COMPLETE

ENGINEERING CHANGE NOTICE

1. ECN 603486

Proj. ECN NA

2. ECN Category (mark one)	3. Originator's Name, Organization, MSIN, and Telephone No.	3a. USQ Required?	4. Date
Supplemental [] Direct Revision [X] Change ECN [] Temporary [] Standby [] Supersedure [] Cancel/Void []	WM Brantley/74410/H5-09/6-2984	[] Yes [X] No	January 18, 1996
	5. Project Title/No./Work Order No. Replacement of Cross-Site Transfer System/Project W-058	6. Bldg./Sys./Fac. No. 200W/600/200E	7. Approval Designator ESQ
	8. Document Numbers Changed by this ECN (includes sheet no. and rev.) WHC-SD-W058-FDC-001, Rev. 3	9. Related ECN No(s). N/A	10. Related PO No. N/A

11a. Modification Work	11b. Work Package No.	11c. Modification Work Complete	11d. Restored to Original Condition (Temp. or Standby ECN only)
[] Yes (fill out Blk. 11b) [X] No (NA Blks. 11b, 11c, 11d)	N/A	N/A Cog. Engineer Signature & Date	N/A Cog. Engineer Signature & Date

12. Description of Change

1. Section 1.0, last sentence: Deleted the words, "Major Project."

2. Section 3.3, introductory sentence: Revised sentence from "The primary and secondary containment piping and all system components shall be designed to transfer tank wastes with the following characteristics:" to "The RCSTS equipment shall be designed such that the velocities shown in Table 3-1 can be achieved for wastes with the corresponding parameters shown in Table 3-1. The critical transfer velocity will be determined by the cognizant engineer before each transfer, based on waste characterization."

(Continued on page 3)

13a. Justification (mark one)

Criteria Change	[X]	Design Improvement	[]	Environmental	[]	Facility Deactivation	[]
As-Found	[]	Facilitate Const	[]	Const. Error/Omission	[]	Design Error/Omission	[]

13b. Justification Details

1. The project has descoped such that it is no longer a Major Project.

2. Revised for clarification.

(Continued on page 3)

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

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15. Design Verification Required	16. Cost Impact						17. Schedule Impact (days)		
	ENGINEERING			CONSTRUCTION					
[] Yes	Additional	[X]	$40K	Additional	[]	$ NA	Improvement	[]	NA
[X] No	Savings	[]	$ NA	Savings	[]	$ NA	Delay	[]	

18. 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 12. Enter the affected document number in Block 19.

SDD/DD	[]	Seismic/Stress Analysis	[]	Tank Calibration Manual	[]
Functional Design Criteria	[X]	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	[]		[]
Environmental Permit	[]	Inventory Adjustment Request	[]		[]

NA

19. 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

20. Approvals

Signature	Date	Signature	Date
OPERATIONS AND ENGINEERING		ARCHITECT-ENGINEER	
AUTHOR ~~Cog. Eng.~~ WM Brantley *W. M. Brantley*	1-17-96	PE	
PROJ ~~Eng.~~ Mgr. GL Parsons *GL Parsons*	1-18-96	QA	
QA LR Hall *Larry R. Hall*	1-17-96	Safety	
Safety W Wedlick *[signature]*	1-17-96	Design	
Environ. WE Toebe *WE Toebe*	1-17-96	Environ.	
COG ~~Other~~ SH Rifaey *[signature]*	1/18/96	Other	
Ops. DR Nunamaker *DR Nunamaker*	1-18-96		
OTHER C.A. Rieck *CA Rieck*	1-19-96		
		DEPARTMENT OF ENERGY	
		Signature or a Control Number that tracks the Approval Signature	
		Change Request W058-050	3/14/96
		ADDITIONAL	

Description of Change (continued)

3. Design Parameters table (now Table 3-1): The word "(mixture)" was added to describe the specific gravity, "displacement vol%" was changed to "% solids volume fraction," and the following note was added, "Achievable design velocity is the theoretical velocity at which the pumped materials with the characteristics shown below can be transferred. It is not intended or implied that these velocities are the optimal transfer velocities for waste with the given characteristics."

4. Section 3.6: Deleted first paragraph, and replaced with the following: "Booster pump(s) shall be provided as required to meet the functional requirements of this document. The design shall also identify the location for a future pumping station for added flexibility."

5. Section 3.8.5: Deleted "The CSTS process control station with the monitor control system (MCS) shall be located in the 200 West Area Shift Office (M0278). The station will be connected via a dedicated phone line modem to a process control unit (PCU) in the new 242-S Substation building (W-322). The system shall have a 1-hour uninterrupted power supply system for the MCS and PCU." Replaced text with, "A modem on a dedicated telephone line will transmit the RCSTS control signals from the 242-S Substation at Building 252-S to the 200 West Area Tank Farm Transition Projects Shift Office in Building 278-WA where the operator control station will be located. The monitor and control system shall be provided with a 1-hour uninterruptible power supply system, and the process control units shall have a minimum of 1-hour battery backup to allow the system to be statused and to maintain programming following a loss of power."

6. Section 4.3, following fourth paragraph: Added the following, "The loads required to operate the backup flush system shall be fed from redundant transformers."

7. Section 4.3.4: Deleted section as follows,

"4.3.4 Backup Power

Upon loss of normal power, the required loads shall be transferred to backup power such that designed safety features identified by the safety analyses shall remain functional (e.g., backup flush system). The backup power source shall meet the requirements specified in WHC-SD-GN-DGS-303, *Backup Electrical Power System Definitions and Design Criteria* (Roberts 1990)."

8. Section 4.4, fourth paragraph: Deleted last sentence as follows, "All access to controlled areas shall be through the existing change room and main vehicle gate."

9. Section 4.6, first sentence: Revised the reference from the QAPP to the PSAR.

10. Section 4.7: Added the following to the end of the paragraph, "Points of contact for environmental permitting are as noted in Chapter 9 of that document."

11. Section 4.12: Deleted text as follows, "The CSTS shielding design from the SY Tank Farm to Station 196+24.29 (the western boundary of proposed pretreatment facility locations) shall be based on the radionuclide inventory concentrations shown in Appendix E, Table E-1. To support future east-to-west transfers of aging waste, shielding design from Station 196+24.29 to the 244-A Lift Station shall be based on the radionuclide inventory concentrations shown in Appendix E, Table E-2. Dose rates shall

be based on pipelines and valving being full of liquid waste. All process piping shall be provided with sufficient earth cover to reduce personnel radiation dose rates ALARA, but not to exceed 0.05 mR/h at grade. The use of berms for radiation shielding shall be minimized and shall not be permitted in traffic areas. Diversion box 1 and the Vent Station shall attenuate the radiation level to <0.05 mR/h at the surface."

Replaced text with the following, "Shielding or other limitations shall be provided to limit personnel radiation dose rates at exposed exterior surfaces of the diversion box and vent station and at the ground surface above all buried process piping to ALARA levels. The rates shall not exceed 0.1 rem/yr in accordance with 10 CFR 835, "Occupational Radiation Protection" and DOE Order 5480.11, *Radiation Protection for Occupational Workers* (DOE 1988). The shielding design shall be based on the source term in Appendix E, Table E-1."

12. Section 5.0: Deleted text as follows, "Quality assurance activities for all contractors involved in Project W-058 design, construction, and testing shall be executed in accordance with WHC-SD-W058-QAPP-001, *Quality Assurance Program Plan* (Chafin 1994) and WHC-SD-WM-QAPP-018, *Tank Waste Projects Quality Assurance Program Plan* (Huston 1993). These QA program plans shall be used by the design contractor to develop verification criteria in design documents (i.e., drawings, specifications, test procedures) and by all contractors to define QA interfaces and specific quality requirements/responsibilities on the project.

The QA program plans shall comply with the quality criteria of DOE Order 5700.6C, *Quality Assurance* (DOE 1991).

The basis for establishing QA Program requirements is safety classification as defined in WHC-CM-1-3, *Management Requirements and Procedures*, MRP 5.46, "Safety Classifications of Systems, Components, and Structures." The safety classifications of items provide a graded approach to the application of quality requirements. This graded approach assigns requirements to items commensurate with the function of each system, component, and structure in preventing or mitigating the consequences of hazards and postulated design basis accidents. The overall safety classifications for this project will be defined in the preliminary safety documents."

Replaced the deleted text with the following, "Quality Assurance (QA) requirements for all contractors involved in the design, construction, inspection, testing and acceptance of the proposed facility provide assurance that the facility is designed and constructed as intended. The design shall be developed in accordance with the RCSTS Quality Assurance Program Plan (QAPP). The QAPP shall comply with 10 CFR 830.120, "Nuclear Safety Management," as implemented in WHC-SP-1131, *WHC Quality Assurance Program and Implementation Plan* (Moss 1995). Construction shall be performed in accordance with the design. Inspection, testing and overview acceptance activities shall confirm the adequacy of the design and construction.

Functional safety classification of structures, systems and components defined in WHC-CM-4-46, *Nonreactor Facility Safety Analysis Manual*, chapter 9.0 was used as the basis for grading QA requirements.

A safety class designation list for structures, systems and components is provided in WHC-SD-W058-PSAR-001, *Replacement of Cross-Site Transfer System Preliminary Safety Analysis Report* (Kidder 1995). This list may be revised, as required, based on the issuance of the final safety analysis report. Safety Class 1 is the highest classification anticipated for any structure, system or component of the facility.

For review and approval purposes, QA technical baseline documents shall be assigned approval designators in accordance with WHC-CM-3-5, "Document Control and Records Management Manual".

Project management plans, statements of work, letters of instruction, and the QAPP will designate the required interfaces among the operating contractor, architect/engineer, contractors and subcontractors to achieve QA requirements without duplication of effort."

13. Section 6.0, paragraphs 2 and 4: Revised PSAR reference from Rev. 0 to Rev. 1.

14. Section 6.1, fifth bullet: Revised as follows, "Exposure of personnel to ionizing radiation shall not be in excess of the standards and guidelines specified in the DOE Order 5480 series and 10 CFR 835, "Occupational Radiation Protection," Section 835.1002.

15. Sections 7.0 and 8.0: Deleted the following, "DOE-RL Order 5440.1A, *Implementation of the National Environmental Policy Act at the Richland Operations Office*, DOE-RL Order 5480.1A, *Environment, Safety, and Health Program for Department of Energy Operations for Richland Operations*, DOE-RL Order 5480.4C, *Environmental Protection, Safety, and Health Protection Standards for RL*, DOE-RL Order 5481.1, *Safety Analysis and Review System*, DOE-RL Order 6430.1C, *Hanford Plant Standards (HPS) Program*, DOE RLIP 4700.1A, *Project Management System*, DOE RLIP 5400.1, *General Environmental Protection Program*, DOE RLIP 5480.10, *Industrial Hygiene Program*, DOE RLIP 5480.11, *Requirements for Radiation Protection.*"

16. Section 8.0: Revised PSAR reference from Rev. 0 to Rev. 1.

17. Appendix A: The following was added to the end of the description, "Table A-1 can be used for material selection purposes." Also, Table A-1 was revised to add analyte concentrations for Ba, Ca, Cd, Cr, La, Na, and U.

18. Appendix E: Shielding source terms were deleted and replaced.

19. Appendix F: Accident source terms were deleted and replaced.

20. Miscellaneous minor, non-technical editorial changes were made.

Justification Details (continued)

3. The specific gravities listed are intended to represent a mixture of the liquids and solids. The term "% solids volume fraction" is more widely used and is more thoroughly understood than the term "displacement volume %." The note was added for clarification.

4. Revised for clarification.

5. Revised for clarification.

6. Backup power for the backup flush system was previously required by section 4.3.4, which is being deleted in change #7 of this ECN.

7. This section required backup power for safety features that would be identified in the PSAR. The PSAR is now approved, and no backup power requirements are identified. This section also required backup power for the backup flush system. That requirement was added to section 4.3 by change #6 of this ECN.

8. Sentence is not applicable to this project.

9. Safety Class is established in the PSAR.

10. This is not a new requirement. WHC-CM-7-5 was already referenced for environmental requirements. This change merely highlights the POC checklist from that document.

11. The radiation exposure rate of 0.05 mR/hr was based on the DOE 5480.11 limit of 100 mR/yr, averaged over 2000 hours per year. The more restrictive rate has been revised to the DOE 5480.11 limit. The revised shielding source term provides conservative values to use for calculation of external exposure from the RCSTS. It is based on data from Savino 1995, and derived from an assumed mixture of two-thirds of the maximum sample activity composite from the "All Liquids" group and one-third of the maximum sample activity composite from the "All Solids" group. This is a conservative source term that can be applied to the entire RCSTS route. This should result in added operational flexibility and ensure that the line is designed to account for potential misroutings of "high-gamma" waste from 200 East to 200 West.

12. This change implements 10 CFR 830.120, which is for use with non-reactor nuclear facilities. DOE 5700.6C is a guide to be used for non-nuclear facilities. The change also implements requirements of Rev. 1 of the PSAR.

13. Revision 1 of the PSAR has been approved.

14. Revised for clarification.

15. These directives have been canceled by DOE.

16. PSAR Rev. 1 has been approved.

17. The table was revised to provide conservative values for the analytes noted. Information added to the table was taken from Appendix F, Table F-2.

18. See change #11 of this ECN.

19. These accident source terms provide conservative values to use for calculation of inhalation doses during postulated accidents. Table F-1 is based on data from *Tank Farm Waste Compositions and Atmospheric Dispersion Coefficients for use in ASA Consequence Assessments*, WHC-SD-WM-SARR-016, Rev. 1, Savino, 1995, and derived from an assumed mixture of two-thirds of the maximum sample activity composite from the worst-case liquids group (i.e., "single-shell tank liquids"), and one-third of the maximum sample activity composite from the worst-case solids group (i.e., "Aging Waste Facility solids") presented in Table 8.1-1 and justified in Chapter 8.0 of *Replacement of Cross-Site Transfer System Preliminary Safety Analysis Report*, WHC-SD-W058-PSAR-001, Rev. 1, Kidder, 1995. This source term is used in the analysis of RCSTS accidents in Chapter 9.0 of the PSAR.

Table F-2 is based on data from *Toxic Chemical Considerations for Tank Farm Releases*, WHC-SD-WM-SARR-011, Rev. 1, Van Keuren, 1995, and derived from an assumed mixture of two-thirds of the maximum sample activity composite from the worst-case liquids group (i.e., "double-shell tank liquids"), and one-third of the maximum sample activity composite from the worst-case solids group (i.e., "single-shell tank solids") presented in Table 8.1-3 of the PSAR. This source term is used in the analysis of RCSTS accidents in Chapter 9.0 of Kidder 1995.

20. Revised for clarification.

Functional Design Criteria for Project W-058, Replacement of the Cross-Site Transfer System

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U.S. Department of Energy Contract DE-AC06-87RL10930

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Key Words: Project W-058, tank farms, cross-site transfer lines, retrieval, design criteria, pipelines

Abstract: This document presents the functional design criteria for a system to transfer waste from the 200 West Area to the 200 East Area. The design criteria specified herein are based on policies, procedures, and definitions of safety class systems as identified in DOE Order 6430.1A, *General Design Criteria*; WHC-CM-4-46, *Nonreactor Facility Safety Analysis Manual*, and HPS-SDC-4.1, "Standard Arch-Civil Design Criteria, Design Loads for Facilities."

MAR 18 1996
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STA: 34 ID: 22

Christine Willingham 3/18/96
Release Approval Date

Release Stamp

Approved for Public Release

RECORD OF REVISION	(1) Document Number WHC-SD-W058-FDC-001	Page 1 of 1

(2) Title
Functional Design Criteria for Project W-058, Replacement of Cross-Site Transfer System.

CHANGE CONTROL RECORD

(3) Revision	(4) Description of Change - Replace, Add, and Delete Pages	Authorized for Release (5) Cog. Engr.	(6) Cog. Mgr. Date
0	(7) Remove pages C-9 through C-20 Insert Page C-9, Rev. 0A This change was made to remove copy-righted material and to cite the references instead.	J.M. Light	R.L. Fritz 12/20/91
1	Incorporate ECN 162715	D.W. Fukumoto 3/11/93	G.L. Parsons 3/11/93
2	Incorporate ECN 165152 (Comprehensive revision)	W.M. Brantley	G.L. Parsons
2A	Incorporate ECN 189570 (Extensive Revision). Only revised FDC pages (i, ii, 1-5, 1-6, 3-1, 3-2, 3-4, 3-6, 3-7, 4-1, 4-4, 4-6, 4-10, 6-1, 7-1, 8-1, B-1 through B-3) issued.	J. Kalia	G.L. Parsons
3	Incorporate ECN 603492 (Comprehensive Revision)	J. Kalia 8/2/95	G.L. Parsons 8/2/95
4 RS	Incorporate ECN 603486 (Comprehensive Revision)	W. Brantley [signature] 3/14/96	G. L. Parsons G L Parsons 3-18-96

FUNCTIONAL DESIGN CRITERIA

PROJECT W-058

REPLACEMENT OF CROSS-SITE TRANSFER SYSTEM

Prepared by

Westinghouse Hanford Company

FEBRUARY 1995

For the U. S. Department of Energy

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FUNCTIONAL DESIGN CRITERIA FOR PROJECT W-058, REPLACEMENT OF CROSS-SITE TRANSFER SYSTEM

1.0 INTRODUCTION

Project W-058 will replace the present cross-site transfer system with a buried pipe-in-pipe system, approximately 6 1/2 miles long. This system will be capable of transferring liquid waste in either direction between the Hanford Site 200 East and 200 West Areas and slurries from the 200 West Area to the 200 East Area. This project is a fiscal year 1993 line item.

1.1 BACKGROUND

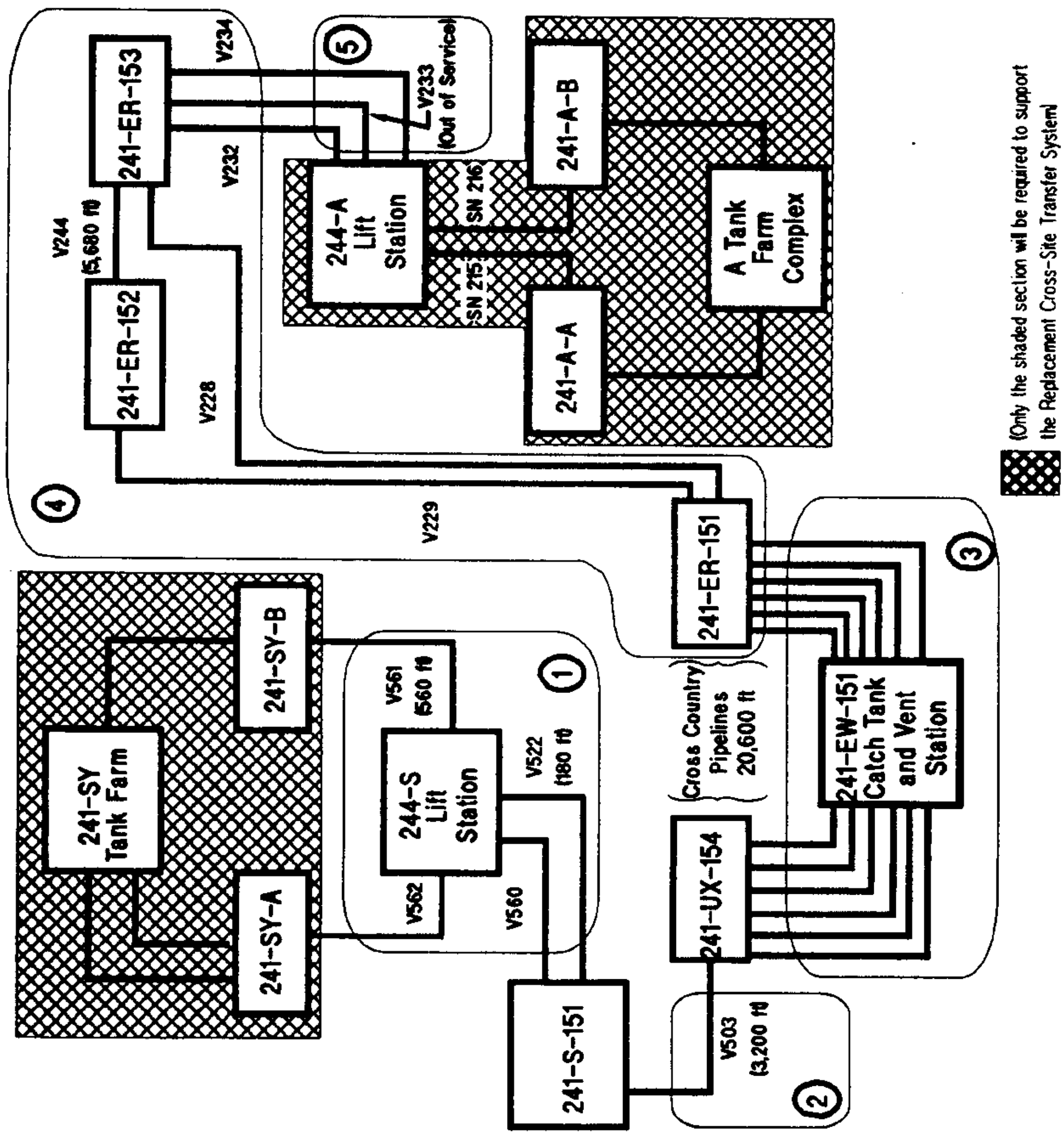
Liquid waste has been transferred between the 200 West and 200 East Area facilities for approximately 30 years. The piping system used in transferring this liquid waste connects the SY Tank Farm in the 200 West Area with the 200 East Area Tank Farms. The system configuration takes its form from a composite of projects that have been installed in the past 7 to 40 years. Figure 1-1 is a schematic representation of the existing composite system. The following is a brief summary of the system segments as they are represented in Figure 1-1.

- Segment 1--The piping system that connects the SY Tank Farm with the 244-S Lift Station and the 241-S-151 Diversion Box includes the V561, V562, V560, and V522 pipelines. The system was installed by Project B-135, circa 1970. The pipelines consist of 3-in. Schedule 40 carbon steel pipe inside a 6-in. carbon steel encasement piping with annulus leak detection. The 244-S Lift Station consists of an underground reinforced concrete pump pit that contains the piping connections and jumpers which transfer the liquid waste through the facility. The 241-S-151 Diversion Box is a reinforced concrete structure that contains piping connections and jumpers providing the routing for 200 West Area facility liquid waste transfers into the SY Tank Farm as well as cross-site transfers. Segment 1 will remain in use but will not be part of the new cross-site transfer system.

- Segment 2--The V503 pipeline connects the 241-S-151 Diversion Box and the 241-UX-154 Diversion Box. The pipeline is 3-in. Schedule 10 stainless steel in a reinforced concrete encasement. This segment was installed by Project HCP-545, circa 1970. This segment will be taken out of cross-site service.

- Segment 3--The portion of the system that lies between the 200 West and 200 East Areas is often referred to as the cross-country transfer system. The system consists of six 3-in. Schedule 10 stainless steel pipelines in a reinforced concrete encasement. This system was installed by Project C-362 III, circa 1950. This pipeline connects 241-UX-154 in the 200 West Area and 241-ER-151 in

Figure 1-1. Existing Cross-Site Transfer System
Shown in Segments 1 through 5.



the 200 East Area. The 241-EW-151 Vent Station is located at the high point between the 200 East and West Areas to accommodate line drainage. Four of the six pipes have plugged during transfers and at least one ruptured during attempts to clear the blockage. This segment will be taken out of cross-site service.

- Segment 4--The segment that connects the 241-ER-151 Diversion Box to the 241-ER-152 and -153 Diversion Boxes was installed under Project B-103, circa 1974. This segment consists of the 241-ER-151, -152, and -153 Diversion Boxes and three pipelines (V229, V228, and V244). The pipelines are 3-in. Schedule 10 stainless steel and are encased with a reinforced concrete structure. This segment will be taken out of cross-site service.

- Segment 5--The segment that connects the 241-ER-153 Diversion Box to the 244-A Lift Station (pipelines V232 and V233) was constructed under Project B-103. The V234 line was installed in the 1980's under a capital work order. The V234 line, a 3-in. carbon steel inner with 6-in. carbon steel encasement, replaced the failed V233 line. This segment will be taken out of cross-site service.

1.2 EVALUATION OF THE EXISTING CROSS-SITE TRANSFER SYSTEM

An audit was performed by the U.S. Department of Energy (DOE), Richland Operations Office (RL) on the Cross-Site Transfer Facilities in the fall of 1988. An audit finding stated that Westinghouse Hanford Company (WHC) was to evaluate the availability of the transfer system to meet projected waste transfer requirements. An engineering study (Cejka 1990), prepared in response to the audit, recommended selective replacement of the transfer system with a new system. This recommendation was made because the age and configuration of some of the segments contribute to a potentially low reliability. Additionally, several segments do not comply with RL and other federal and state standards. A brief summary of the deficiencies follows.

- Segments 2, 3, and 4 in Figure 1-1 do not comply with the state and federal criteria for secondary encasement. The concrete encasement would not meet leak-tightness criteria. The design could allow leaked waste from the primary piping to enter the environment. The configuration also does not promote rapid detection of potential primary leaks and would be difficult to decontaminate.

- Segments 2, 3, and 4 are relatively thin-walled, stainless steel pipes that have exceeded or are nearing the end of their useful design life. The current transfers are caustic liquid wastes and require a heavier wall stainless steel pipe.

- Segment 2 provides a transfer function that has no backup. A failure in this segment could lead to a long-term outage of the system.

The piping systems within the SY Tank Farm, Segments 1 and 5, and the remainder of the piping from the 241-A-A and -A-B Valve Boxes to the 200 East Area tank farms meet the basic *Resource Conservation and Recovery Act of 1976*

(RCRA) requirements for secondary containment and interstitial leak detection. The ancillary systems and features of these segments may require upgrades to comply with current RL and RCRA standards. A separate programmatic effort is preparing an environmental and facility compliance assessment of the tank farm systems. Should the study determine that upgrades or modifications are required, they would be done as a separate effort outside the scope of this project. It is assumed that these segments will continue containment and interstitial leak detection functions.

The study conclusion (Cejka 1990) supported the continued use of the SY Tank Farm process piping system, Segments 1 and 5, and the remainder of the 200 East Area transfer system to the double-shell tanks. This functional design criteria document implements the functional requirements for the replacement of the cross-site transfer system (RCSTS) recommended in the study.

The new facilities provided by Project W-058 are required to provide the system reliability and facility compliance to support the planned mission of the cross-site transfer system. The key function is to support the transfer of liquid wastes from the SY Tank Farm to the treatment, storage, and disposal facilities in the 200 East Area. The waste associated with the SY Tank Farm includes 222-S Laboratory and decontamination and decommissioning waste, Plutonium Finishing Plant waste, 200 West Area single-shell tank (SST) waste, and decontamination and decommissioning cleanup waste streams from various facilities such as T Plant and U Plant. The SY Tank Farm is planned to be the staging facility for cross-site transfers.

Failure to implement Project W-058 would put these missions and functions at risk. This could lead to plant shutdowns, fines, and/or legal actions against the DOE and/or its contractors. Additionally, part of the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al. 1994) regarding SST cleanout would be jeopardized should the cross-site transfer system be shut down. Project W-058 supports those portions of the Tri-Party Agreement that deal with tank cleanup. The cross-site transfer line will be the principal means of transferring liquid waste.

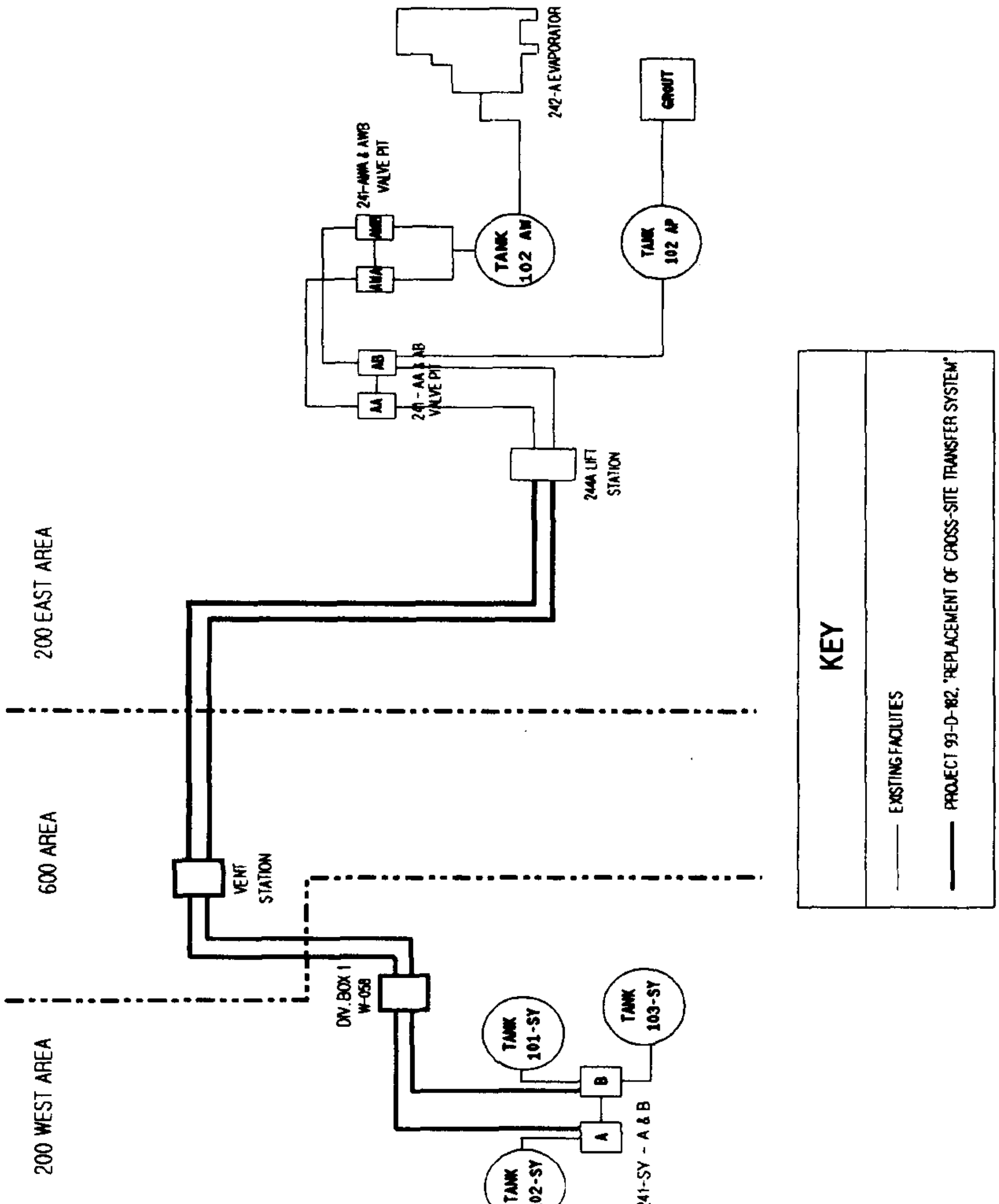
1.3 SCOPE OF PROJECT W-058

The work scope of Project W-058 is to provide a replacement piping system for the existing cross-site transfer system. The system shall consist of a pipe-in-pipe system connecting the 241-SY Tank Farm at 241-SY-A and -B valve boxes with the 244-A Lift Station (see Figure 1-2).

The purpose of this system is to pump liquid and slurry waste from the 200 West to the 200 East Area, and to facilitate connection for future Tank Waste Remediation System (TWRS) projects (see Figure 1-2).

Nonslurry liquid waste can be transferred from the 200 East to the 200 West Area using the 200 East Tank Farm transfer pumps and the piping from Project W-058. The pump(s) supplied by Project W-058 are not configured to support 200 East to 200 West Area liquid or slurry waste transfers. The system shall include leak detection, monitoring and control, operational and safety features, ancillary components, and functions specified and referenced

Figure 1-2. Replacement of Cross-Site Transfer System.



within this document. The new system complies with the required DOE facility criteria for radioactive liquid waste facilities specified in DOE Order 6430.1A, *General Design Criteria*, Division 1323 (DOE 1989). The replacement system also complies with secondary containment requirements in WAC 173-303-400 and WAC 173-303-640. The system shall include approximately 6 1/2 miles of pipe-in-pipe transfer lines. All transfers and project-supplied booster pump(s) shall be controlled from a process control station in the 200 West Area provided for the RCSTS. The existing interlocks, alarms, and safety features of the monitoring and control system are to be incorporated into the replacement system. The system will incorporate testing and cleaning features compatible with the current plant. Access for surveillance and safety functions will be provided along the pipeline route. The project also will provide required isolation of unused portions of the existing cross-site transfer system. These portions are Segments 2, 3, 4, and 5 shown in Figure 1-1. However, this project does not provide for the decontamination and decommissioning or removal of the existing pits or pipelines.

For installation of this project, decontamination activities will be performed by the operating contractor. Radiological control area work will be required to make the system interfaces. As low as reasonably achievable (ALARA) principles will be followed.

1.4 INTEGRATION

The mission of Project W-058 is to allow for pumping of slurry transfers from the 200 West to the 200 East Area, and the transfer of liquid waste in either direction between the 200 East and 200 West Areas, and to facilitate future connection for all applicable TWRS facilities. This activity assists other activities that directly support Tri-Party Agreement milestones.

One of the cross-site lines shall be designed as the dedicated 200 West to 200 East Area slurry route. The other transfer line shall be configured to facilitate east to west or west to east nonslurry liquid waste transfers and shall not connect to the booster pump(s) (see Figure 1-2). Interconnections between these transfer lines shall be minimized to reduce the likelihood of a misrouting accident.

2.0 FUNCTION

Project W-058 will transfer liquid waste, slurry, and raw water flush between the SY Tank Farm in the 200 West Area and the 200 East Area Tank Farms. The system will operate from the process control station in the 200 West Area for west-to-east transfers. East-to-west transfers will be controlled from the originating facility and the 200 West Area process control station. The system shall be equipped with a leak detection system that initiates safe shutdown if a primary piping system is breached. The leak detection system shall be designed to facilitate the location of a leak in the primary containment system. The project also shall be designed to facilitate testing of the integrity of the primary and secondary containment systems by pressure testing. Further leak detection capabilities will be provided through the above-mentioned integrity testing provisions.

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3.0 DESIGN CRITERIA

3.1 CAPACITIES

Each pipeline shall be capable of transporting liquid waste with the characteristics given in this functional design criteria document as follows:

- Peak flow of 20 million gallons per year
- Total of 200 million gallons over the design life of the project.

3.2 DESIGN LIMITATIONS

3.2.1 Temperature

The transfer piping system (both primary and secondary containment) shall be designed to withstand normal liquid waste temperatures in the range of 80 to 200 °F. The system also shall be designed to withstand flush water temperatures in the range of 35 to 200 °F. The underground piping systems shall be buried or bermed to prevent freezing during winter months. The system shall consider thermal effects between the piping and the soil, and between the primary and secondary piping.

3.2.2 Fluid Flow

The minimum design velocity and flow rate of liquid waste through the system shall be high enough to prevent solids from settling and clogging the pipelines during a transfer of a Newtonian/non-Newtonian fluid based on the provided waste physical characteristics (see Section 3.3). A non-Newtonian friction factor of 0.0404 shall be used for the design of the system for 200 West to 200 East Area transfers.

3.2.3 Operational Pressures

The transfer system and all its components that would be subjected to the system pressure shall be designed to withstand a minimum of 400 psi so that the pipe can withstand operating pressure from other systems. The system can be designed to higher pressures if cost-effective and if other systems are protected from overpressurization. The system also shall be designed to withstand the pressures produced by the various integrity tests and normal operation plus a reasonable safety factor for the design life of the project.

3.3 RANGE OF OPERATION

The RCSTS equipment shall be designed such that the velocities shown in Table 3-1 can be achieved for wastes with the corresponding parameters shown in Table 3-1. The critical transfer velocity will be determined by the cognizant engineer before each transfer, based on waste characterization.

3.4 PIPING

The pipeline system shall consist of pipe-in-pipe transfer lines in a routing configuration as shown in Figure 1-2. The pipe-in-pipe transfer lines shall comply with the secondary containment requirements in WAC 173-303-400; WAC 173-303-640; and DOE Order 6430.1A, *General Design Criteria* (DOE 1989).

The primary piping shall be 304L stainless steel and the encasement piping shall be carbon steel (Parsons 1994). The piping components shall be chemically compatible with the alkaline radioactive mixed liquid waste listed in Appendix A. The system also shall be designed with a 230 psi relief valve to prevent overpressurization of the existing connecting transfer line network. Pump 102-SY will be capable of supplying 140 gal/min and 20 ft of net positive suction head to the suction of the Project W-058 booster pump(s).

All pipe and pipe fittings outside the diversion boxes and other boxes are to (1) be joined with welds, (2) be provided with the capability for periodic pressure tests, and (3) have water flush capabilities. Piping within the boxes may be joined via jumpers, welds, or mechanical means as required for transfer flexibility and ease of maintenance. However, national pipe thread connections shall not be used for piping in contact with the waste. Provisions for maintenance shall be incorporated.

The system shall be designed and constructed to minimize the settling of solids in the pipes, pipe fittings, or other piping components during and after the batch transfers. The system also shall be designed such that the

Table 3-1. Design Parameters.

Achievable design velocity*	4.5 ft/s	6.0 ft/s
Specific gravity (mixture)	1.5	1.25
Viscosity	30.0 cP	10 cP
Solid content	30% solids volume fraction	20% solids volume fraction
Miller number		
Minimum pH (Harris 1992)	<100	<100
Transfers/flushes		
Temperature	11.0	11.0
Transfers/flushes		
Insulation	35 to 200 °F	35 to 200 °F
Particle size**	Required	Required
Friction factor	0.5 to 4,000 μm	0.5 to 4,000 μm
	0.0404 (non-Newtonian)	Newtonian flow

*Achievable design velocity is the theoretical velocity at which the pumped materials with the characteristics shown in this table can be transferred. It is not intended or implied that these velocities are the optimal transfer velocities for waste with the given characteristics.

**0- to 50-μm particles will comprise approximately 95% of total.
50- to 500-μm particles will comprise <5% of total.
500- to 4,000-μm particles will comprise <1% of total.

vent station is the high point of the system and the two ends are the low points. The pipe shall have a continuous slope of at least 0.25% to avoid traps. The design shall minimize air entrapment in the primary containment pipe.

The primary and secondary piping shall be designed to withstand a Safety Class 1 seismic event (see Table 4-1). The system shall consider the effects of loads such as soil friction forces generated by ground seismic movements or thermal expansion of both pipes, building or structure seismic anchor movements or settlements, internal pressure, and weight of external soil cover and surface vehicles.

3.5 VENT STATION

The vent station shall be located at the high point of the transfer system. The station shall be designed to introduce air into the lines after a transfer to facilitate draining of the primary containment pipe. The secondary piping also shall accommodate draining. Appropriate valving and backflow prevention shall be incorporated into the design to prevent the movement of waste into systems and components that were not intended to contain the waste.

The vent station shall be equipped with a stainless steel liner, capability to remove accumulated liquids, wash-down decontamination capability, and a connection for a portable ventilation system for maintenance. The vent station shall control the release of contamination to the environment.

Those features required to mitigate the consequences of an accidental spray release to the environment (e.g., from valve stems, pump[s], piping, etc.) must retain their mitigation function following a Safety Class 1 seismic event (see Table 4-1).

3.6 BOOSTER PUMP(S)

Booster pump(s) shall be provided as required to meet the functional requirements of this document. The design also shall identify the location for a future pumping station for added flexibility.

A bypass shall be provided around each of the booster pump(s). The bypass shall be designed to allow transfers of dilute solutions by bypassing the booster pump(s) when required. Isolation shall be provided so that the bypass will not remain liquid filled during pump operations. The design of the bypass shall be configured so that its use during bypass of a pump meets the requirements regarding slope, draining, low pockets, etc.

The booster pump(s) shall be equipped with variable-speed drives. The booster pump(s) shall be designed to withstand a Safety Class 1 seismic event (see Table 4-1).

3.7 DIVERSION BOX

A diversion box shall be incorporated into the design of the system. The purpose of the box is to facilitate the transfer of liquid waste between the 200 West and 200 East Areas and future TWRS projects. The location shall be determined to support efficient pumping and connection to the existing and planned facilities.

The diversion box shall be equipped with a stainless steel liner, capability to remove accumulated liquids, wash-down decontamination capability, and a connection for a portable ventilation system for maintenance. The diversion box shall control the release of contamination to the environment.

Provision shall be made for the storage of equipment removed during maintenance. The diversion box shall be designed to prevent intrusion of rain or snow melt. Diversion box sumps shall be routed to the transfer line(s).

The RCSTS design shall allow four spaces in the diversion box, two spaces for each transfer line, for future tie-ins by any new facilities that may require access to it. Because the project includes provisions for flushing the lines following transfers, residual contamination and radiological exposure to workers performing these tie-ins will be minimized.

Those features required to mitigate the consequences of an accidental spray release to the environment (e.g., from valve stems, pump[s], piping, etc.) must retain their mitigation function following a Safety Class 1 seismic event (see Table 4-1).

3.8 INSTRUMENTATION

Instrument wiring shall be housed separately from power wiring for protection and to facilitate future modifications. As a general practice, 120-Vac and 24 Vdc-cables should not be run in common duct and manhole systems. Underground instrument and electrical wiring will be installed in accordance with the requirements specified in DOE Order 6430.1A.

3.8.1 Pipeline and Pump Instrumentation

The following parameters shall be monitored:

- Temperature
- Pressure
- Flow measurement
- Valve positioning.

Leak detection devices shall be provided to detect leaks from the primary pipe to the secondary pipe, diversion box, and vent station. Monitoring instrumentation shall be capable of detecting the failure of the containment system within 24 hours as required by WAC 173-303-640. (The system shall be capable of testing the integrity of the secondary pipe periodically to ensure that a primary pipe leak will be contained in the secondary pipe.) The design shall incorporate a remote alarm system to facilitate quick and safe transfer shutdowns if the primary containment pipe is breached.

Leak detection associated with the liquid waste transfer route shall be interlocked to effect safe shutdown of the transfer pump(s). Pump control capability shall be associated with the facility conducting the transfer. Specific locations for tank farm waste transfer equipment control and indicators shall be determined during the preparation of the definitive design documents.

3.8.2 Diversion Box and Vent Station Instrumentation

Leak detection shall be provided in the diversion box and vent station. Interlocks shall shut down a liquid waste transfer through the diversion box if a leak is detected.

3.8.3 Interlocks

Transfer pump(s) shall be interlocked to shut down waste transfers in the event of a system failure. Interlocks can be hardware or software.

3.8.4 Insulation and Preheating

The secondary containment pipe shall be insulated such that heat loss during a slurry transfer using the booster pump, pumping waste at 4.5 ft/s, with 1.5 specific gravity at 200 °F, is $\leq$20 °F. Preheating liquid up to 200 °F can be supplied to the 241-SY-A and -B valve pits through the existing SY flush pits and/or Project W-211.

3.8.5 Process Control Station

A modem on a dedicated telephone line will transmit the RCSTS control signals from the 242-S Substation at Building 252-S to the 200 West Area Tank Farm Transition Projects Shift Office in Building 278-WA where the operator control station will be located. The monitor and control system shall be provided with a 1-hour uninterruptible power supply system, and the process control units shall have a minimum of 1-hour battery backup to allow the system to be statused and to maintain programming following a loss of power.

3.9 WASTE TRANSFER NOZZLES

Core drills and nozzles shall be provided to connect the pipelines to new and existing facilities. Core drilling and nozzles shall be compatible with the new liquid waste transfer system and existing facilities.

3.10 VALVING

Valving shall be provided to obtain the necessary waste transfer flexibility. The valving shall be equipped with position indication devices.

3.11 BACKUP FLUSHING

A backup flush system shall be designed to flush at 6 ft/s from an independent water source. The backup flush system shall be capable of supplying 140 °F water to the suction of the pump. The flush system shall retain its structural integrity following a Safety Class 1 seismic event (see Table 4-1). The flushing system shall be operated from the process control station.

4.0 GENERAL REQUIREMENTS

4.1 NUMBER OF OPERATION PERSONNEL

No additional personnel are required to operate the new transfer system. However, because the system will have increased instrumentation requirements, additional personnel probably will be required for calibration and maintenance of the instrumentation during the life of the plant.

4.2 COMMUNICATION SYSTEM

The communication system that is presently in place is adequate for this project. Telephones will be used where they exist and radios will be used at remote locations.

4.3 GENERAL UTILITY REQUIREMENTS

Electrical power (e.g., 120 V, 208 V, 240 V, 480 V, etc.) shall be provided for operation of pump(s), valves, instrumentation, and outlets for remotely operated impact wrenches and other equipment, as required.

Diversion Box 1 shall be powered from two new 13.8-kV primary voltage and 480Y/277V transformers. Either transformer shall be able to carry the electrical load of the facility. The transformers shall be electrically interlocked and shall be fed from two separate 13.8-kV sources.

The new transformers shall be delta-wye, liquid-filled, standard impedance units.

The vent station shall be powered from an existing 13.8-kV-480Y/277V transformer.

The loads required to operate the backup flush system shall be fed from redundant transformers.

Electrical systems design and installation shall conform to NFPA 70-1993, *National Electrical Code* (NFPA 1993) and ANSI C2, *National Electrical Safety Code* (ANSI 1993). No equipment or material containing mercury or polychlorinated biphenyls shall be used. To the extent possible, all electrical equipment shall be isolated from mechanical equipment. Electrical systems shall be sized to provide a minimum of 20% spare capacity.

All control circuits and cables shall be numbered on design documents and be identifiable when installed. Instrument conductors shall be identified by the instrument served. Lighting circuits, receptacle circuits, power supply circuits, and heat trace circuits shall be identified with the originating panel identification and corresponding circuit breaker as a minimum.

Where applicable, the equipment shall be designed to operate in a radiation field.

All safety switches and circuit breakers, including 208Y/120-V panelboards, shall be equipped with provisions for locking out. Power and instrument circuits shall be in separate raceways.

Safety Class 1 design shall minimize single active failures in conformance with IEEE 379-1988 (IEEE 1988), and provide independence of Safety Class 1 circuits if used in the design, in conformance with IEEE 384-1992 (IEEE 1992) and independence of Safety Class 2 circuits using IEEE 384-1992 as a guide.

4.3.1 Lighting

Personnel doors for staffed facilities shall have lighted exit signs placed above the doors to designate exit routes. Exit sign design shall be such that when normal power fails, a backup source will provide power. Tritium-energized exit signs shall not be used.

All ballast-type discharge lighting shall have a power factor of 95% or better.

4.3.2 Metering

The normal power sources shall be metered and shall use digital metering technology. Metering shall, as a minimum, measure amperes, volts, watt-hours, and watt-hour demand. The watt-hour demand shall have a minimum 15- to 60-minute data collection interval.

4.3.3 Normal Power

The RCSTS shall be designed to use 208Y/120-Vac and 480Y/277-Vac, 3-phase, 4-wire and 120/240-Vac, single phase, 3-wire electrical distribution systems.

Electrical equipment (e.g., transformers, load centers, motor control centers, and distribution panelboards) shall be provided to distribute the electrical power required to operate the system.

4.3.4 Receptacles

The 120-Vac electrical receptacles shall be provided throughout the system (interior and exterior). Welding receptacles (480 Vac) shall be provided as required.

4.3.5 Grounding

A system for the grounding of electrical equipment, structural components, diversion box/vent station liners, equipment, structural steel, metal stairways, etc., shall be provided.

Grounding shall be in accordance with NEC-250 (NFPA 1993) and HPS-SDC-7.5, "Standard Electrical Design Criteria for Interior Power and Lighting Systems (DOE-RL 1986). Grounding pads shall be installed wherever possible for general-purpose grounding. The grounding system shall be tied to the cathodic protection system.

Lightning protection shall be considered in accordance with NFPA 780-1992, *Lightning Protection Code* (NFPA 1992).

4.3.6 System Design Power Factor

The normal distribution system shall meet a minimum design power factor of 0.95.

Motors and loads fed via the electrical distribution system shall meet the design power factor of 0.95. The use of high-efficiency motors, high-efficiency lighting ballasts, variable-speed drive controllers, capacitors (for power factor correction), or other proven measures is required.

4.4 MAINTENANCE REQUIREMENTS

The project design shall incorporate the use of interchangeable parts and access for visual inspection and maintenance using standard tools and equipment. If special tools are required, the tools and instructions for use shall be provided with the equipment.

The design shall consider minimizing hands-on contact maintenance, either at conceptual design or definitive design. The design shall incorporate human factors for safety of operations in accordance with requirements in DOE Order 6430.1A and WHC-SD-GN-DGS-30011, *Radiological Design Guide* (Evans 1994). Note that the diversion box and vent station will not be staffed during a waste transfer under normal conditions.

The "Conduct of Operations," as practiced by the tank farms personnel in day-to-day operations, shall be used to the maximum extent practical. These requirements are described in plant operational procedures, safety analysis reports, operational safety documents, training programs, emergency and contingency plans, WHC manuals, and ALARA goals. Conduct of Operations shall be in accordance with DOE Order 5480.19, *Conduct of Operations Requirements for DOE Facilities* (DOE 1990), as applicable.

Modular/prefabrication of components can be used to enhance future site closure, ease construction costs, and improve schedules if all DOE Orders and federal, state, and local regulations, codes, and standards are satisfied. Facilities must be integrated to make use of common needs (e.g., existing office space and communications). As many structures as possible shall be kept in clean areas.

All equipment and instruments shall be designed to operate in the environment in which they are located and to be maintained with standard tools wherever practical.

Equipment and systems shall be capable of in-place preventive maintenance, repair, and calibration, where applicable. Piping, equipment, and instrumentation located in the diversion box and the vent station shall have remote testing and interrogation capability to determine performance and condition. They also must be capable of being remotely removed and replaced or the area decontaminated such that hands-on maintenance is feasible. The diversion box design shall facilitate access to, or removal of, equipment, and consider shielding requirements described in Section 4.12.

4.5 SECURITY AND SAFEGUARDS

Parts of the project will be within the 200 East Area, 600 Area, and 200 West property protected area. A safeguards and security-approved construction and security plan shall be provided in accordance with WHC procedures.

4.6 NATURAL FORCES CRITERIA

This facility and all necessary components shall comply with the design loads for nonreactor structures in accordance with HPS-SDC-4.1, "Standard Arch-Civil Design Criteria, Design Loads for Facilities" (RL 1993) for the applicable safety class as defined in WHC-SD-W058-PSAR-001, *Replacement of Cross-Site Transfer System Preliminary Safety Analysis Report* (Kidder 1995), except that the seismic design shall be in accordance with HPS-SDC-4.1, Table 4-1 (Conrads 1994), and WHC-SD-W236A-DGS-001, *Structural Design Guidelines for Multi-Function Waste Tank Facility Underground Tanks and Piping for Project W-236A* (Shrivastava 1994).*

Table 4-1. Seismic Design Criteria.

Safety Class	Ground motion loads (g)
1 (Nonreactor)	0.20*
2	0.15*
3	0.15
4	0.10

*See Appendix C for response spectra.

*Methodology from WHC-SD-W236A-DGS-001 is applicable only for design of underground piping.

4.7 ENVIRONMENTAL CONDITIONS

All components of this facility will be exposed to the environmental conditions experienced on the 200 Area plateau of the Hanford Site, and must be designed to meet the temperature conditions for process buildings and equipment. The RCSTS shall neither be compromised by the full range of anticipated temperature, pressure, humidity, wind, or precipitation, nor shall it be compromised by the periodic fluctuations of meteorological conditions typical of the daily or seasonal cycles at the Hanford Site. The system shall comply with the requirements of WHC-CM-7-5, *Environmental Compliance*. Points of contact for environmental permitting are as noted in Chapter 9.0 of that document.

4.8 ARCHITECTURAL

The structures shall protect the equipment, components, and personnel from the environmental conditions anticipated for the Hanford Site. The operations process control station will accommodate 24-hour operation and permit continuous staffed operation and surveillance during transfer in compliance with DOE Order 6430.1A.

4.9 DECONTAMINATION AND DECOMMISSIONING

All equipment, components, and structures provided by this project are designed and constructed to facilitate eventual decontamination and decommissioning activities. Decontamination and decommissioning of existing facilities is not within the scope of this project. Any waste piping systems that are removed from service by this project shall be isolated in an environmentally acceptable manner.

4.10 SITE LOCATION

The RCSTS shall replace the present pipeline system that runs between the SY Tank Farm in the 200 West Area and the 244-A Lift Station in the 200 East Area. The RCSTS shall run adjacent to the existing system but far enough away to comply with ALARA standards.

4.11 CORROSION PROTECTION

The design of the RCSTS shall consider cost-effective means to achieve the design life by minimizing corrosion of system components. Materials in contact with transfer media shall be corrosion-resistant. The system shall be designed to satisfy WAC 173-303-640(3)(a).

The designed system shall be compatible with the existing cathodic protection systems of the surrounding facilities. If an impressed current system is used, a startup survey shall be performed to verify that the completed system is functioning as designed and does not cause stray current damage to other metallic structures within the zone of influence.

4.12 SHIELDING REQUIREMENTS

Shielding or other limitations shall be provided to limit personnel radiation dose rates at exposed exterior surfaces of the diversion box and vent station and at the ground surface above all buried process piping to ALARA levels. The rates shall not exceed 0.1 rem/yr in accordance with 10 CFR 835, "Occupational Radiation Protection" and DOE Order 5480.11, *Radiation Protection for Occupational Workers* (DOE 1988). The shielding design shall be based on the source term in Appendix E, Table E-1.

4.13 DESIGN LIFE

The piping in the RCSTS shall be designed with a service life of 40 years. Components must be easily replaceable if they have a shorter design life. Components shall have the longest economically achievable design life.

4.14 NONDESTRUCTIVE EXAMINATION

The diversion box and vent station shall be designed to provide access for in-line decontamination, inspection, and testing of the pipe, valves, and pump(s). Access shall be designed to allow insertion of flushing equipment (hydrolaze, snake, etc.). Bends, junctions, and fittings shall be designed to allow passage of the above-mentioned flushing equipment. Access also shall be provided to allow insertion of a nondestructive testing probe into the buried portions of the primary piping.

4.15 ACCIDENT ANALYSIS WASTE INVENTORIES

Accident analyses shall be based on the radionuclide inventory concentrations shown in Appendix F, Table F-1, and on the chemical inventory concentrations shown in Appendix F, Table F-2.

4.16 MODE OF OPERATION

See Appendix D for details on mode of operation.

5.0 QUALITY ASSURANCE (QA) REQUIREMENTS

Quality assurance requirements for all contractors involved in the design, construction, inspection, testing, and acceptance of the proposed facility provide assurance that the facility is designed and constructed as intended. The design shall be developed in accordance with the RCSTS Quality Assurance Program Plan (QAPP). The QAPP shall comply with 10 CFR 830.120, "Nuclear Safety Management," as implemented in WHC-SP-1131, *WHC Quality Assurance Program and Implementation Plan* (Moss 1995). Construction shall be performed in accordance with the design. Inspection, testing, and overview acceptance activities shall confirm the adequacy of the design and construction.

Functional safety classification of structures, systems, and components defined in WHC-CM-4-46, *Nonreactor Facility Safety Analysis Manual*, Chapter 9.0, was used as the basis for grading QA requirements.

A safety class designation list for structures, systems, and components is provided in WHC-SD-W058-PSAR-001, *Replacement of Cross-Site Transfer System Preliminary Safety Analysis Report* (Kidder 1995). This list may be revised, as required, based on the issuance of the final safety analysis report. Safety Class 1 is the highest classification anticipated for any structure, system, or component of the facility.

For review and approval purposes, QA technical baseline documents shall be assigned approval designators in accordance with WHC-CM-3-5, *Document Control and Records Management Manual*.

Project management plans, statements of work, letters of instruction, and the QAPP will designate the required interfaces among the operating contractor, architect-engineer, contractors, and subcontractors to achieve QA requirements without duplication of effort.

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6.0 RISK DISCUSSION AND HAZARD CLASSIFICATION

The design criteria described in this document provide an environmentally suitable liquid waste transfer system. This system meets the requirements of a nonreactor nuclear facility, in accordance with DOE Order 6430.1A.

The hazard classification depends on the radiological dose consequences of postulated accidents. The hazard classification analysis originally performed and a hazard analysis performed (Kidder 1995) classify this project as a moderate hazard. This functional design criteria document has been developed using this basis.

The chemical toxicity of double-shell tank liquid waste was analyzed using similar postulated accidents. For every compound, the consequences were far below the protective action guides; therefore, the hazard classification does not depend on toxicological consequences. The determining factors are the radiological consequences (Johnston 1990).

The highest safety classification of components for this project will be Safety Class 1 (Kidder 1995).

Risks associated with construction are also relatively low. Construction shall be performed in accordance with Occupational Safety Health Administration and Washington Industrial Safety and Health Administration regulations. Some construction activities will require work near, and adjacent to, existing nonreactor nuclear facilities. Existing work procedures shall be implemented to ensure the safety of the construction and operating personnel in the area of the existing facilities.

The design shall ensure that a single failure does not result in the loss of capability of a safety class system to accomplish its required safety functions.

To protect against single failures, the design shall include appropriate redundancy and shall consider diversity to minimize the possibility of concurrent common-mode failures of redundant items.

6.1 UNACCEPTABLE SAFETY CONSEQUENCES

The following documents/criteria are applicable and establish unacceptable safety consequences:

- DOE Order 6430.1A, 99.0, "General," and 99.17, "Radioactive Liquid Waste Facilities"
- DOE Order 6430.1A, 1300, "General Requirements," and 1323, "Radioactive Liquid Waste Facility Requirements"
- Fire/explosion. The fire hazards analysis will determine the need for fire protection systems. The fire hazards analysis and the fire protection systems (if required) shall be in accordance with

DOE Order 5480.7A, *Fire Protection* (DOE 1993), and DOE RLID 5480.7, *Fire Protection* (RL 1994).

- Criticality. According to WHC-CM-4-29, *Nuclear Criticality Safety Manual*, Section 2.0, at least two unlikely, independent, and concurrent changes (contingencies) in processing and/or operating conditions must occur before a criticality accident is possible. A criticality event is anticipated to be an unlikely event, and will be verified in accordance with DOE Order 6430.1A.

- Exposure of personnel to ionizing radiation shall not be in excess of the standards and guidelines specified in the DOE Order 5480 series and 10 CFR 835, "Occupational Radiation Protection," Section 835.1002.

7.0 CODES AND STANDARDS

The RCSTS shall be designed to comply with secondary containment and leak detection criteria found in WAC 173-303-400 and WAC 173-303-640. Engineering and construction activities shall be in accordance with DOE Order 6430.1A and with applicable regulations, codes, and standards (including DOE Orders) referenced in the following documents. The latest edition in effect at the start of definitive design shall be used. Applicable RL supplements to referenced DOE Orders shall be included.

NOTE: In accordance with DOE Order 6430.1A, "99" Sections and Division 13 special facilities only:

1. 1300, "General Requirements," and 1323, "Radioactive Liquid Waste Facility Requirements," are applicable
2. 99.0, "General," and 99.17, "Radioactive Liquid Waste Facilities," are applicable.

- 10 CFR 830, "Nuclear Safety Management"
- 10 CFR 835, "Occupational Radiation Protection"
- ANSI C2, *National Electrical Safety Code* (ANSI 1993)
- ANSI/ASME B31.3-1993, *Chemical Plant and Petroleum Refinery Piping* (ANSI/ASME 1993)
- DOE Order 4700.1, *Project Management System* (DOE 1987)
- DOE Order 5480.7A, *Fire Protection* (DOE 1993)
- DOE Order 5480.11, *Radiation Protection for Occupational Workers*, (DOE 1988)
- DOE Order 5480.19, *Conduct of Operations Requirements for DOE Facilities* (DOE 1990)
- DOE Order 5484.1, *Environmental Protection, Safety, and Health Protection Information Reporting Requirements* (DOE 1981)
- DOE Order 6430.1A, *General Design Criteria* (DOE 1989)
- HPS-SDC-1.3, "Preparation and Control of Engineering and Architectural Drawings" (DOE-RL 1990)
- HPS-SDC-4.1, "Standard Arch-Civil Design Criteria, Design Loads for Facilities" (RL 1993)
- HPS-SDC-7.5, "Standard Electrical Design Criteria for Interior Power and Lighting Systems" (DOE-RL 1986)

- IEEE 379-1988, *Application of the Single-Failure Criterion to Nuclear Power Generating Station Safety Systems* (IEEE 1988)
- IEEE 384-1992, *Criteria for Independence of Class 1E Equipment and Circuits* (IEEE 1992)
- NACE RP-01-69-92, *Control of External Corrosion on Underground or Submerged Metallic Piping Systems* (NACE 1992)
- NFPA 70-1993, *National Electrical Code* (NFPA 1993)
- NFPA 780-1992, *Lightning Protection Code* (NFPA 1992)
- DOE RLID 5480.7, *Fire Protection* (RL 1994)
- *Uniform Building Code* (ICBO 1988)
- WAC 173-201, "Water Quality Standards for Waters of the State of Washington"
- WAC 173-303, "Dangerous Waste Regulations"
- WHC-CM-1-3, *Management Requirements and Procedures*
- HSRCM-1, *Hanford Site Radiological Control Manual* (WHC 1994)
- WHC-CM-4-3, *Industrial Safety Manual*
- WHC-SD-GN-DGS-30011, *Radiological Design Guide* (Evans 1994)
- WHC-CM-4-11, *ALARA Program Manual*
- WHC-CM-4-29, *Nuclear Criticality Safety Manual*
- WHC-CM-4-33, *Security Manual*
- WHC-CM-4-46, *Nonreactor Facility Safety Analysis Manual*
- WHC-CM-6-1, *Standard Engineering Practices*
- WHC-CM-7-5, *Environmental Compliance*
- WHC-EP-0063, *Hanford Radioactive Solid Waste Packaging, Storage, and Disposal Requirements* (Stickney 1988)
- WHC-EP-0137, *Best Available Technology (Economically Achievable) Guidance Document for the Hanford Site Waste Management Systems Engineering* (Flyckt 1988).

In addition to the above standards, applicable "national consensus" codes and standards and pertinent state and local codes and standards will be used. The latest edition of all codes and standards in effect at the start of definitive design shall be used.

8.0 REFERENCES

10 CFR 830, "Nuclear Safety Management," *Code of Federal Regulations*, as amended.

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

ANSI, 1993, *National Electrical Safety Code*, ANSI C2, American National Standards Institute, New York, New York.

ANSI/ASME, 1993, *Chemical Plant and Petroleum Refinery Piping*, ANSI/ASME B31.3-1993, American National Standards Institute/American Society of Mechanical Engineers, New York, New York.

Cejka, C. C., 1990, *Engineering Study Replacement of the Cross-Site Transfer System*, WHC-SD-W058-ES-001, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Conrads, T. J., 1994, *Project W-058, Replacement of Cross-Site Transfer System, Seismic Design Criteria* (internal memo SMA:TJC:94-005 to W. M. Brantley, February 7), Westinghouse Hanford Company, Richland, Washington.

DOE, 1981, *Environmental Protection, Safety, and Health Protection Information Reporting Requirements*, DOE Order 5484.1, U.S. Department of Energy, Washington, D.C.

DOE, 1987, *Project Management System*, DOE Order 4700.1, U.S. Department of Energy, Washington, D.C.

DOE, 1988, *Radiation Protection for Occupational Workers*, DOE Order 5480.11, U.S. Department of Energy, Washington, D.C.

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

DOE, 1990, *Conduct of Operations Requirements for DOE Facilities*, DOE Order 5480.19, U.S. Department of Energy, Washington, D.C.

DOE, 1993, *Fire Protection*, DOE Order 5480.7A, U.S. Department of Energy, Washington, D.C.

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10.0 GLOSSARY

ABBREVIATIONS AND ACRONYMS

ALARA	as low as reasonably achievable
DOE	U.S. Department of Energy
QA	quality assurance
QAPP	quality assurance program plan
RCRA	Resource Conservation and Recovery Act of 1976
RCSTS	Replacement of Cross-Site Transfer System
RL	U.S. Department of Energy, Richland Operations office
SST	single-shell tank
TWRS	Tank Waste Remediation System
WHC	Westinghouse Hanford Company

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APPENDIX A

CHEMICAL COMPOSITIONAL RANGE

CONTENTS

LIST OF TABLES

APPENDIX A

CHEMICAL COMPOSITIONAL RANGE

This appendix provides the chemical compositions of the retrieved single- and double-shell tank waste that is expected to be transferred through the replacement of cross-site transfer system piping (WHC 1993). Table A-1 can be used for material selection purposes.

Table A-1. Chemical Compositional Range.[a] (sheet 1 of 2)

Retrieved waste				
Species	DST		SST	
	Anion/cation		Anion/cation	
	min mol/L	max mol/L	min mol/L	max mol/L
Ag	0	0.0013	--	--
Al	0.05	1.1	0.029	0.5
B	0	0.013	--	--
Ba	--	0.095[b]	--	0.095[b]
Bi	--	--	0	0.076
Ca	--	0.45[b]	--	0.45[b]
Cd	--	0.0054[b]	--	0.0054[b]
Cr	--	0.44[b]	--	0.44[b]
Cu	0	0.02	--	--
Fe	0.0004	0.26	0.0057	0.89
Hg	0	2.80 E-05	0	0.0001
K	0.044	0.55	0.0002	0.0095
La, Nd	--	0.12[b]	--	0.12[b]
Mg	0.0004	0.046	--	--
Mn	0.0003	0.16	0.0009	0.41
Mo	0	0.0029	--	--
Na	--	13.0[b]	--	13.0[b]
Ni	0.0002	0.008	0	0.042
Pb	0	0.004	0	0.12
Pd, Rh	0	0.0063	--	--
Si (SiO_2)	0.0024	0.028	0.0004	0.46
Ti	0	0.002	--	--
U	--	0.42[b]	--	0.42[b]
Zr (ZrO_2)	0	0.3	0	0.065
Acetate	--	--	0	0.0055
Citrate	0	0.03	0.0042	0.06

Table A-1. Chemical Compositional Range.[a] (sheet 2 of 2)

Retrieved waste				
Species	DST		SST	
	Anion/cation		Anion/cation	
	min mol/L	max mol/L	min mol/L	max mol/L
EDTA	0	0.016	0	0.011
HEDTA	0	0.021	--	--
$Fe(CN)_6$	--	--	0	0.025
Cl	0.003	0.17	0	0.022
CO_3	0.03	0.69	0.014	0.38
F	0.014	1	0.001	0.71
Fission product	0	0.0001	--	--
NO_2	0.1	1.8	0.0086	0.83
NO_x (NO_3)	0.15	3.6	0.64	5.1
OH	0.24	4.4	0.25	6.9
PO_4	0	0.4	0.0007	3.8
SO_4	0.003	0.16	0.01	0.22

[a]Source: WHC, 1993, *Recommended Waste Composition Changes to the MWTF FDC-Rev. 1* (Waste Management Engineering internal memo 22170-93-012 to J. M. Light, June 23), Westinghouse Hanford Company, Richland, Washington.

[b]These values are based on information from WHC-SD-WM-SARR-011, *Toxic Chemical Considerations for Tank Farm Releases* (Van Keuren 1995), as described in Appendix F and Table F-2 of this document.

DST = Double-shell tank
EDTA = Ethylenediametetraacetic acid
HEDTA = N-(hydroxyethyl)-ethylenediaminetriacetic acid
SST = Single-shell tank

A1.0 REFERENCES

Van Keuren, J. C., 1995, *Toxic Chemical Considerations for Tank Farm Releases*, WHC-SD-WM-SARR-011, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

WHC, 1993, *Recommended Waste Composition Changes to the MWTF FDC-Rev. 1* (Waste Management Engineering internal memo 22170-93-012 to J. M. Light, June 23), Westinghouse Hanford Company, Richland, Washington.

APPENDIX B

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APPENDIX C

SEISMIC RESPONSE SPECTRA

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Table C-1. Seismic Response Spectra.*

Safety Class 1 (0.20 g) Spectral acceleration for damping ratio (%):						
Period	0.5	2.0	5.0	7.0	10.0	12.0
0.033	0.200	0.200	0.200	0.200	0.200	0.200
0.100	0.755	0.554	0.420	0.373	0.319	0.289
0.200	0.966	0.699	0.525	0.462	0.394	0.362
0.300	0.929	0.674	0.506	0.446	0.381	0.349
0.500	0.775	0.565	0.426	0.377	0.321	0.294
1.000	0.526	0.389	0.293	0.258	0.223	0.206
2.000	0.219	0.163	0.125	0.111	0.099	0.092

Safety Class 2 (0.15 g) Spectral acceleration for damping ratio (%):						
Period	0.5	2.0	5.0	7.0	10.0	12.0
0.033	0.150	0.150	0.150	0.150	0.150	0.150
0.100	0.556	0.415	0.315	0.280	0.239	0.217
0.200	0.724	0.525	0.394	0.347	0.296	0.271
0.300	0.700	0.506	0.380	0.334	0.286	0.262
0.500	0.581	0.424	0.319	0.283	0.241	0.220
1.000	0.395	0.292	0.220	0.194	0.167	0.154
2.000	0.165	0.122	0.094	0.083	0.074	0.069

*Source: R. Youngs, 1994, Letter No. 2169.01 to A. Tallman, Westinghouse Hanford Company, Richland, Washington, May 5, Geomatrix Consultants, Inc., San Francisco, California.

C1.0 REFERENCES

Youngs, R., 1994, Letter No. 2169.01 to A. Tallman, Westinghouse Hanford Company, Richland, Washington, May 5, Geomatrix Consultants, Inc., San Francisco, California.

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APPENDIX D

MODE OF OPERATION

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APPENDIX D

MODE OF OPERATION

The cognizant engineer shall determine the characteristics of the waste before its transfer. The engineer shall, from the waste characterization data, determine the maximum and minimum permissible flow rates, the pump pressure and transfer head losses, critical waste temperature, interlock activation, and the dilution ratio of each waste transfer.

In accordance with the cognizant engineer's instructions and standard operating procedures, operations personnel will prepare the waste for transfer. The pipeline will then be filled to minimize vapor entrapment and "water hammer." The vapor in the pipeline will be pushed ahead of the waste to an exhaust system at the receiving tank. (This exhaust system is assumed by this project to be existing and in good working order.)

During the transfer operations, personnel shall monitor the system to ensure that the pipe is not clogging, the primary containment system is not leaking, and the pressure and fluid velocity rates are sufficient to avoid solids from settling in the pipe.

After the transfer is completed the system shall be flushed and a vent valve in the vent station will be opened. This will allow air to enter the pipeline, allowing the flush water to drain to both ends of the system.

The cognizant engineer shall inform the operating personnel of the appropriate procedure to use if a leak occurs in the primary containment system.

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APPENDIX E

RADIONUCLIDE INVENTORY CONCENTRATIONS FOR USE IN SHIELDING DESIGN

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APPENDIX E

RADIONUCLIDE INVENTORY CONCENTRATIONS FOR USE IN SHIELDING DESIGN

E1.0 DESCRIPTION

This shielding source term provides conservative values to use for calculation of external exposure from the Replacement of Cross-Site Transfer System. It is based on data from WHC-SD-WM-SARR-016 (Savino 1995), and derived from an assumed mixture of two-thirds of the maximum sample activity composite from the "All Liquids" group and one-third of the maximum sample activity composite from the "All Solids" group. This is a conservative source term that can be applied to the entire Replacement of Cross-Site Transfer System route. This should result in added operational flexibility and ensure that the line is designed to account for potential misroutings of "high-gamma" waste from the 200 East Area to the 200 West Area.

Table E-1. Radionuclide Activity Concentrations to be used for Shielding Design.

Nuclide	Nuclide concentrations (Bq/L)		
	All liquids	All solids	RCSTS
^{14}C	2.3 E+05	1.6 E+05	2.1E+05
^{60}Co	4.6 E+07	6.1 E+08	2.3E+08
^{79}Se	a	1.7 E+04	5.7E+03
^{90}Sr	1.1 E+10	3.0 E+12	1.0E+12
^{90}Y	1.1 E+10	3.0 E+12	1.0E+12
^{99}Tc	1.7 E+07	1.2 E+10	4.0E+09
^{106}Ru	3.3 E+03	2.4 E+05	8.2E+04
^{125}Sb	5.3 E+04	2.8 E+08	9.3E+07
^{129}I	2.0 E+04	6.4 E+06	2.1E+06
^{134}Cs	1.1 E+07	1.7 E+07	1.3E+07
^{137}Cs	9.2 E+10	1.0 E+11	9.5E+10
^{144}Ce	4.3 E+01	1.6 E+03	5.6E+02
^{147}Pm	5.7 E+07	a	3.8E+07
^{154}Eu	2.7 E+09	1.3 E+10	6.1E+09
^{237}Np	7.5 E+07	6.4 E+06	3.3E+08
^{238}Pu	2.3 E+05	9.9 E+08	6.5E+07
^{239}Pu[b]	1.8 E+06	1.9 E+08	5.6E+08
^{241}Pu	3.6 E+07	1.6 E+09	1.6E+09
^{241}Am	2.8 E+08	4.1 E+09	3.7E+09
^{242}Cm	3.7 E+07	1.1 E+10	1.1E+03
^{244}Cm	1.7 E+02	3.0 E+03	2.2E+07
^{155}Eu	1.3 E+05	6.5 E+07	5.2E+07

[a]No available data.
[b]The ^{239}Pu activity concentration also includes ^{240}Pu.

RCSTS = Replacement of Cross-Site Transfer System

E2.0 REFERENCES

Savino, A. V., 1995, *Tank Farm Waste Compositions and Atmospheric Dispersion Coefficients for use in ASA Consequence Assessments*, WHC-SD-WM-SARR-016, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

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APPENDIX F

ACCIDENT ANALYSIS WASTE INVENTORY CONCENTRATIONS

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APPENDIX F

ACCIDENT ANALYSIS WASTE INVENTORY CONCENTRATIONS

F1.0 DESCRIPTION

Table F-1 provides conservative radionuclide concentrations to use for calculation of inhalation doses during postulated accidents. The table is based on data from WHC-SD-WM-SARR-016 (Savino 1995), and derived from an assumed mixture of two-thirds of the maximum sample activity composite from the worst-case liquids group (i.e., "single-shell tank liquids"), and one-third of the maximum sample activity composite from the worst-case solids group (i.e., "Aging Waste Facility solids") presented in Table 8.1-1 of WHC-SD-W058-PSAR-001 (Kidder 1995). This source term is used in the analysis of Replacement of Cross-Site Transfer System accidents in Chapter 9.0 of WHC-SD-W058-PSAR-001.

Table F-2 provides conservative chemical analyte concentrations to use for calculation of inhalation doses during postulated accidents. It is based on data from WHC-SD-WM-SARR-011 (Van Keuren 1995), and derived from an assumed mixture of two-thirds of the maximum sample activity composite from the worst-case liquids group (i.e., "double-shell tank liquids"), and one-third of the maximum sample activity composite from the worst-case solids group (i.e., "single-shell tank solids") presented in Table 8.1-3 of WHC-SD-W058-PSAR-001 (Kidder 1995). This source term is used in the analysis of Replacement of Cross-Site Transfer System accidents in Chapter 9.0 of WHC-SD-W058-PSAR-001.

Table F-1. Radionuclide Activity Concentrations to be used for Accident Analyses.

Nuclide	Nuclide concentrations (Bq/L)		
	SST liquid	AWF solid	RCSTS
^{14}C	1.0E+05	1.0E+05	1.0E+05
^{60}Co	1.2E+07	6.1E+08	2.1E+08
^{79}Se	a	a	a
^{90}SR	1.1E+10	3.0E+12	1.0E+12
^{90}Y	1.1E+10	3.0E+12	1.0E+12
^{99}Tc	1.7E+07	2.8E+08	1.0E+08
^{106}Ru	3.3E+03	a	2.2E+03
^{125}Sb	5.3E+04	a	3.5E+04
^{129}I	1.0E+04	4.1E+06	1.4E+06
^{134}Cs	2.1E+05	a	1.4E+05
^{137}Cs	2.3E+10	1.0E+11	4.9E+10
^{144}Ce	4.3E+01	a	2.9E+01
^{147}Pm	a	a	a
^{154}Eu	2.7E+09	1.3E+10	6.1E+09
^{237}Np	a	9.9E+08	3.3E+08
^{238}Pu	9.3E+04	6.8E+07	2.3E+07
^{239}Pu[b]	3.6E+07	4.4E+08	1.7E+08
^{241}Pu	2.8E+08	1.8E+09	7.9E+08
^{241}Am	3.7E+07	1.1E+10	3.7E+09
^{242}Cm	a	3.0E+03	1.0E+03
^{244}Cm	a	6.5E+07	2.2E+07
^{155}Eu	7.5E+07	a	5.0E+07

[a]No available data. These radionuclides have a negligible impact on the radiological dose evaluations due to their low-activity concentrations.

[b]The ^{239}Pu activity concentration also includes ^{240}Pu.

AWF = Aging Waste Facility (Tank Farms 241-AY and 241-AZ)
RCSTS = Replacement of Cross-Site Transfer System
SST = Single-shell tanks

Table F-2. Chemical Analyte Concentrations to be used for Accident Analyses.

Analyte concentrations (g/L)			
Analyte	DST liquids	SST solids	RCSTS
Ammonia (NH_3)	7.1E+00	3.3E-01	4.8E+00
Antimony (Sb)	6.4E-03	1.5E+00	5.0E-01
Arsenic (As)	8.7E-03	1.2E+00	4.1E-01
Barium (Ba)	3.3E-02	4.0E+01	1.3E+01
Beryllium (Be)	3.8E-03	2.6E-02	1.1E-02
Cadmium (Cd)	7.0E-02	1.7E+00	6.1E-01
Calcium (Ca)	1.3E+00	5.1E+01	1.8E+01
Cerium (Ce)	5.8E-02	9.0E-01	3.9E-02
Chromium (Cr^{+3})	a	6.9E+01	2.3E+01
Cobalt (Co)	8.8E-03	5.4E-01	1.9E-01
Cyanide (Cn)	9.1E-02	2.8E+00	9.9E-01
Dysprosium (Dy)	a	a	a
Lanthanum (La)	1.0E+00	5.0E+01	1.7E+01
Mercury (Hg)	2.4E-04	5.4E+01	1.8E+01
Neodymium (Nd)	5.6E-03	2.3E-01	8.0E-02
Oxalate (C_2O_4)	a	2.8E+02	9.3E+01
Selenium (Se)	2.8E-01	3.5E+00	1.4E+00
Sodium hydroxide (NaOH)	2.1E+02	2.1E+02	2.1E+02
Sodium (Na) minus NaOH[b]	2.1E+02	4.8E+02	3.0E+02
Tellurium (Te)	2.7E-03	2.0E-01	6.8E-02
Thallium (Tl)	3.7E-02	1.2E+00	4.2E-01
TOC[c] minus Oxalate	4.0E+01	7.5E+01	5.2E+01
Uranium (U)	1.1E+01	2.8E+02	1.0E+02
Vanadium (V)	2.1E-03	3.3E-02	1.2E-02

[a]The best available data indicates there are not significant concentrations of these analytes in this composite.
[b]Designates sodium not associated with sodium hydroxide.
[c]Designates TOC not associated with oxalate.

DST = Double-shell tank
SST = Single-shell tank
TOC = Total organic compounds

F2.0 REFERENCES

Kidder, R. J., 1995, *Replacement of Cross-Site Transfer System Preliminary Safety Analysis Report*, WHC-SD-W058-PSAR-001, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

Savino, A. V., 1995, *Tank Farm Waste Compositions and Atmospheric Dispersion Coefficients for use in ASA Consequence Assessments*, WHC-SD-WM-SARR-016, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

Van Keuren, J. C., 1995, *Toxic Chemical Considerations for Tank Farm Releases*, WHC-SD-WM-SARR-011, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

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