S

# ENGINEERING CHANGE NOTICE



1. ECN 644520

Proj. ECN

| 2. ECN Category (mark one) | 3. Originator's Name, Organization, MSIN, and Telephone No. | 4. USQ Required? | 5. Date |
|---|---|---|---|
| Supplemental []<br>Direct Revision [X]<br>Change ECN []<br>Temporary []<br>Standby []<br>Supersedure []<br>Cancel/Void [] | CE Graves, Plant Support Engrg, R3-73, 376-5235 | [] Yes [X] No | December 15, 2000 |
| | 6. Project Title/No./Work Order No.<br>RPP/WFD | 7. Bldg./Sys./Fac. No.<br>Tank Farms | 8. Approval Designator<br>ESQ |
| | 9. Document Numbers Changed by this ECN (includes sheet no. and rev.)<br>HNF-4160, Rev. 0 and HNF-4161, Rev. 0 | 10. Related ECN No(s).<br>NA | 11. Related PO No.<br>NA |

| 12a. Modification Work | 12b. Work Package No. | 12c. Modification Work Complete | 12d. Restored to Original Condition (Temp. or Standby ECN only) |
|---|---|---|---|
| [] Yes (fill out Blk. 12b)<br>[X] No (NA Blks. 12b, 12c, 12d) | NA | NA<br>Design Authority/Cog. Engineer Signature & Date | NA<br>Design Authority/Cog. Engineer Signature & Date |

13a. Description of Change

13b. Design Baseline Document? [X] Yes [] No

See page 3 for list of sections to be changed in each specification.

| 14a. Justification (mark one) | 14b. Justification Details |
|---|---|
| Criteria Change [X]<br>Design Improvement []<br>Environmental []<br>Facility Deactivation []<br>As-Found []<br>Facilitate Const. []<br>Const. Error/Omission []<br>Design Error/Omission [] | This ECN incorporates DST Transfer Valving and Piping Subsystem specification changes detailed in RPP-7011, *DST Subsystem Specification/Project Media Baseline Comparison Summary Report*, as agreed to by the Baseline Comparison team. Pressure and flow rate values have been updated to the revised values in Rev. 1 of RPP-5346, *Waste Feed Delivery Transfer System Analysis*. Procedure references and boilerplate text are also updated. |

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

See Distribution List

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A-7900-013-2 (10/97)

| ENGINEERING CHANGE NOTICE | Page 2 of 3 | 1. ECN 644520 |
|---|---|---|

| 16. Design Verification Required | 17. Cost Impact | | | | 18. Schedule Impact (days) | |
|---|---|---|---|---|---|---|
| | ENGINEERING | | CONSTRUCTION | | | |
| [] Yes | Additional | [] $ NA | Additional | [] $ NA | Improvement | [] NA |
| [X] No | Savings | [] $ | Savings | [] $ | Delay | [] _____ |

19. Change Impact Review: Indicate the related documents (other than the engineering documents identified on Side 1) that will be affected by the change described in Block 13. Enter the affected document number in Block 20.

| | | | | | |
|---|---|---|---|---|---|
| SDD/DD | [] | Seismic/Stress Analysis | [] | Tank Calibration Manual | [] |
| Functional Design Criteria | [] | Stress/Design Report | [] | Health Physics Procedure | [] |
| Operating Specification | [] | Interface Control Drawing | [] | Spares Multiple Unit Listing | [] |
| Criticality Specification | [] | Calibration Procedure | [] | Test Procedures/Specification | [] |
| Conceptual Design Report | [] | Installation Procedure | [] | Component Index | [] |
| Equipment Spec. | [] | Maintenance Procedure | [] | ASME Coded Item | [] |
| Const. Spec. | [] | Engineering Procedure | [] | Human Factor Consideration | [] |
| Procurement Spec. | [] | Operating Instruction | [] | Computer Software | [] |
| Vendor Information | [] | Operating Procedure | [] | Electric Circuit Schedule | [] |
| OM Manual | [] | Operational Safety Requirement | [] | ICRS Procedure | [] |
| FSAR/SAR | [] | IEFD Drawing | [] | Process Control Manual/Plan | [] |
| Safety Equipment List | [] | Cell Arrangement Drawing | [] | Process Flow Chart | [] |
| Radiation Work Permit | [] | Essential Material Specification | [] | Purchase Requisition | [] |
| Environmental Impact Statement | [] | Fac. Proc. Samp. Schedule | [] | Tickler File | [] |
| Environmental Report | [] | Inspection Plan | [] | None | [X] |
| Environmental Permit | [] | Inventory Adjustment Request | [] | _____ | [] |

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

| Document Number/Revision | Document Number/Revision | Document Number Revision |
|---|---|---|
| NA | | |

21. Approvals

| | Signature | | Date | | Signature | Date |
|---|---|---|---|---|---|---|
| Design Authority RW Reed | RW Reed | R3-83 | 16 Jan 2001 | Design Agent | | |
| Cog. Eng. CE Graves | C.E. Graves | R3-73 | 01/15/01 | PE | | |
| Cog. Mgr. TJ Conrad | T.J. Conrad | R3-73 | 1/16/01 | QA | | |
| QA WL Adams | W.L. Adams | S5-11 | 1/17/01 | Safety | | |
| Safety/Licensing JP Harris | J.P. Harris | R1-49 | 1-17-01 | Design | | |
| Environ. KS Tollefson | KS Tollefson | R1-51 | 1/17/01 | Environ. | | |
| Other | | | | Other | | |
| CE Grenard | Charles E. Grenard | R3-73 | 1/15/01 | | | |

DEPARTMENT OF ENERGY

Signature or a Control Number that tracks the Approval Signature

ADDITIONAL

**Changes to HNF-4160, *DST Transfer Valving Subsystem Specification***

Revise these Sections per Appendix L in RPP-7011:

| | | | | |
|---|---|---|---|---|
| 3.1.2.1.1.a | 3.1.2.1.7.a | 3.2.1.7.1.a | 3.3.1.e | 3.5.1.f |
| 3.1.2.1.2.a | 3.1.2.1.8.a | 3.2.1.7.2.a* | 3.3.1.m | 3.5.1.g |
| 3.1.2.1.2.b | 3.2.1.2.1.a | 3.2.1.8.a | 3.3.3.b | 3.5.2.a |
| 3.1.2.1.3.a | 3.2.1.4.a* | 3.2.1.9.b | 3.3.3.d | |
| 3.1.2.1.4.a | 3.2.1.4.c* | 3.2.1.11.a | 3.3.6.1.c | |
| 3.1.2.1.6.a | 3.2.1.5.a* | 3.2.2.b | 3.4.a | |

Delete these Sections per Appendix L in RPP-7011:

| | | | | |
|---|---|---|---|---|
| 3.2.1.3.c | 3.2.1.9.a | 3.2.1.12.a | 3.2.1.13.a | 3.5.1.e |

Update procedure references in Sections 3.3.6.1.a, 3.3.6.3.a, and 3.4.b.

Update boilerplate text (for consistency amongst Subsystem specifications).

Update Section 3.1 (including Table 3-1 and 3-2) to match subfunctions in Rev. 1 of HNF-4155.

Update Table 2-1, Table 2-2, Section 7.0, and Appendix A to reflect the above changes/deletions.

**Changes to HNF-4161, *DST Transfer Piping Subsystem Specification***

Revise these Sections per Appendix L in RPP-7011:

| | | | | |
|---|---|---|---|---|
| 3.1.2.1.1.a | 3.2.1.1.a* | 3.2.2.b | 3.3.6.2.a | 3.5.2.a |
| 3.1.2.1.1.b | 3.2.1.3.a | 3.3.1.a | 3.4.a | |

Update procedure references in Sections 3.3.6.1.a, 3.3.6.3.a, and 3.4.b.

Update boilerplate text (for consistency amongst Subsystem specifications).

Update Table 2-1, Table 2-2, and Appendix A to reflect the above changes/deletions.

* Update to use new pressure and/or flow rate value(s) in Rev. 1 of RPP-5346.

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| A. F. Choho | R2-50 | X | | | |
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| A. H. Friberg | R1-56 | X | | | |
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| K. S. Tollefson | R1-51 | X | | | |
| R. P. Tucker | S5-07 | X | | | |
| K. A. White | R3-47 | X | | | |

# Double-Shell Tank Transfer Piping Subsystem Specification

**Carolyn E. Graves**
Fluor Federal Services
Richland, WA 99352
U.S. Department of Energy Contract DE-AC06-99RL-14047

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

Abstract:

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

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HNF-4161
Revision 1

# Double-Shell Tank Transfer Piping Subsystem Specification

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

**CH2MHILL**
*Hanford Group, Inc.*
Richland, Washington

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

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HNF-4161
Revision 1

# Double-Shell Tank Transfer Piping Subsystem Specification

Prepared by:
C. E. Graves
W. T. Susiene

Date Published
January 2001

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

CH2MHILL
*Hanford Group, Inc.*

P. O. Box 1500
Richland, Washington

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

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# 1.0 SCOPE

## 1.1 DESCRIPTION

This specification establishes the performance requirements and provides references to the requisite codes and standards to be applied during design of the Double-Shell Tank (DST) Transfer Piping Subsystem that supports the first phase of waste feed delivery. This subsystem transfers waste between transfer-associated structures (pits) and to the River Protection Project (RPP) Waste Treatment Plant where it will be processed into an immobilized waste form.

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

## 1.2 CLASSIFICATION

Not applicable.

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# 2.0 APPLICABLE DOCUMENTS

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

## 2.1 GOVERNMENT DOCUMENTS

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

Table 2-1. Government Documents.

| Document Number | Title |
|---|---|
| 10 CFR 835, 2000 | "Occupational Radiation Protection," *Code of Federal Regulations*, as amended. |
| 29 CFR 1910, 1999 | "Occupational Safety and Health Standards," *Code of Federal Regulations*, as amended. |
| 40 CFR 265, Subpart J, 1999 | "Interim Status TSD Facility Standards, Tank Systems," *Code of Federal Regulations*, as amended. |
| DOE 5820.2A, 1988 | *Radioactive Waste Management,* U.S. Department of Energy, Washington, D.C. |
| DOE 6430.1A, 1989 | *General Design Criteria,* U.S. Department of Energy, Washington, D.C. |
| WAC 173-303-640, 1999 | "Dangerous Waste Regulations," *Washington Administrative Code,* as amended. |

## 2.2 NON-GOVERNMENT DOCUMENTS

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

Table 2-2. Non-Government Documents. (3 Sheets)

| Document Number | Title |
|---|---|
| AASHTO, H20-44, 1996 | *Standard Specifications for HS-20, Highway Loading*, American Association of State Highway and Transportation Officials, Washington, D.C. |
| ASME B31.3, 1999 | *Process Piping,* American Society of Mechanical Engineers, New York, New York. |
| ASME B&PV, Section III, ND 5300, 1998 | *ASME Class 3 Components, Acceptance Standards,* American Society of Mechanical Engineers, New York, New York. |
| ASME B&PV, Section V, 1998 | *Non-Destructive Examination,* American Society of Mechanical Engineers, New York, New York. |
| ASME NQA-1, 1994 | *Quality Assurance Program Requirements for Nuclear Facilities,* American Society of Mechanical Engineers, New York, New York. |
| ASTM A312, 2000 | *Standard Specification for Seamless and Welded Austenitic Stainless Steel Pipes,* American Society for Testing and Materials, West Conshohocken, Pennsylvania. |
| HNF-2004, Rev. 1, 1999 | *Estimated Dose to In-Tank Equipment and Ground-Level Transfer Equipment During Privatization,* COGEMA Engineering Corporation for Lockheed Martin Hanford Corporation, Richland, Washington. |
| HNF-2937, Rev. 0, 1999 | *Estimated Maximum Concentration of Radionuclides and Chemical Analytes in Phase 1 and Phase 2 Transfers*, COGEMA Engineering Corporation for Lockheed Martin Hanford Corporation, Richland, Washington. |
| HNF-5183, Rev. 0, 2000 | *Tank Farms Radiological Control Manual (TFRCM)*, CH2M HILL Hanford Group, Inc., Richland, Washington. |
| HNF-IP-0842, Vol. II, Section 6.1, Rev. 0, 1999 | *RPP Administration*, "Tank Farm Operations Equipment Labeling," Lockheed Martin Hanford Corporation, Richland, Washington. |
| HNF-IP-0842, Vol. IV, Section 5.4, Rev. 12, 1999 | *RPP Administration*, "Unreviewed Safety Questions," Lockheed Martin Hanford Corporation, Richland, Washington. |
| HNF-IP-0842, Vol. IV, Section 6.9, Rev. 0, 2000 | *RPP Administration,* "Hazard and Accident Analysis Process," CH2M HILL Hanford Group, Inc., Richland, Washington. |

Table 2-2. Non-Government Documents. (3 Sheets)

| Document Number | Title |
|---|---|
| HNF-IP-0842, Vol. IV, Section 6.10, Rev. 0, 2000 | *RPP Administration,* "Safety Analysis Process – New Project," CH2M HILL Hanford Group, Inc., Richland, Washington. |
| HNF-IP-0842, Vol. IV, Section 6.11, Rev. 0, 2000 | *RPP Administration,* "Safety Analysis Process – Facility Change or Modification," CH2M HILL Hanford Group, Inc., Richland, Washington. |
| HNF-IP-0842, Vol. IV, Section 6.12, Rev. 0, 2000 | *RPP Administration,* "Safety Analysis and Technical Safety Requirements," CH2M HILL Hanford Group, Inc., Richland, Washington. |
| HNF-IP-0842, Vol. V, Section 7.3, Rev. 4d, 2000 | *RPP Administration,* "Preventive Maintenance Program," CH2M HILL Hanford Group, Inc., Richland, Washington. |
| HNF-IP-0842, Vol. VII, Section 12.4, Rev. 0, 2000 | *RPP Administration,* "Radiological Design Preview Process," CH2M HILL Hanford Group, Inc., Richland, Washington. |
| HNF-IP-0842, Vol. XI, Section 1.0, Rev. 2, 1999 | *RPP Administration*, "Quality Assurance Program," Lockheed Martin Hanford Corporation, Richland, Washington. |
| HNF-IP-1266, Chapter 5.16, Rev. 2, 1999 | *Tank Farms Operations Administrative Controls*, "Dome Loading Controls," DE&S Hanford, Incorporated for Fluor Daniel Hanford, Inc., Richland, Washington. |
| HNF-PRO-224, Rev. 3, 2000 | *Document Control Program Standards*, Fluor Hanford, Inc., Richland, Washington. |
| HNF-SD-GN-ER-501 Rev. 1, 1998 | *Natural Phenomena Hazards, Hanford Site Washington,* Numatec Hanford Corporation for Fluor Daniel Hanford, Inc., Richland, Washington. |
| HNF-SD-WM-SAR-067, Rev. 1, 1999 | *Tank Waste Remediation System Final Safety Analysis Report,* Lockheed Martin Hanford Corporation for Fluor Daniel Hanford, Inc., Richland, Washington. |
| HNF-SD-WM-TSR-006, Rev. 1, 1999 | *Tank Waste Remediation System Technical Safety Requirements,* Fluor Daniel Hanford, Inc., Richland, Washington. |
| NACE RP 0169-96, 1996 | *Control of External Corrosion on Underground or Submerged Metallic Piping Systems*, National Association of Corrosion Engineers, Houston, Texas. |

Table 2-2. Non-Government Documents. (3 Sheets)

| Document Number | Title |
|---|---|
| NACE RP 0285-95, 1995 | *Corrosion Control of Underground Storage Tank Systems by Cathodic Protection*, National Association of Corrosion Engineers, Houston, Texas. |
| RPP-5346, Rev. 1, 2001 | *Waste Feed Delivery Transfer System Analysis*, CH2M HILL Hanford Group, Inc., Richland, Washington. |
| RPP-6759, Rev. 0, 2000 | *Determination of Secondary Encasement Pipe Design Pressure*, CH2M HILL Hanford Group, Inc., Richland, Washington. |
| RPP-PRO-097, Rev. 0, 1999 | *Engineering Design and Evaluation*, CH2M HILL Hanford Group, Inc., Richland, Washington. |
| RPP-PRO-222, Rev. 0, 1999 | *Quality Assurance Records Standards*, CH2M HILL Hanford Group, Inc., Richland, Washington. |
| RPP-PRO-709, Rev. 0, 1999 | *Preparation and Control Standards for Engineering Drawings*, CH2M HILL Hanford Group, Inc., Richland, Washington. |
| RPP-PRO-1819, Rev. 0, 1999 | *Engineering Requirements*, CH2M HILL Hanford Group, Inc., Richland, Washington. |

# 3.0 REQUIREMENTS

## 3.1 SUBSYSTEM/COMPONENT DEFINITION

The DST System provides safe storage of waste products, serves as a waste processing system for waste pretreatment, and provides a staging system for delivery of waste feed to the RPP Waste Treatment Plant for waste treatment/immobilization.

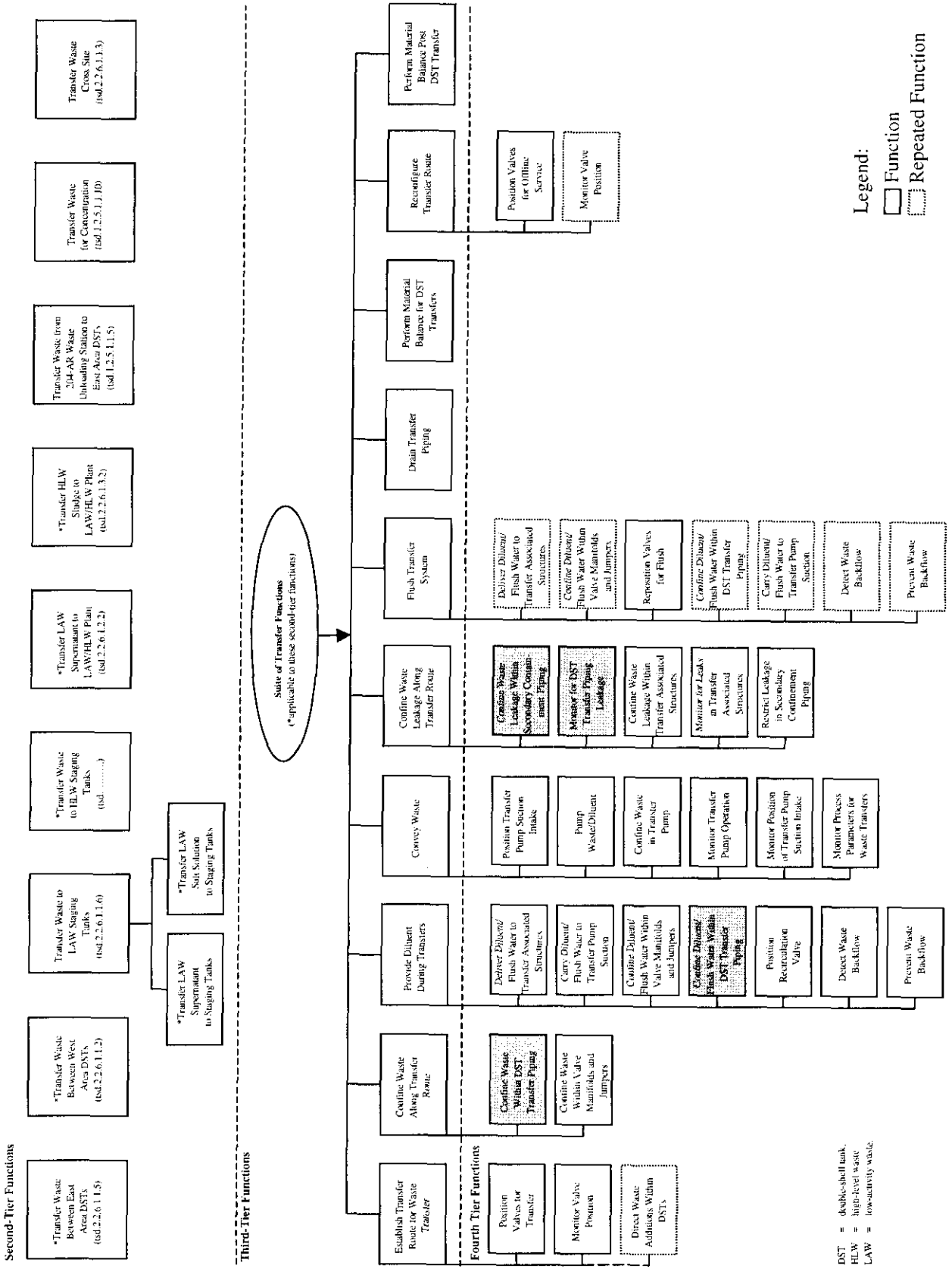
The DST system includes six tank farms containing a total of 28 DSTs. Five of the DST farms are located in the 200 East Area (241-AN, 241-AP, 241-AW, 241-AY, and 241-AZ), and one is located in the 200 West Area (241-SY). The four tanks in the 241-AY and 241-AZ tank farms are designed to store high heat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

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

The Monitor for DST Transfer Piping for Leakage function shown in Figure 3-1 is not wholly allocable to a subsystem. It therefore has been decomposed into the following subfunctions:

- Detect leak in transfer piping
- Transmit transfer piping leak signal
- Receive transfer piping leak signal
- Display leak in transfer piping
- Record transfer-associated leak status.

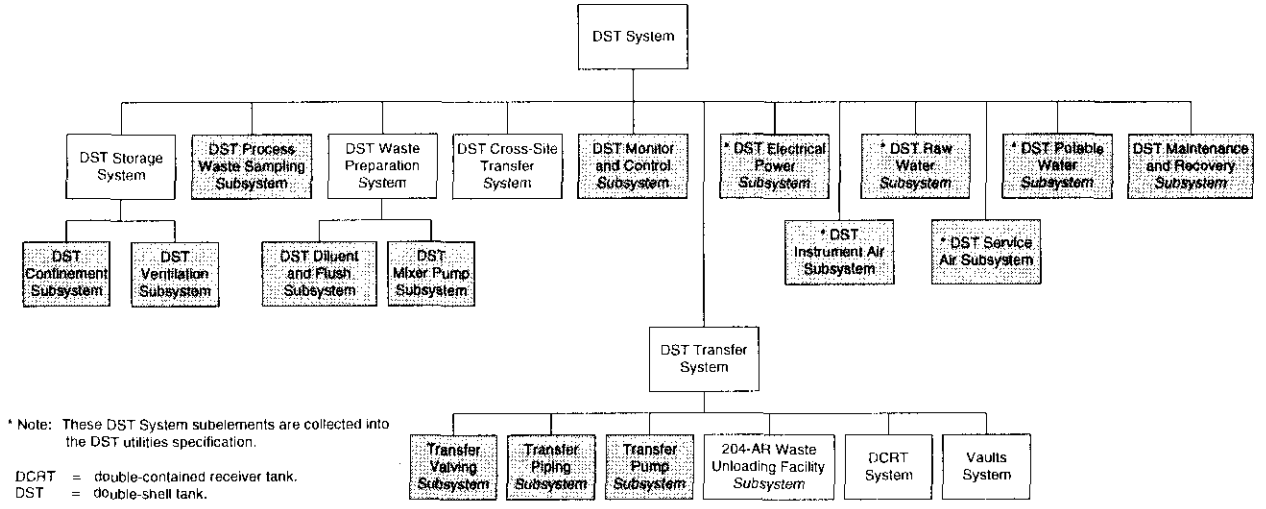
Figure 3-1. Double-Shell Tank Transfer Piping Subsystem Functional Hierarchy for Waste Transfers.



Of the above functions, only the Detect Leak in Transfer Piping subfunction applies to the DST Transfer Piping Subsystem (see Section 3.2.1.3). The "Transmit" subfunction will be allocated to the DST Transfer Piping Subsystem in the next revision of this specification as a result of ongoing Monitor and Control functional analysis revisions.

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

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




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

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

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

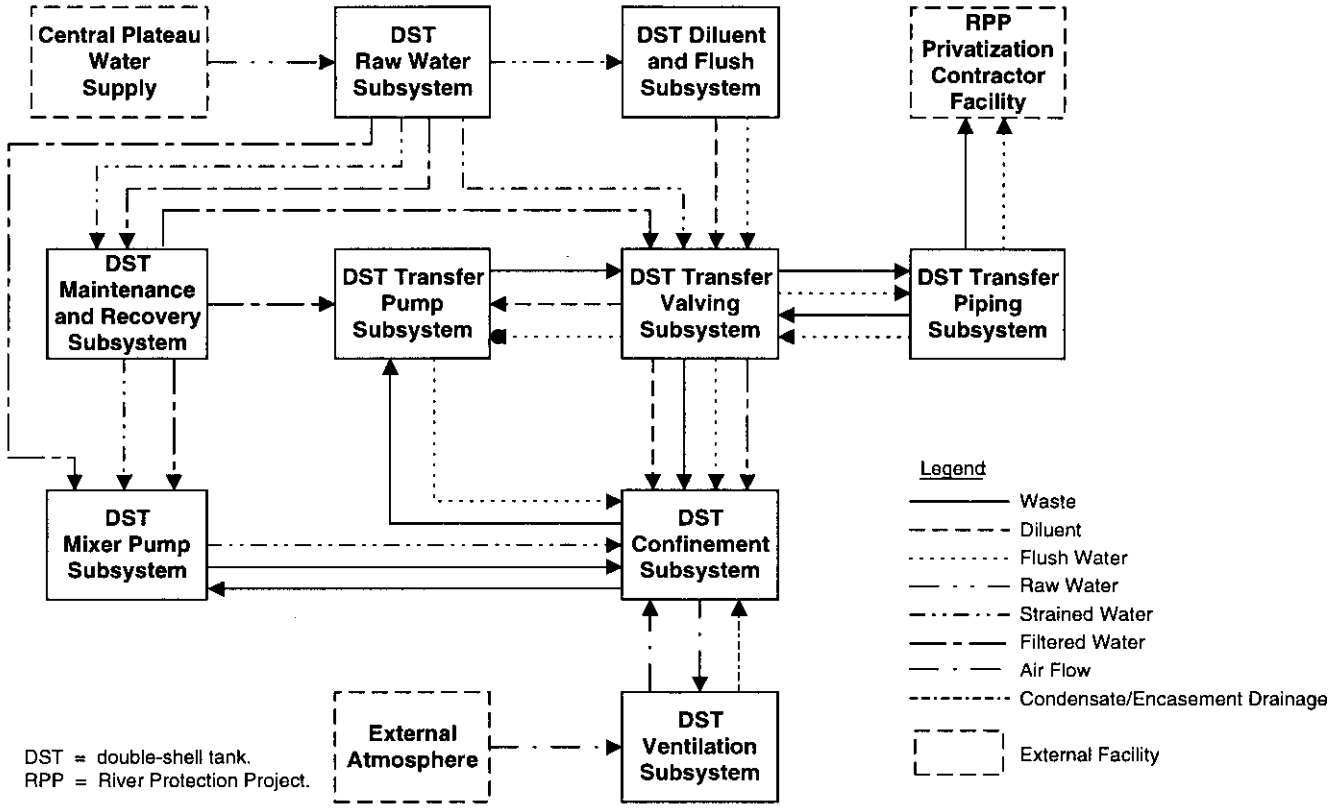
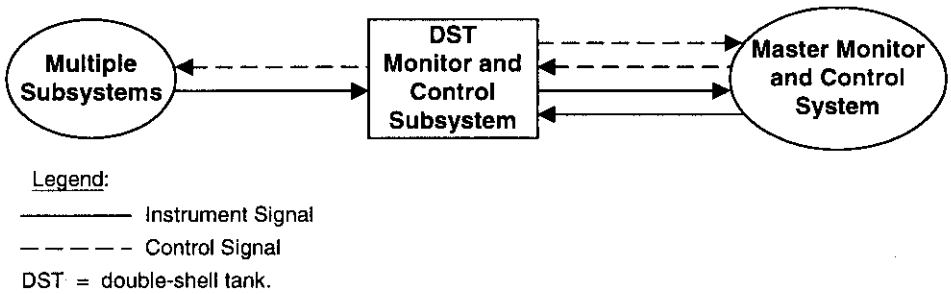



Figure 3-4. Subsystem for Double-Shell Tank Monitor and Control Subsystem Interfaces.




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

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

The DST Raw Water Subsystem filters water to remove small particles before the water is piped directly to the mixer pump and transfer valving subsystems. Filtered water is routed to the confinement subsystem via the transfer valving subsystem. Filtered water also can be routed to the mixer pump, the transfer pump, and the valve pit via the DST Maintenance and Recovery Subsystem for infrequent needs. Infrequent needs may include filling a mixer pump drive shaft and providing water to the pump seals.

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

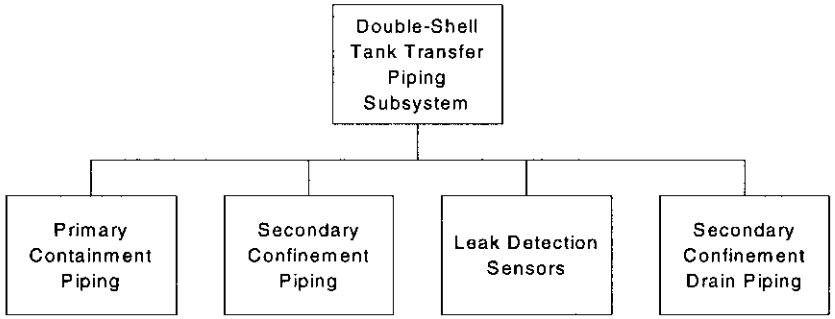
Figure 3-4 generically shows how the DST Monitor and Control Subsystem interfaces with other systems. All of the subsystems shown in Figure 3-3 provide instrument data signals to the DST Monitor and Control Subsystem. The DST Monitor and Control Subsystem transmits selected data to the Master Monitor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

### 3.1.1 Subsystem/Component Diagrams

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

- Primary containment piping
- Secondary confinement piping
- Leak detection sensors
- Secondary confinement drain piping.

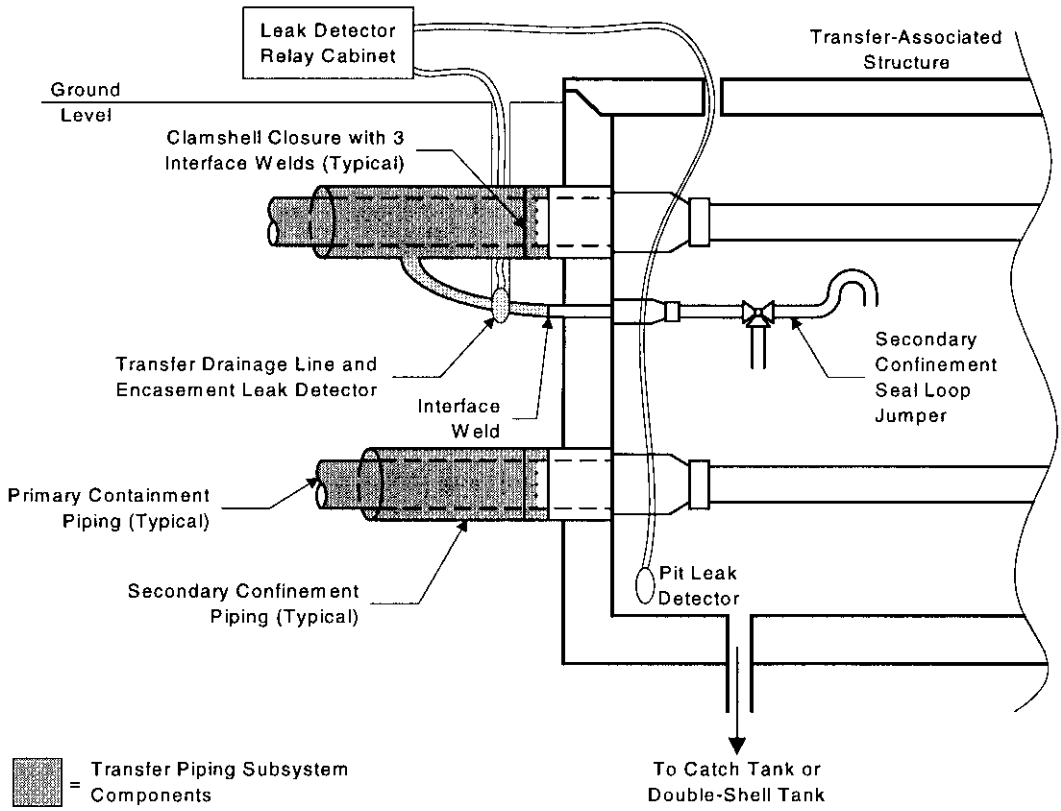
Figure 3-5. Architectural Decomposition for the Double-Shell Tank Transfer Piping Subsystem.



Waste is moved among DSTs by transfer subsystems using transfer pumps, valve manifolds, jumpers, and underground pipelines. The DST Transfer Pump Subsystem provides the motive force to move the waste through the DST Transfer Piping Subsystem as routed by the DST Transfer Valving Subsystem.

A general description of these DST Transfer Piping Subsystem elements is provided in Section 3.7. Figure 3-6 shows how these elements interface with the transfer-associated structures in the DST Transfer Valving Subsystem. The primary and the secondary confinement piping and secondary confinement drain piping extend into the pit. The DST Transfer Piping Subsystem provides a leak detection system, external to the transfer-associated structure, which is designed to detect a failure of the primary containment system or the presence of any release of dangerous waste or accumulated liquid in the secondary containment system within 24 hours.

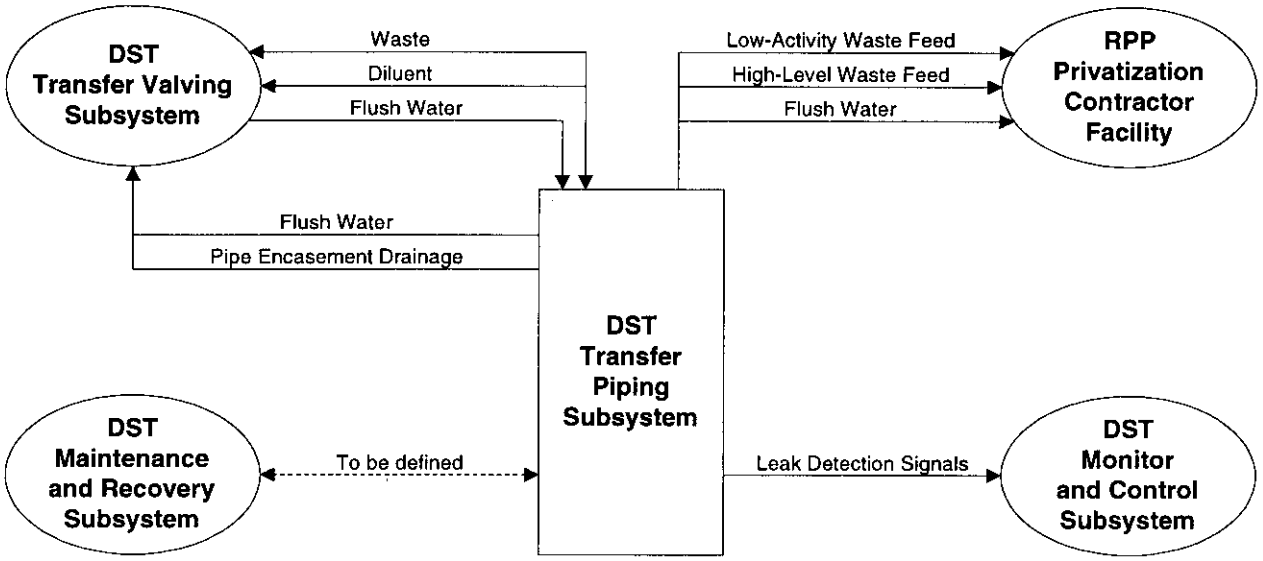
Figure 3-6. Interface Schematic for Double-Shell Tank Transfer Piping Subsystem.




### 3.1.2 Interface Definition

This section identifies the major interfaces of the DST Transfer Piping Subsystem with other systems. The interface descriptions that follow are intended to help define the subsystem boundaries. These interface relationships are illustrated in Figure 3-7. This section discusses the inputs from these interfacing systems and facilities. Outputs from the DST Transfer Piping Subsystem to other systems and facilities are discussed in Section 3.2.1.

Figure 3-7. Major Interfaces of the Double-Shell Tank Transfer Piping Subsystem.




DST = double-shell tank.
RPP = River Protection Project.

### 3.1.2.1 Functional Interfaces

**3.1.2.1.1 Double-Shell Tank Transfer Valving Subsystem.** The DST Transfer Valving Subsystem shall route waste, water, flush, or diluent to the DST Transfer Piping Subsystem.

a. The DST Transfer Piping Subsystem shall be designed to receive and transfer the waste, flush, or diluent coming from the DST Transfer Valving Subsystem at a pressure not less than the design pressure defined in Section 3.2.1.1.a.

b. The DST Transfer Piping Subsystem shall be designed such that the leak detector sensor, combined with the secondary confinement device (e.g., seal loop jumper), will detect a leak as defined in Section 3.2.1.3.a.

**3.1.2.1.2 Double-Shell Tank Maintenance and Recovery Subsystem.** The requirements for this subsystem have not been defined (TBD).

### 3.1.2.2 Physical Interfaces

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

## 3.1.3 Major Component List

Major components of the DST Transfer Piping Subsystem are listed in Section 3.1.1.

### 3.1.4 Government Furnished Property List

Not applicable.

### 3.1.5 Government Loaned Property Lists

Not applicable.

## 3.2 CHARACTERISTICS

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

### 3.2.1 Performance Characteristics

This section contains requirements related to functionality and performance capabilities for the DST Transfer Piping Subsystem.

#### 3.2.1.1 Confine Waste Within Double-Shell Tank Transfer Piping

The DST Transfer Piping Subsystem shall confine the waste within the primary containment piping.

a. The primary containment piping shall confine waste at a design pressure of >6240 kPa (>905 lbf/in$^2$).

#### 3.2.1.2 Confine Waste Leakage Within Secondary Confinement Piping

The DST Transfer Piping Subsystem shall be capable of confining waste leaked from the primary piping.

a. The secondary confinement piping design pressure shall be determined during detail design.

#### 3.2.1.3 Detect Leak in Double-Shell Tank Transfer Piping

The DST Transfer Piping Subsystem shall detect leakage from the primary confinement piping into the secondary confinement piping.

a. The leak detector sensor combined with the secondary confinement device (e.g., seal loop jumper) (from the DST Transfer Valving Subsystem) shall be designed and operated such that it will detect the failure of the primary containment or the presence of any release of

dangerous waste or accumulated liquid in the secondary containment system within 24 hours. The amount of anticipated leakage to actuate the leak detector shall be calculated during design of the system. The Washington State Department of Ecology, through the final status permitting process, may approve or disapprove the final system design.

#### 3.2.1.4 Confine Diluent/Flush Water Within Double-Shell Tank Transfer Piping

The DST Transfer Piping Subsystem shall confine diluent/flush water within the primary confinement piping.

a. The primary confinement piping shall confine the diluent/flush water at the design pressure defined in Section 3.2.1.1.a.

### 3.2.2 Physical Characteristics

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

a. Primary confinement piping should be 80 mm (3-in.) inside diameter.

b. Transfer piping shall slope continuously from the high point(s) to a transfer-associated structure(s) with a minimum slope of 0.25%.

c. The heat transfer properties of the as-installed piping subsystem shall be such that the waste heat loss is less than 25.6 joules (26.2 Btu/h per foot) of pipe at the maximum waste temperature and flow rate.

### 3.2.3 Reliability

This section contains the requirements and other features to promote reliability.

a. The DST Transfer Piping Subsystem shall have a design life of 35 years.

b. Pipe bends in the primary confinement piping should have a minimum bend radius of five pipe diameters.

### 3.2.4 Maintainability

The design shall consider the maintainability factors peculiar to the specific equipment to be used in the DST Transfer Piping Subsystem.

a. The low point leak detector sensors should be repairable or replaceable within 8 hours. Time to repair does not include preparatory work, such as preparing procedures, staging personnel and equipment, or conducting preparatory training.

b. The continuous leak detectors should be repairable or replaceable within <TBD> hours. Time to repair does not include preparatory work, such as preparing procedures, staging personnel and equipment, or conducting preparatory training.

### 3.2.5 Environmental Conditions

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

#### 3.2.5.1 Natural Environments

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

a. The subsystem shall be designed for the natural environmental conditions specified in HNF-SD-GN-ER-501.

b. The subsystem shall be designed to withstand the natural phenomena hazards as specified in RPP-PRO-097.

#### 3.2.5.2 Induced Environments

This section defines the induced environment impinging on the subsystem including waste chemistry, radiation, and waste properties.

**3.2.5.2.1 Chemistry.** The subsystem components shall be designed to perform their intended function in the chemical environment defined in HNF-2937.

**3.2.5.2.2 Radiation.** The subsystem shall be designed for the 1,000 rad/h radiation environment for direct contact with tank waste as defined in HNF-2004.

**3.2.5.2.3 Waste Properties.** The subsystem components shall be fabricated using materials compatible with the transfer of solutions over the range specified in *Waste Feed Delivery Transfer System Analysis*, RPP-5346, Table 5-1. These waste properties reflect conditions at the transfer pump discharge.

### 3.2.6 Transportability

Not applicable.

### 3.2.7 Flexibility and Expansion

Not applicable.

## 3.3 DESIGN AND CONSTRUCTION

The subsystem shall comply with the general design guidelines provided in DOE Order 6430.1A, Sections 1300-7 and 1323.

### 3.3.1 Materials, Processes, and Parts

This section defines piping requirements governing the use of materials and processes.

a. The primary and secondary confinement piping and leak detector riser pressure boundary, shall be designed, fabricated, and installed in accordance with ASME B31.3. PUREX nozzles are exempt from this requirement.

b. Primary confinement pipe shall be ASTM A312, Type 304L stainless steel.

### 3.3.2 Electromagnetic Radiation

Not applicable for underground piping.

### 3.3.3 Nameplates and Product Marking

This section defines marking and nameplate requirements of the various assemblies and subassemblies that make up the DST Transfer Piping Subsystem.

a. The subsystem shall label new equipment and/or modifications to existing equipment in a standardized format in accordance with the tank farm labeling program as specified in HNF-IP-0842, Volume II, Section 6.1.

### 3.3.4 Workmanship

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

### 3.3.5 Interchangeability

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

### 3.3.6 Safety

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

#### 3.3.6.1 Personnel Safety

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

a. Routing and shielding of the transfer piping shall be designed to keep personnel exposures as low as reasonable achievable (ALARA) in accordance with Section 12.4 of HNF-IP-0842, Volume VII.

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

#### 3.3.6.2 Equipment Protection

The DST Transfer Piping Subsystem shall be designed to avoid damage to other components.

a. The subsystem shall incorporate corrosion prevention and control features in accordance with WAC 173-303-640(3) for final status facilities and 40 CFR 265, Subpart J for interim status facilities; DOE Order 6430.1A, Section 0262; and DOE Order 5820.2A, Chapter 1, Sec. 3.b(2)(g).

b. Cathodic Protection Systems, if required, shall be designed in accordance with the guidelines provided in NACE RP 0285-95 and NACE RP 0169-96.

c. The subsystem shall be designed to withstand soil loads imposed by an AASHTO H20-44 wheel loading and a 100,000-lb crane loading in the tank farm area.

d. Tank dome loading shall satisfy the requirements specified in HNF-IP-1266, Chapter 5.16.

#### 3.3.6.3 Environmental Safety

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

a. The DST Transfer Piping Subsystem and components shall be designed in accordance with the safety classification for each. The safety classification shall be determined using the process described in Sections 6.9 – 6.12 of HNF-IP-0842, Volume IV, based on the guidelines in HNF-SD-WM-SAR-067, Section 3.0. Unreviewed safety question screening will be required for system installation in accordance with "Unreviewed Safety Questions," HNF-IP-0842, Volume IV, Section 5.4.

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

### 3.3.7 Human Performance/Human Engineering

The subsystem shall be designed for ease of operation.

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

### 3.3.8 Decontamination and Decommissioning

This section defines features found to enhance decontamination at the end of the DST Transfer Piping Subsystem's life.

a. All components that may become contaminated with radioactive or other hazardous materials under normal or abnormal operating conditions shall be designed to incorporate measures to simplify future decontamination and decommissioning in accordance with DOE Order 6430.1A, Section 1300.11.

b. Primary piping and encasements shall be fully drainable.

c. Piping shall be designed and fabricated to minimize crud traps.

## 3.4 DOCUMENTATION

This section defines the procedures that will control various documents associated with the DST Transfer Piping Subsystem.

a. Records, documents, and drawing control pertinent to design functions shall be in accordance with RPP-PRO-222 and HNF-PRO-224. Drafting standards for drawings and interface control shall be in accordance with RPP-PRO-709.

b. All DST Transfer Piping Subsystem structures, systems, and components (SSC) shall be incorporated into the master equipment list in accordance with the component index process requirements defined in Section 7.3 of HNF-IP-0842, Volume V.

## 3.5 LOGISTICS

This section identifies maintenance infrastructure support requirements.

### 3.5.1 Maintenance

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

a. Below-grade portions of the subsystem either shall not require preventive or corrective maintenance over the design life or shall be designed for preventive or corrective maintenance without requiring excavation.

b. If cathodic protection is required, test stations shall be designed for limited contact maintenance and operation.

c. If cathodic protection is required, the subsystem shall be designed to have the capability to periodically test sources of impressed current.

d. Leak detectors shall be capable of being functionally tested.

### 3.5.2 Supply

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

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

### 3.5.3 Facility and Facility Equipment

The subsystem shall provide the connections to periodically test the integrity of the primary and secondary confinement piping.

## 3.6 PERSONNEL AND TRAINING

Not applicable.

## 3.7 CHARACTERISTICS OF SUBELEMENTS

The major elements of the DST Transfer Piping Subsystem are as follows:

- Primary confinement piping
- Secondary confinement piping
- DST confinement leak detector system
- Secondary confinement drain piping.

### 3.7.1 Primary Containment Piping

The primary containment piping is used to confine waste as it moves between transfer-associated structures or from a transfer-associated structure to the RPP Waste Treatment Plant interface points. The transfer piping is designed to be self-draining and is capable of moving waste in either direction.

### 3.7.2 Secondary Confinement Piping

The safety function of the secondary confinement piping is to direct the flow of leaked waste from the primary piping to a waste transfer-associated structure for detection. The secondary piping provides the guides, deadweight supports, and anchors necessary to support the primary confinement piping. The secondary confinement piping also provides standpipes, as required, for the installation and maintenance of the leak detectors and for integrity testing of the secondary confinement piping.

### 3.7.3 Leak Detection Sensor

The DST Transfer Piping Subsystem includes the leak detector sensor, the secondary confinement drain pipe, leak detector riser, and the leak detector riser pressure boundary. The leak detector sensor combined with the seal loop jumper (in the DST Transfer Valving Subsystem) will be designed and operated such that it will detect the presence of any release of dangerous waste or accumulated liquid in the secondary containment system within 24 hours. The minimum amount of leakage to actuate the leak detector will be calculated during design of the system. The Washington State Department of Ecology, through the final status permitting process, may approve or disapprove the final system design.

### 3.7.4 Secondary Confinement Drain Piping

Drain piping will drain waste from the secondary confinement piping low points into a transfer-associated structure. The transfer-associated structure provides the capability to accumulate a sufficient amount of leaked waste in the drain piping to ensure leak detection.

## 3.8 PRECEDENCE

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

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

- RPP procedures
- National consensus codes and standards.

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

## 3.9 SECURITY

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

## 3.10 COMPUTER RESOURCE RESERVE CAPACITY

Not applicable.

# 4.0 QUALITY ASSURANCE PROVISIONS

Quality assurance for the DST Transfer Piping Subsystem shall be performed in accordance with HNF-IP-0842, Volume XI, Section 1.0.

## 4.1 GENERAL

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

### 4.1.1 Responsibility

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

### 4.1.2 Special Tests

The following design verification qualification testing requirements apply to the qualification tests of the DST Transfer Piping Subsystem components. These test requirements correlate to the qualification testing of the design to the requirements of Section 3.0 of this specification. The design agent is responsible for planning and executing the required qualification tests.

a. Electrical materials and equipment shall be qualification tested unless they are Underwriters Laboratories, Inc. (UL) listed, or factory mutual tested, with label attached, and for the purpose intended, whenever such products are available. Where no UL or factory mutual listed products are available, testing and certification by another nationally recognized testing agency may be acceptable, as long as the design agent documents the acceptance of the testing agency.

b. The encasement pipe will be examined in accordance with Paragraph 341 of ASME B31.3 for normal fluid service. The requirement for 5% random radiography will be increased to 20%. In-process examination in accordance with Paragraph 344.7 may be substituted for the radiographic examination. If in-process examination is used, the root pass shall be examined by either the liquid penetrant or magnetic particle method.

c. In addition to the requirements of ASME B31.3, all secondary confinement piping welds will be examined either by the liquid penetrant test or by the magnetic particle test. The

exception is longitudinal welds, which are required to be examined by ultrasonic test. The requirement for ultrasonic examination of longitudinal welds is in addition to any nondestructive examination required during the manufacture of the pipe. Examinations by liquid penetrant test, magnetic particle test, and ultrasonic test will be performed in accordance with the requirements of ASME Section V. The acceptance criteria for these examinations will be in accordance with the requirements of ASME Section III, ND-5300.

d. Material coupons, traceable to the heat number(s) of the pipe, will be tested to verify that the chemical and physical properties comply with the applicable ASTM Standards for the pipe. Certified Material Test Reports for the pipe will be submitted as a quality record.

e. Secondary confinement piping shall be leak tested hydrostatically or pneumatically. Hydrostatic tests shall be performed at 150% of design pressure in accordance with the test methodology in ASME B31.3. Pneumatic tests shall be performed to 120% of design pressure in accordance with the test methodology in ASME B31.3.

f. In addition to the requirements of ASME B31.3, all primary pipe welds shall be examined by 100% radiography.

## 4.2 DESIGN VERIFICATION

Design verification shall be performed on the DST Transfer Piping Subsystem, as represented in design drawings, prototypes, engineering models, etc., for the purposes of verifying that the design meets the requirements of this specification. Design verification is subject to the procedure identified in RPP-PRO-1819, Section 2.5.1. Inspection of the subsystem design to ensure compliance with the requirements of Section 3.0 shall be performed by one or more of the following methods: qualification testing, reviews, and/or alternate calculations. The verification method(s) that applies to each specification requirement is identified in Appendix A. Definitions of qualification testing, reviews, and alternate calculations are as follows:

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

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

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

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

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

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

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

Field verification of DST Transfer Piping Subsystem performance/design features and acceptance inspection of construction is called out in Section 2.5.2 of RPP-PRO-1819.

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# 5.0 PREPARATION FOR DELIVERY

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

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# 6.0 NOTES

## 6.1 DEFINITIONS

**Active**—An active component is one that is part of the "as-built" tank farms and has not been isolated and disconnected from all other tank farm components as part of an approved Engineering Change Notice.

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

**Design-Basis Accidents**—Postulated accidents or natural forces and resulting conditions for which the confinement structure, systems, components, and equipment must meet their functional goals. These safety class items are those necessary to ensure the capability to safely shut down operations, maintain the plant in a safe shutdown condition, and maintain integrity of the final confinement barrier of radioactive or other hazardous materials; to prevent or mitigate the consequences of accidents; or to monitor releases that could result in potential offsite exposures.

**Equivalent Length**—The equivalent length is the actual length of piping plus the friction loss of all valves and fitting in the system expressed in terms of equivalent feet of piping.

**General Service (GS) SSC**—Structures, systems, and components (SSC) not classified as either Safety-Class or Safety-Significant.

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

**Local Alarm**—A local alarm is defined as an alarm located at or near the point of measurement.

**Limited Contact Maintenance**—Infrequent maintenance activities requiring access to equipment in a radiation environment.

**Operator Control Area**—A location within or near a designated tank farm or plant area for the purpose of maintaining control, orderly shutdown, and/or surveillance of operations and equipment during normal and off-normal conditions.

**Physically Connected**—Physically connected piping is any piping that is part of the direct transfer path or is connected to the transfer path. Piping is not considered to be connected to the transfer path if it is physically disconnected by (1) an air gap, (2) a blind flange or process blank, (3) an operable Safety-Significant service water pressure detection system, (4) an operable

Safety-Significant backflow prevention system, or (5) two closed Safety-Significant isolation valves. It is important to note that closed valves that are not designated as Safety-Significant cannot be credited with physically disconnecting piping from the active transfer route.

**Procuring Authority**—A qualified engineer responsible for procurement of the equipment according to a procurement specification developed based on the design requirement.

**RPP Design Authority**—A qualified engineer responsible for implementation of authorization basis requirements into the facility design.

**Safety-Class (SC) SSC**—Safety functions performed by Safety-Class SSCs prevent or mitigate releases to the public that would otherwise exceed the offsite radiological risk guidelines or prevent a nuclear criticality.

**Safety-Significant (SS) SSC**—Safety functions performed by Safety-Significant SSCs prevent or mitigate releases of radiological materials to onsite workers and toxic chemicals to the offsite public and onsite workers. Safety-Significant SSCs also include those safety SSCs that protect the facility worker from serious injury (or fatality) because of hazards not controlled by institutional safety programs.

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

**Shall**—Denotes a requirement.

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

**Tank Opening**—Tank risers and pits with an open path to the tank.

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

**TBR**—To be refined. A "soft" basis for the requirement has been identified. However, a further study and/or calculation needs to be performed in order to solidify the requirement's technical basis.

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

## 6.2 LIST OF TERMS

| | |
|---|---|
| ALARA | as low as reasonably achievable |
| DOE | U.S. Department of Energy |
| DCRT | double-contained receiver tank |
| DST | double-shell tank |
| ORP | Office of River Protection |
| RPP | River Protection Project |

| | |
|---|---|
| SC | safety-class |
| SS | safety-significant |
| SSC | structures, systems, and component |
| TBD | to be determined |
| TBR | to be refined |
| UL | Underwriters Laboratories, Inc. |

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# 7.0 REFERENCES

DOE Order 5480.23, *Nuclear Safety Analysis Reports*, U.S. Department of Energy, Washington, D.C.

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

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

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

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

HNF-SD-WM-SP-012, 1999, *Tank Waste Remediation System Operations 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, 1999, *System Specification for the DST System*, Rev. E, (draft), COGEMA Engineering for Fluor Daniel Hanford, Inc., Richland, Washington.

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# SOURCE DOCUMENTS AND TEST METHODS

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|---|---|---|---|---|---|---|---|---|---|
| | | | | Exam | Demo | Test | Anal | Alt Calc | N/A |
| 3.1.2.1.1.a | The DST Transfer Piping Subsystem shall be designed to receive and transfer the waste, flush, or diluent coming from the DST Transfer Valving Subsystem at a pressure not less than the design pressure defined in Section 3.2.1.1.a. | RPP-5346 | | | | | | | X |
| 3.1.2.1.1.b | The DST Transfer Piping Subsystem shall be designed such that the leak detector sensor, combined with the secondary confinement device (e.g., seal loop jumper), will detect a leak as defined in Section 3.2.1.3.a. | WAC 173-303-640;<br>40 CFR 265, Subpart J | | | | | | | X |
| 3.2.1.1.a | The primary confinement piping shall confine waste at a design pressure of >6240 kPa (>905 lbf/in$^2$). | RPP-5346 | | | | | | X | |
| 3.2.1.2.a | The secondary confinement piping design pressure shall be determined during detail design. | N/A | | | | | | X | |

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|---|---|---|---|---|---|---|---|---|---|
| | | | | Exam | Demo | Test | Anal | Alt Calc | N/A |
| 3.2.1.3.a | The leak detector sensor combined with the secondary confinement device (e.g., seal loop jumper) (from the DST Transfer Valving Subsystem) shall be designed and operated such that it will detect the failure of the primary containment or the presence of any release of dangerous waste or accumulated liquid in the secondary containment system within 24 hours. The amount of anticipated leakage to actuate the leak detector shall be calculated during design of the system. The Washington State Department of Ecology, through the final status permitting process, may approve or disapprove the final system design. | WAC 173-303-640;<br>40 CFR 265, Subpart J | | | | | | X | |
| 3.2.1.4.a | The primary confinement piping shall confine the diluent/flush water at the design pressure defined in Section 3.2.1.1.a. | RPP-5346 | | | | | | X | |
| 3.2.2.a | Primary confinement piping should be 80 mm (3-in.) inside diameter. | RPP-5346 | | | X | | | | |
| 3.2.2.b | Transfer piping shall slope continuously from the high point(s) to a transfer-associated structure(s) with a minimum slope of 0.25%. | WHC-SD-GN-DGS-30011, Section 10.4.3 | Current value based on current Hanford practice until verified by independent study. | | X | | | | |
| 3.2.2.c | The heat transfer properties of the as-installed piping subsystem shall be such that the waste heat loss is less than 25.6 joules (26.2 Btu/h per foot) of pipe at the maximum waste temperature and flow rate. | HNF-5442 | | | | | | X | |

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|---|---|---|---|---|---|---|---|---|---|
| | | | | Exam | Demo | Test | Anal | Alt Calc | N/A |
| 3.2.3.a | The DST Transfer Piping Subsystem shall have a design life of 35 years. | HNF-SD-WM-SP-012 | Phase II retrieval operation are scheduled to be completed in the year 2034. | | | | | X | |
| 3.2.3.b | Pipe bends in the primary confinement piping should have a minimum bend radius of five pipe diameters. | WHC-SD-GN-DGS-30011, Section 3.4.2 | | | | | | X | |
| 3.2.4.a | The low point leak detector sensors should be repairable or replaceable within 8 hours. Time to repair does not include preparatory work, such as preparing procedures, staging personnel and equipment, or conducting preparatory training. | HNF-5141, Table 4-1 | | | | | | | X |
| 3.2.4.b | The continuous leak detectors should be repairable or replaceable within <TBD> hours. Time to repair does not include preparatory work, such as preparing procedures, staging personnel and equipment, or conducting preparatory training. | TBD | | | | | | | X |
| 3.2.5.1.a | The subsystem shall be designed for the natural environmental conditions specified in HNF-SD-GN-ER-501. | HNF-SD-GN-ER-501 | | | | | | X | |
| 3.2.5.1.b | The subsystem shall be designed to withstand the natural phenomena hazards as specified in RPP-PRO-097. | RPP-PRO-097 | | | | | | X | |
| 3.2.5.2.1 | The subsystem components shall be designed to perform their intended function in the chemical environment defined in HNF-2937. | HNF-2937 | | | | | | X | |

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|---|---|---|---|---|---|---|---|---|---|
| | | | | Exam | Demo | Test | Anal | Alt Calc | N/A |
| 3.2.5.2.2 | The subsystem shall be designed for the 1,000 rad/h radiation environment for direct contact with tank waste as defined in HNF-2004. | HNF-2004 | | | | | | X | |
| 3.2.5.2.3 | The subsystem components shall be fabricated using materials compatible with the transfer of solutions over the range specified in RPP-5346, Table 5-1. These waste properties reflect conditions at the transfer pump discharge. | RPP-5346, Table 5-1 | | | | | | X | |
| 3.2.6 | Not applicable | Not applicable. | | | | | | | X |
| 3.2.7 | Not applicable | N/A | | | | | | | X |
| 3.3 | The subsystem shall comply with the general design guidelines provided in DOE Order 6430.1A, Sections 1300-7 and 1323. | DOE Order 6430.1A, Sections 1300-7 and 1323 | | | | | | | X |
| 3.3.1.a | The primary and secondary confinement piping and leak detector riser pressure boundary, shall be designed, fabricated, and installed in accordance with ASME B31.3. PUREX nozzles are exempt from this requirement. | WHC-SD-GN-DGS-30008, Section 4.1; RPP-PRO-097, Table B-1 | Standard Design Code | | X | | | X | |
| 3.3.1.b | Primary confinement pipe shall be ASTM A312, Type 304L stainless steel. | WHC-SD-GN-DGS-30011, Section 3.4.2; WHC-SD-W236A-ER-003 | Stainless steel has better corrosion resistance to this waste type than carbon steel. | | X | | | | |
| 3.3.2 | Not applicable for underground piping. | N/A | | | X | | | X | |

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|---|---|---|---|---|---|---|---|---|---|
| | | | | Exam | Demo | Test | Anal | Alt Calc | N/A |
| 3.3.3 | The subsystem shall label new equipment and/or modifications to existing equipment in a standardized format in accordance with the tank farm labeling program as specified in HNF-IP-0842, Volume II, Section 6.1. | HNF-IP-0842, Volume II, Section 6.1 | | | X | | | | |
| 3.3.4 | Reserved. The requirements for workmanship are to be addressed in lower level project design documentation (drawings, procurement specifications, etc.). | Not applicable | | | | | | | X |
| 3.3.5 | All like equipment and parts shall be interchangeable/standardized to the maximum extent practical. | DOE Order 6430.1A, Sections 0110-3 and 1100 | "Flexibility" and "Equipment – General" | | X | | | | |
| 3.3.6.1.a | Routing and shielding of the transfer piping shall be designed to keep personnel exposures as low as reasonable achievable (ALARA) in accordance with Section 12.4 of HNF-IP-0842, Volume VII. | HNF-IP-0842 | | | | | | X | |
| 3.3.6.1.b | The subsystem shall incorporate design features that comply with the applicable requirements of 29 CFR 1910, Subparts D, E, G, J, L, M, O, and S. | RPP-PRO-097, Table B-1 | | | | | | | X |
| 3.3.6.2.a | The subsystem shall incorporate corrosion prevention and control features in accordance with WAC 173-303-640(3) for final status facilities and 40 CFR 265, Subpart J for interim status facilities; DOE Order 6430.1A, Section 0262; and DOE Order 5820.2A, Chapter 1, Sec. 3.b(2)(g). | 40 CFR 265, Subpart J; WAC 173-303-640(3); DOE Order 6430.1A, Section 0262; and DOE Order 5820.2A, Chapter 1, Sec. 3.b(2)(g). | | | | | | X | |

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|---|---|---|---|---|---|---|---|---|---|
| | | | | Exam | Demo | Test | Anal | Alt Calc | N/A |
| 3.3.6.2.b | Cathodic Protection Systems, if required, shall be designed in accordance with the guidelines provided in NACE RP 0285-95 and NACE RP 0169-96. | NACE RP 0285-95 and NACE RP 0169-96. | Standard Design Codes | | X | | | X | |
| 3.3.6.2.c | The subsystem shall be designed to withstand soil loads imposed by an AASHTO H20-44 wheel loading and a 100,000-lb crane loading in the tank farm area. | WHC-SD-GN-DGS-30008, Section 4.2.4 | | | | | | X | |
| 3.3.6.2.d | Tank dome loading shall satisfy the requirements specified in HNF-IP-1266, Chapter 5.16. | HNF-IP-1266, Chapter 5.16 | | | | | | X | |
| 3.3.6.3.a | The DST Transfer Piping Subsystem and components shall be designed in accordance with the safety classification for each. The safety classification shall be determined using the process described in Sections 6.9 - 6.12 of HNF-IP-0842, Volume IV, based on the guidelines in HNF-SD-WM-SAR-067, Section 3.0. Unreviewed safety question screening will be required for system installation in accordance with "Unreviewed Safety Questions," HNF-IP-0842, Volume IV, Section 5.4. | HNF-IP-0842; HNF-SD-WM-SAR-067, Section 3.0 | | | X | | | | |

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|---|---|---|---|---|---|---|---|---|---|
| | | | | Exam | Demo | Test | Anal | Alt Calc | N/A |
| 3.3.6.3.b | All equipment installed in areas in and around the tank that are subject to ignition controls shall be designed to meet the requirements of HNF-SD-WM-TSR-006, Section 5.10, "Ignition Controls." Areas requiring controls are delineated in HNF-SD-WM-SAR-067, Appendix K. The Flammable Gas Equipment Advisory Board shall be consulted whenever the application or interpretation of the requirements is unclear. | HNF-SD-WM-TSR-006, Section 5.10;<br>HNF-SD-WM-SAR-067, Appendix K | | | | | | X | |
| 3.3.7.a | Subsystem design shall comply with DOE Order 6430.1A, Section 1300.12, "Human Factors Engineering." | DOE Order 6430.1A, Section 1300.12 | | | | | | | X |
| 3.3.8.a | All components that may become contaminated with radioactive or other hazardous materials under normal or abnormal operating conditions shall be designed to incorporate measures to simplify future decontamination and decommissioning in accordance with DOE Order 6430.1A, Section 1300.11. | DOE Order 6430.1A, Section 1300-11.2 | "Decommissioning" | | | | | | X |
| 3.3.8.b | Primary piping and encasements shall be fully drainable. | WHC-SD-GN-DGS-30011, Section 3.4.2 | | | X | | | | |

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|---|---|---|---|---|---|---|---|---|---|
| | | | | Exam | Demo | Test | Anal | Alt Calc | N/A |
| 3.3.8.c | Piping shall be designed and fabricated to minimize crud traps. | RPP-PRO-1622, Appendix E, Section 9.1 | | | X | | | | |
| 3.4.a | Records, documents, and drawing control pertinent to design functions shall be in accordance with RPP-PRO-222 and HNF-PRO-224. Drafting standards for drawings and interface control shall be in accordance with RPP-PRO-709. | RPP-PRO-222; HNF-PRO-224; RPP-PRO-709 | | | | | | | X |
| 3.4.b | All DST Transfer Piping Subsystem structures, systems, and components (SSC) shall be incorporated into the master equipment list in accordance with the component index process requirements defined in Section 7.3 of HNF-IP-0842, Volume V. | HNF-IP-0842 | New master equipment list procedure under development. | | | | | | X |
| 3.5.1.a | Below-grade portions of the subsystem either shall not require preventive or corrective maintenance over the design life or shall be designed for preventive or corrective maintenance without requiring excavation. | DOE Order 6430.1A, Section 1300-6.3 | Promotes ALARA principles. | | X | | | X | |
| 3.5.1.b | If cathodic protection is required, test stations shall be designed for limited contact maintenance and operation. | DOE Order 6430.1A, Section 1300-6.3 | Promotes ALARA principles. | | | | | X | |
| 3.5.1.c | If cathodic protection is required, the subsystem shall be designed to have the capability to periodically test sources of impressed current. | DOE Order 6430.1A, Section 0262-3 | "Cathodic Protection Systems" | | X | | | | |

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|---|---|---|---|---|---|---|---|---|---|
| | | | | Exam | Demo | Test | Anal | Alt Calc | N/A |
| 3.5.1.d | Leak detectors shall be capable of being functionally tested. | HNF-4553 | To be added to HNF-4553 per Memorandum of Understanding dated 10/28/99 between Cary Graves and Gary Duncan. | | | | X | | |
| 3.5.2 | The subsystem shall use readily available commercial parts and components to the greatest extent practical. | DOE Order 6430.1A, Section 1100 | "Equipment – General" | | | | | | X |
| 3.5.2.a | Minimum numbers of spares for like components shall be determined based on mean time between failure and the number of like components installed. | HNF-4553 | To be added to HNF-4553 per Memorandum of Understanding dated 10/28/99 between Cary Graves and Gary Duncan. | | | | | | X |
| 3.5.3 | The subsystem shall provide the connections to periodically test the integrity of the primary and secondary confinement piping. | HNF-4553 | Required to perform hydrostatic testing. To be added to HNF-4553 per Memorandum of Understanding dated 10/28/99 between Cary Graves and Gary Duncan. | | X | | X | | |
| 3.6 | Not applicable. | Not applicable. | | | | | | | X |
| 3.7 | Characteristics of Subelements | Not applicable. | | | | | | | X |
| 3.7.1 | Primary Confinement Piping | Not applicable. | | | | | | | X |
| 3.7.2 | Secondary Confinement Piping | Not applicable. | | | | | | | X |
| 3.7.3 | Leak Detection Sensors | Not applicable. | | | | | | | X |
| 3.7.4 | Secondary Confinement Drain Piping | Not applicable. | | | | | | | X |

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|---|---|---|---|---|---|---|---|---|---|
| | | | | Exam | Demo | Test | Anal | Alt Calc | N/A |
| 3.8 | Except in those instances where Washington State has been granted regulatory authority by the Federal Government, the hierarchical relationship among requirements specified in Section 3.0 is as follows:<br>• Federal requirements (e.g., Code of Federal Regulations, DOE orders)<br>• State requirements (e.g., Revised Code of Washington as specified in the Washington Administrative Code)<br>• Local ordinances<br>• RPP procedures<br>• National consensus codes and standards.<br>The hierarchy is useful in establishing the relative order of precedence of the requirements documents levied in this specification. | Not applicable. | | | | | | | X |
| 3.9 | The subsystem shall be designed such that access controls to radiation and high-radiation areas meet the requirements of HNF-5183 (local implementation of 10 CFR 835). | HNF-5183 | | | | | | | X |
| 3.10 | Not applicable. | Not applicable. | | | | | | | X |
| 4.0 | Quality assurance for the DST Transfer Piping Subsystem shall be performed in accordance with HNF-IP-0842, Volume XI, Section 1.0. | HNF-IP-0842, Volume XI, Section 1.0 | | | | | | | X |

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|---|---|---|---|---|---|---|---|---|---|
| | | | | Exam | Demo | Test | Anal | Alt Calc | N/A |
| 4.1.2.a | Electrical materials and equipment shall be qualification tested unless they are Underwriters Laboratories, Inc. (UL) listed, or factory mutual tested, with label attached, and for the purpose intended, whenever such products are available. Where no UL or factory mutual listed products are available, testing and certification by another nationally recognized testing agency may be acceptable, as long as the design agent documents the acceptance of the testing agency. | DOE Order 6430.1A, Section 1605-1 | "General" | | | | X | | |
| 4.1.2.b | The encasement pipe will be examined in accordance with Paragraph 341 of ASME B31.3 for normal fluid service. The requirement for 5% random radiography will be increased to 20%. In-process examination in accordance with Paragraph 344.7 may be substituted for the radiographic examination. If in-process examination is used, the root pass shall be examined by either the liquid penetrant or magnetic particle method. | ASME B31.3; ASME BPVC, Section III & V; RPP-PRO-097, Table B-1 | Standard Design Codes | | | | X | | |

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|---|---|---|---|---|---|---|---|---|---|
| | | | | Exam | Demo | Test | Anal | Alt Calc | N/A |
| 4.1.2.c | In addition to the requirements of ASME B31.3, all secondary confinement piping welds will be examined either by the liquid penetrant test or by the magnetic particle test. The exception is longitudinal welds, which are required to be examined by ultrasonic test. The requirement for ultrasonic examination of longitudinal welds is in addition to any nondestructive examination required during the manufacture of the pipe. Examinations by liquid penetrant test, magnetic particle test, and ultrasonic test will be performed in accordance with the requirements of ASME Section V. The acceptance criteria for these examinations will be in accordance with the requirements of ASME Section III, ND-5300. | ASME B31.3;<br>ASME BPVC, Section III & V;<br>RPP-PRO-097, Table B-1 | Standard Design Codes | | | | X | | |
| 4.1.2.d | Material coupons, traceable to the heat number(s) of the pipe, will be tested to verify that the chemical and physical properties comply with the applicable ASTM Standards for the pipe. Certified Material Test Reports for the pipe will be submitted as a quality record. | ASTM Piping Standards | | | | | X | | |
| 4.1.2.e | Secondary confinement piping shall be leak tested hydrostatically or pneumatically. Hydrostatic tests shall be performed at 150% of design pressure in accordance with the test methodology in ASME B31.3. Pneumatic tests shall be performed to 120% of design pressure in accordance with the test methodology in ASME B31.3. | ASME B31.3;<br>RPP-PRO-097, Table B-1 | Standard Design Code | | | | X | | |

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|---|---|---|---|---|---|---|---|---|---|
| | | | | Exam | Demo | Test | Anal | Alt Calc | N/A |
| 4.1.2.f | In addition to the requirements of ASME B31.3, all primary pipe welds shall be examined by 100% radiography. | RPP-PRO-097, Table B-1 | Standard Design Code | | | X | | | |
| 4.2 | Design Verification. | RPP-PRO-1819, Sections 2.9.1 and 2.9.2 | | X | | | | | |

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## REFERENCES

10 CFR 835, 2000, "Occupational Radiation Protection," *Code of Federal Regulations*, as amended.

29 CFR 1910, 1999, "Occupational Safety and Health Standards," *Code of Federal Regulations,* as amended.

40 CFR 265, Subpart J, 1999, "Interim Status TSD Facility Standards, Tank Systems," *Code of Federal Regulations,* as amended.

AASHTO, H20-44, 1996, *Standard Specifications for HS-20, Highway Loading,* American Association of State Highway and Transportation Officials, Washington, D.C.

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

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