consideration for Future Development. (5 Sheets)

Flowsheet/Process Step	DST 2nd Tier Function	DST 3rd Tier Function	DST 4th Tier Function	Associated Process Concerns	Potential Control Variables (examples)	Choice of Variable(s) to be Controlled	Monitor/ Control
		Provide diluent during transfers	Deliver caustic/diluent to transfer associated structures Deliver diluent/flush water to transfer pump suction Confine diluent within valve manifolds and jumpers Confine diluent/flush water within DST transfer piping	Assure that the correct amount of diluent is delivered	Metering pump flow rate	Metering pump flow rate	M, C
					Diluent supply flow rate	Diluent supply flow rate	M, C
					Line pressure		
					Material balance	Material balance	M
					Waste flow rate		
				Assure that the correct amount of diluent is delivered to the transfer pump suction	Metering pump flow rate	Metering pump flow rate	M, C
					Diluent supply flow rate	Diluent supply flow rate	M, C
					Material balance	Material balance	M
				Assure there are no leaks in valve manifolds or jumpers	Leak detection	Leak detection	M, C
					Valve positioning	Valve positioning	M, C
					Tank liquid level	Tank liquid level	M
					Waste flow rate		
					Material balance	Material balance	M
				Assure there are no leaks in the primary piping	Leak detection	Leak detection	M, C
					Valve positioning		
					Tank liquid level	Tank liquid level	M
					Waste flow rate		
					Material balance	Material balance	M
					Line pressure		
		Convey waste	Position transfer pump suction intake	Assure waste concentration is within transfer and specification parameters	Sampling	Sampling	M
					Pump suction elevation	Pump suction elevation	M, C
					Waste concentration profile		

Table A-3b. Low-Activity Waste Process Control Strategy Transfer Waste Function Control Variable Consideration for Future Development. (5 Sheets)

Flowsheet/Process Step	DST 2nd Tier Function	DST 3rd Tier Function	DST 4th Tier Function	Associated Process Concerns	Potential Control Variables (examples)	Choice of Variable(s) to be Controlled	Monitor/ Control
					Sludge layer interface elevation	Sludge layer interface elevation	M
					Solids settling rate		
Transfer LAW	Transfer LAW cross site/transfer waste to intermediate/LAW staging tanks and to LAW/HLW plant		Confine waste in transfer pump Monitor transfer pump operation Monitor position of transfer pump suction Monitor process parameters for waste transfers	Transfer pump failure	Sludge layer interface elevation		
					Solids settling rate		
					Pump discharge pressure	Pump discharge pressure	M
					Pump suction location	Pump suction location	M, C
					Pump power	Pump power	M
					Pump rotational speed		
					Pump motor amperage		M
					Pump bearing temperature		
					Seal water flow		
					Pump specific operating parameters	Pump specific operating parameters	M
					Waste properties		
				Avoid gelling, salt precipitation, and solids settling	Mixing time	Mixing time	M, C
					Waste characterization	Waste characterization	M
					Solids settling time		
					Sampling		
				Assure there are no leaks in transfer pump or jumpers	Transfer pit leak detection	Transfer pit leak detection	M
					Material balance	Material balance	M

Table A-3b. Low-Activity Waste Process Control Strategy Transfer Waste Function Control Variable Consideration for Future Development. (5 Sheets)

Flowsheet/Process Step	DST 2nd Tier Function	DST 3rd Tier Function	DST 4th Tier Function	Associated Process Concerns	Potential Control Variables (examples)	Choice of Variable(s) to be Controlled	Monitor/ Control
				Assure transfer pump will not cavitate	Pump discharge pressure	Pump discharge pressure	M
					Pump suction location	Pump suction location	M, C
					Pump power	Pump power	M
					Pump rotational speed		
					Pump motor amperage	Pump motor amperage	M
					Pump bearing temperature		
					Seal water flow		
					Pump specific operating parameters	Pump specific operating parameters	M
				Assure that transfer lines will not get plugged during transfer	Change in differential pressure in transfer lines	Change in differential pressure in transfer lines	M
					Pump discharge pressure	Pump discharge pressure	M
					Waste SpG		
					Flow rate	Flow rate	M, C
		Confine waste leakage along transfer route	Confine waste leakage within secondary containment piping Monitor for DST transfer pipe leakage	Assure no waste leaks from transfer pipe into the environment	Line pressure		
					Waste flow rate	Waste flow rate	M
					Encasement leak detection	Encasement leak detection	M
					Waste transfer	Waste transfer	C
					Leak detection - line	Leak detection - line	M, C
					Material balance	Material balance	M

Table A-3b. Low-Activity Waste Process Control Strategy Transfer Waste Function Control Variable Consideration for Future Development. (5 Sheets)

Flowsheet/Process Step	DST 2nd Tier Function	DST 3rd Tier Function	DST 4th Tier Function	Associated Process Concerns	Potential Control Variables (examples)	Choice of Variable(s) to be Controlled	Monitor/ Control
Transfer LAW	Transfer LAW cross site/transfer waste to intermediate/LAW staging tanks and to LAW/HLW plant		Confine waste leakage within transfer associated structures Monitor for leaks in transfer associated structures	Assure no waste leaks from transfer associated structures into the environment	Line pressure		
					Encasement leak pit liquid level	Encasement leak pit liquid level	M
					Waste transfer	Waste transfer	C
					Leak detection - line	Leak detection - line	M, C
					Material balance	Material balance	M
		Flush transfer system	Deliver flush waste to transfer associated structures Confine flush water within valve manifolds and jumpers Confine flush water within DST transfer piping Deliver flush water to transfer pump suction	Leak of contaminated flush water	Line pressure	Line pressure	M, C
					Leak detection - line	Leak detection - line	M
					Limit flush volume	Limit flush volume	C
				Flush water misrouted	Valve position	Valve position	M, C
		Drain transfer piping		Misrouting of residual waste	Valve position	Valve position	M, C
		Perform material balance for DST transfers		Material balance discrepancy	Tank liquid level	Tank liquid level	M
					Material balance calc.	Material balance calc.	M
		Reconfigure transfer route	Position valves for offline service	Assure no accidental startup of the transfer pump will result in a waste misrouting	Transfer pump lockout	Transfer pump lockout	C
			Monitor valve position	Assure that all waste transferred has been received	Material balance	Material balance	M

APPENDIX B

PROCESS CONTROL STRATEGY LOGIC DIAGRAM

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APPENDIX C

LOW-ACTIVITY WASTE PROCESS CONTROL STRATEGY TASK TEAM DECISIONS MEETINGS MINUTES

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FOSTER WHEELER ENVIRONMENTAL CORPORATION

April 16, 2000
FWRD-ADM-00-024

Tom Conrads,
CH2M Hill Hanford Group, Inc.
P.O. Box 1500
MS R3-73
Richland, WA 99352

SUBJECT: LAW AND HLW PROCESS CONTROL STRATEGY TASK TEAM DECISIONS MEETINGS MINUTES

Dear Mr.Conrads:

Attached are the results of a series of meetings held on 2/10/00, 2/14/00, and 2/22/00 to resolve key issues which have arisen during the production of the LAW/HLW process control strategy logic drawings. The purpose of this letter is to document these decisions as a basis for formalizing parts of the Process Control Strategy (PCS). Attendees on 2/10/00 included C. Grenard, T. Staehr, P.E., R. Bafus, R. Orme, D. Tulberg, P.E., C. Weingardt and M. Dippre, P.E. Attendees on 2/14/00 included T. Staehr, R. Bafus, R. Orme, C. Weingardt, and M. Dippre. Attendees on 2/22/00 included C. Grenard, T. Staehr, R. Bafus, R. Orme, C. Weingardt, and M. Dippre. The resolved issues will be integrated into the PCS Logic drawings.

Please contact me at (425) 688-3749 or Connie Weingardt at (509) 373-0000 if you have any questions or concerns regarding these documents.

Sincerely,

for

D. Mark Gerboth, P.E.
Western Region Engineering Manager
Foster Wheeler Environmental Corporation

DMG/jbw

Attachment(s)

cc: Dean Tulberg
Marc Dippre
Connie Weingardt
Charles Grenard

3200 George Washington Way, Suite G, Richland, WA 99352
Tel: 509-372-5800 Fax: 509-372-5801

The resolutions of issues from these meetings are grouped according to the Functional Analysis 2nd Tier breakdowns:

Store Waste (LAW / HLW):

1. The air lift circulators are not planned to be maintained operable for WFD. The reference to them as a method for controlling tank and waste temperature should be deleted.
2. References to the specific thermocouple locations for measuring tank or waste temperature should be avoided and will be part of the Process Control Plan (future).
3. A distinction should be made between supernate and sludge temperature, since they can be significantly different and are measured separately.
4. A basis for monitoring tank headspace temperature should be documented, if available. (Note: author cannot find a reference to support this measurement, therefore deleted).
5. The ventilation system parameters should be shown as a unit input to the store function. Hence, annulus temperature, radioactivity release, and LFL are now replaced with a "Ventilation System Operational" block input to the "Store Waste Function Enabled".
6. There is an administrative check on the dp between the annulus and tank headspace. This will be taken account by the "Tank Hydrostatic Pressure OK" decision, shown as an operator input/decision since it is a manual calculation.
7. The administrative decision for "waste temperature rate of rise" should be relocated to below the block for "tank concrete temperature".
8. The administrative decision block for "tank liquid level constant" should only be made when preparation or transfer functions are not occurring, as these operations would disturb the liquid levels significantly.
9. The decision block for "GRE bubble possible" should be changed to "Vapor bubble possible" for HLW, and changed to a manual decision, which requires an adjustment to ventilation if the possibility exists. The "GRE bubble possible" for LAW should remain unchanged.
10. In the PCS logic decision block for "Primary liquid leak detection", remove "Primary". Also, delete the decision block for "Leak tolerable".
11. Remove the decision block for "Offgas FID VOC >xppm", as there is currently no requirement for this control variable.
12. An administrative decision block for "Chemical composition OK" should be shown as an input to the "Store Waste Function Enabled". The unacceptable condition should indicate "Adjust chemical composition of tank".

Prepare Waste:

LAW / HLW:

1. Show an administrative decision block for "Adjust Primary Ventilation" before the "Ramp up mixer pump VFD", as the ventilation will possibly be adjusted before ramping up the mixer pump.

2. Remove mixer pump parameters which may be specific to only certain types of mixer pumps, including pump column water pressure, motor bearing temperature, pump shaft vibration, and pump column filter dp. Lump these variables as a manual decision for "Mixer pump specific operation parameters OK".
3. Remove the decision block for "In-tank component deflection OK per CCTV", and associated adjustments for mixer pump speed and jet angle.
4. In-tank dilution (if required) should be shown as an option, any time during the "Prepare" function, regardless of mixer pump operation.
5. Flushing of the mixer pump should not be shown, as the available volume of flush water would be insignificant in the current configuration.
6. The administrative decision for "Re-Perform mixing" should be changed to "Perform additional mixing" to imply that improved mobilization or homogenization could be expected by this repetition.
7. A manual operation for "Bump mixer pump periodically" should be shown during the "Settle solids in source tank" process.

HLW only:

1. For the manual decision block "ECR OK per thermocouples or strain gauges", delete the portion "per thermocouples or strain gauges". The Process Control Plan (future) will determine which instrumentation methodology will be used.

LAW only:

1. The decision block for "Storage time adequate" during "Store Diluted Supernate in Staging Tank" should be deleted.
2. An administrative decision block for "Settling Time Adequate" should be shown just before "Settle Solids in Source Tank".
3. An administrative decision block for "In-tank dilution" should be shown just before the process block for "Settle Solids in Source Tank". This would allow re-dilution of the solids in the source tank, if sampling indicates the necessity.

<u>Transfer Waste:</u>

LAW/HLW:

1. The operation of the mixer pump for suspension of the waste before transfer should show an option for turning the mixer pump off.
2. An in-line dilution option shown is for the purposes of transfer line preheating. This option should be available in parallel with the operation of the mixer pump.
3. An option for in-line dilution should be shown after "Start transfer pump".
4. A configuration check for bypassing the transfer pump during transfer line preheating should be shown.
5. An administrative decision block for recirculating the transfer pump discharge during initial in-line dilution should be shown. A PLC logic check for flow volume ratios and a manual check for densitometer readings should be shown as a permissive for opening the recirculation valve to the transfer line.
6. A configuration check during in-line dilution for preheating should include "preheat water arrives at PC within x minutes".

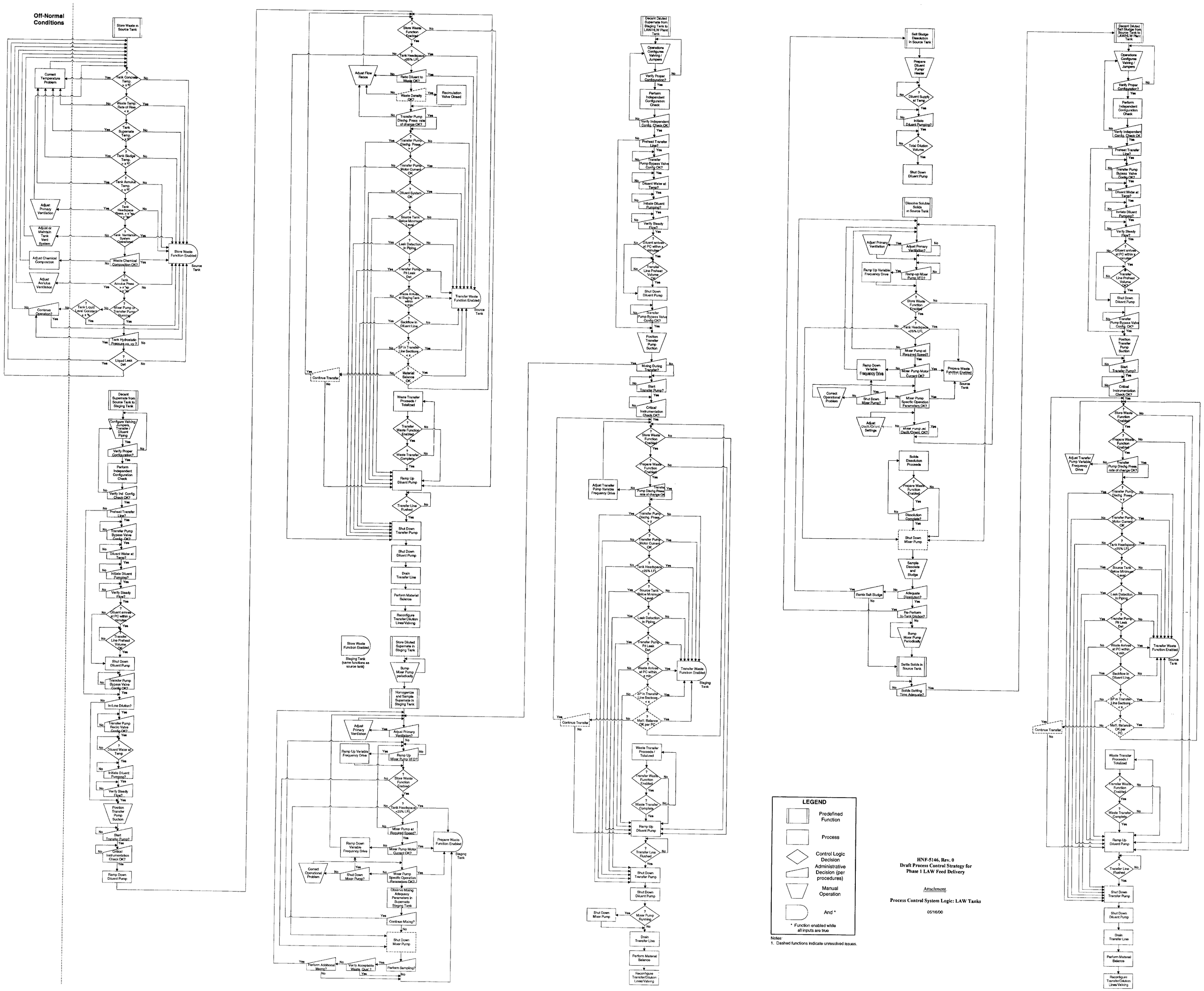
7. The operation "Drain transfer line" after shutdown of transfer pump should be shown.
8. The operation "Reconfigure transfer/dilution lines" should be shown after waste transfer is complete.
9. Flushing of the mixer pump should not be shown, as the available volume of flush water would be insignificant in the current configuration.
10. Shutdown of the transfer pump without line flushing should be shown for the condition of diluent line backflow.
11. The transfer pump operation should be shown as disabled when doing a direct diluent flush of the transfer line.
12. An administrative decision should be shown for transfer line preheating, with preheating defined as complete when a predetermined volume of preheat water is pumped.
13. The manual operation "Position Transfer Pump" should indicate "Position Transfer Pump Suction", and be located immediately before "Start Transfer Pump".
14. The check for "Transfer pump discharge pressure OK" should be changed to an administrative decision block indicating "Transfer pump discharge pressure rate of change OK".
15. The PLC logic decision block for determining when flushing of the transfer line begins should indicate "Flush volume remains", upon which the diluent pump ramps up.
16. A PLC logic permissive for transfer enable should be added for "minimum waste level in source tank exceeded". If the minimum tank level is exceeded, the system should immediately begin a normal shutdown with transfer line flushing.

LAW only:

1. After sludge dissolution in the source tanks, the waste is allowed to settle and decanted to the PC tank. There is no staging tank for dissolved sludge.
2. An option should be shown for operating the mixer pump during the process "Decant diluted supernate from Staging Tank to PC Tank".

The unresolved issues remain as follows. These issues are shown as dashed blocks on the logic diagrams:

1. The parameters, which define adequate mixing, remain undefined.
2. The time, which is allowable between waste sampling and transfer, remains undefined. If adequate mixing can be defined, then remixing would solve this question.
3. It is uncertain whether sampling of the tank waste will be implemented during mixer pump operation, as complex technology would have to be developed. Thus, the option of shutting down the mixer pump before sampling is shown as tentative.
4. Does the in-tank diluent water (if used) need to match the waste temperature to any extent? Since diluent water may be added for cooling purposes, the temperatures may be considerably different. The addition of relatively cold water may impact the concrete rate-of-rise criteria.
5. The check for material balance during waste transfer as an operator decision is tentative. The ICD requirements, which determine an agreeable material balance, are uncertain at this time.



Notes:
1. Dashed functions indicate unresolved issues.

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Draft Process Control Strategy for Phase 1 LAW Feed Delivery

Attachment

Process Control System Logic: LAW Tanks

05/16/00

APPENDIX D

LOW-ACTIVITY WASTE PROCESS CONTROL STRATEGY UNRESOLVED ISSUES

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Low-Activity Waste Process Control Strategy Unresolved Issues. (2 Sheets)

Issue No.	Functional Analysis Reference	Unresolved Issue
1	• Prepare Waste	Instrumentation to monitor waste homogeneity and solids concentration has not been proven at the Hanford Site. Without these instruments, additional samples will have to be taken to determine mixer pump effectiveness. The mixer pump test in Tank 241-AZ-101 should be performed as soon as possible to mitigate this risk.
2	• Prepare Waste • Prepare Waste in West/East Area DSTs • Dissolve Soluble Waste - Dissolve Salts • Mobilize Solids in LAW Source Tanks with Mixer Pump	The parameters that define adequate mixing remain undefined. It is uncertain that current instrumentation will be sufficient to measure these parameters.
3	• Prepare Waste • Prepare Waste in West/East Area DSTs • Dissolve Soluble Waste – Sample Prepared LAW	The time that is allowable between waste sampling and transfer remains undefined. If adequate mixing can be defined, then remixing may potentially solve this question.
4	• Prepare Waste • Prepare Waste in West/East Area DSTs • Dissolve Soluble Waste - Sample Prepared LAW	The allowable duration from the time the mixer pump is shut off until the sample is pulled has not been determined.
5	• Prepare Waste • Prepare Waste in West/East Area DSTs • Dissolve Soluble Waste - Dissolve Salts • Dissolve Salts in Source Tank	Does the in-tank diluent water (if used) need to match the waste temperature to any extent? Because diluent water may be added for cooling purposes, the temperatures may be considerably different. The addition of relatively cold water may impact the concrete rate-of-rise criteria.
6	• Transfer Waste • Transfer Waste Cross-Site • Transfer Waste to Intermediate/LAW Staging Tanks and to LAW/HLW Plant • Perform Material Balance for DST Transfers	The check for material balance during waste transfer as an operator decision is tentative. The ICD requirements that determine an agreeable material balance are uncertain at this time. The existing requirement for source tank level agreement with destination tank level is likely to be inaccurate because of gas release, crust presence, and in-line dilution. Consideration should be given to changing the requirement to transfer pump volumetric flowmeter/totalizer agreement with destination tank level changes. This method would eliminate several uncertainties.

Low-Activity Waste Process Control Strategy Unresolved Issues. (2 Sheets)

Issue No.	Functional Analysis Reference	Unresolved Issue
7	• Transfer Waste • Transfer Waste Cross-Site • Transfer Waste to Intermediate/LAW Staging Tanks and to LAW/HLW Plant • Convey Waste • Monitor Process Parameters for Waste Transfers	Will a densitometer be used as an administrative control variable to determine whether transferred waste is within solids concentration specifications?
8	• Transfer Waste • Transfer Waste Cross-Site • Transfer Waste to Intermediate/LAW Staging Tanks and to LAW/HLW Plant • Convey Waste • Monitor Process Parameters for Waste Transfers	A method for indicating line pluggage has not been determined. For example, PNNL recommended observing variations in differential pressure changes in line sections during transfers.
9	• Transfer Waste	What administrative controls exist to ensure that waste transfers will consider the impact of adding supernatant to tanks containing heels of different envelope types?
10	• Transfer Waste	The crust in Tanks 241-AN-103, -104, -105, 241-AW-101, and 241-SY-103 are 1 ft to 3 ft thick and have the potential to cause structural damage to the tank walls, floors, and in-tank components when liquid is removed from beneath them. The crust behavior could potentially be monitored with CCTV. Hold-points in these cases should be a part of the process control strategy during supernatant removal.
11	• Transfer Waste • Transfer Waste to Intermediate/LAW Staging Tanks and to LAW/HLW Plant • Establish Transfer Route	The procedure for verifying valve configuration between DOE and BNFL facilities needs to be discussed, agreed upon, and placed into the ICDs. This procedure may involve signatories from both parties verifying their respective facility valve configurations since neither party will have full access to the transfer route.

CCTV = closed-circuit television.
BNFL = BNFL Inc.
DOE = U.S. Department of Energy.
DST = double-shell tank.
HLW = high-level waste.
ICD = interface control document.
LAW = low-activity waste.
PNNL = Pacific Northwest National Laboratory.

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