S

ENGINEERING CHANGE NOTICE

Page 1 of 2

1. ECN 675701

Proj. ECN

2. ECN Category (mark one)	3. Originator's Name, Organization, MSIN, and Telephone No.	4. USQ Required?	5. Date
Supplemental ☐ Direct Revision ☒ Change ECN ☐ Temporary ☐ Standby ☐ Supersedure ☐ Cancel/Void ☐	Don Legare, Numatec, R3-25, 376-3489	☒ Yes ☒ No DCZ 8/21/03	07/30/03
	6. Project Title/No./Work Order No.	7. Bldg./Sys./Fac. No.	8. Approval Designator
	Project W-314, Requirements Verif. Rpt/AN Farm to 200E WTS	200 East Tank Farms	ESQ
	9. Document Numbers Changed by this ECN (includes sheet no. and rev.)	10. Related ECN No(s).	11. Related PO No.
	HNF-4533, Rev. 1	N/A	N/A

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

13a. Description of Change — 13b. Design Baseline Document? ☐ Yes ☒ No

As-built of RVR for 200E AN to Waste Transfer System.

14a. Justification (mark one)	14b. Justification Details
Criteria Change ☐ Design Improvement ☐ Environmental ☐ Facility Deactivation ☐ As-Found ☒ Facilitate Const. ☐ Const. Error/Omission ☐ Design Error/Omission ☐	This revision is required to as-built the 200E AN to WTS Requirements Verification Report.

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

See distribution sheet.

RELEASE STAMP

DATE: AUG 27 2003
STA: 4
HANFORD RELEASE
ID: 2

ENGINEERING CHANGE NOTICE

1. ECN (use no. from pg. 1): 675701

16. Design Verification Required	17. Cost Impact		18. Schedule Impact (days)
	ENGINEERING	CONSTRUCTION	
☐ Yes	Additional ☐ $ N/A	Additional ☐ $ N/A	Improvement ☐
☒ 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	☐		☐
Environmental Permit	☐	Inventory Adjustment Request	☐	None	☒

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

Document Number/Revision	Document Number/Revision	Document Number/Revision
N/A		

21. Approvals

	Signature	Date		Signature	Date
Design Authority	DE Bowers D.E. Bowers	8/21/03	Design Agent		
Cog. Eng.	~~DE Ledgre~~ JW Bailey	8/22/03	PE		
Cog. Mgr.	BH Thacker	8-20-03	QA		
QA	TL Bennington	8-11-03	Safety		
Safety	PJ Vopalensky	8-5-03	Design		
Environ.	JD Guberski	8/5/03	Environ.		
Other			Other		
Ops	MS Garrett	8/22/03			
Rad Con	R. J. Thomas	8-15-2003			
NS&L	RF Carlstrom	8-22-03	DEPARTMENT OF ENERGY		
	KN Jordan	8-26-03	Signature or a Control Number that tracks the Approval Signature		
			ADDITIONAL		

DISTRIBUTION SHEET

To	From	Page 1 of 1
Distribution	DE Legare	Date 07/30/2003
Project Title/Work Order		EDT No.
Project W-314, Requirements Verification Report for AN Farm to 200E Waste Transfer System		ECN No. 675701

Name	MSIN	Text With All Attach.	Text Only	Attach./ Appendix Only	EDT/ECN Only
DE Bowers	S5-13	X			
KN Jordan	R3-25	X			
TL Bennington	R3-25	X			
PJ Vopalensky	S5-12	X			
MS Garrett	S6-18	X			
DE Legare	R3-25	X			
~~RE Carlstrom~~	~~R1-43~~	~~X~~			
W-314 Project Library (3-hole punch)	R3-25	X H			
W-314 Project Files	R1-29	X H			

A-6000-135 (10/97)

CCC 8-26-03

~~RPP~~ HNF-4533, Rev. ~~1~~ 2

Project W-314, Requirements Verification Report for AN Farm to 200E Waste Transfer System

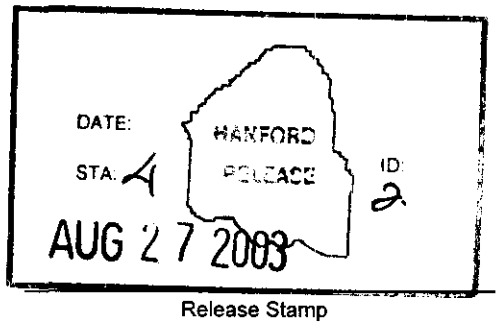
DE Legare for
CH2M HILL Hanford Group, Inc.
Richland, WA 99352
U.S. Department of Energy Contract DE-AC27-99RL14047

EDT/ECN: 675701 UC: N/A
Cost Center: N/A Charge Code: N/A
B&R Code: N/A Total Pages: ~~180~~ 182
CCC 8-26-03

Key Words: WTS, W-314, Acceptance for Beneficial Use, ABU Waste Transfer System

Abstract: N/A

8/26/03
Release Approval Date



Release Stamp

Approved For Public Release

RECORD OF REVISION

(1) Document Number: ~~ECN-675701~~ ~~RPP~~ HNF-4533

Page 1

(2) Title

Project W-314, Requirements Verification Report for AN Farm to 200E Waste 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) EDT-627811		
1	Direct Revision ECN-666457		
2 RS	Direct Revision ECN-675701	DE Legare 8/22/03	KN Jordan 8/26/03

A-7320-005 (10/97)

Requirements Verification Report

for

AN Farm to 200E Waste Transfer System

Project W-314
Tank Farm Restoration and Safe Operations

July 2003

Prepared by:	J.R. Collins, FFS, Engineering Manager	8/21/03 Date
Concurrence:	J. W. Viita, FFS, Project Manager	8-25-03 Date
Approval:	K. N. Jordan, Project Manager	8-26-03 Date
Approval:	D. E. Bowers, RPP Design Authority	8/21/03 Date
Approval:	M. S. Garrett, CHG, W-314 Retrieval Operations	8/22/03 Date

1 INTRODUCTION

This Requirements Verification Report provides the traceability of how Project W-314 fulfilled the Project Development Specification (PDS) requirements for the AN Farm to 200E Waste Transfer System Upgrade (WBS 1.4.L) package.

2 REFERENCE DOCUMENTS

HNF-SD-W314-PDS-001, Rev. 4, *Project Development Specification for Transfer Piping*

HNF-SD-W314-PDS-002, Rev. 4, *Project Development Specification for Valve Pit Manifold*

HNF-SD-W314-PDS-003, Rev. 4, *Project Development Specification for Pit Leak Detection*

HNF-SD-W314-PDS-005, Rev. 4, *Project Development Specification for Special Protective Coating*

3 APPROACH

This Requirements Verification Report was assembled to provide the documented basis of how the requirements specified in the referenced PDSs were met for the AN Farm to 200E Waste Transfer System Upgrade (WBS 1.4.L) package. Each appendix of this report contains a specific verification report for the applicable PDS associated with this work package. Each appendix is a stand alone document that follows the same section numbering as the applicable PDS for ease of cross referencing. Each requirement is listed and followed by a "verification" section that documents how the requirement has been verified. Table 4-1 of each applicable PDS lists the requirements and how they are to be verified.

The verification method listed in Table 4-1 is being considered as the minimum required verification method. This report is a "living document" and will be revised and updated as information changes and/or becomes available.

The following appendices are attached:

Appendix A Requirements Verification for PDS-001, *Project Development Specification for Transfer Piping*

Appendix B Requirements Verification for PDS-002, *Project Development Specification for Valve Pit Manifold*

Appendix C Requirements Verification for PDS-003, *Project Development Specification for Pit Leak Detection*

Appendix D Not used

Appendix E Requirements Verification for PDS-005, *Project Development Specification for Special Protective Coating*

4 SCOPE

In providing the PDS requirements verification associated with the AN Farm to 200E Waste Transfer System Upgrade package for Project W-314, only those requirements which are applicable to this specific package are analyzed. The specific scope of work associated with the AN Farm to 200E Waste Transfer System Upgrade package includes:

- Four (4) new process lines installed in the 241-AN Tank Farms
- New pit leak detection for Pump Pits 241-AN-01A and 04A
- 1 new 3-inch nozzle in 241-AN-04A for new 3-inch SN-636 process line
- 2 new 3-inch nozzles in 241-AN-01A for new 3-inch SNL-3150 and SN-630 process lines
- New low point encasement pipe leak detectors for Waste Transfer Lines SN-630, and SN-636.
- Special Protective Coating for each pit
- New overpressure detection for waste transfer line SLL-3160

Approval of this document signifies the customer acceptance of the applicability of the requirements and how these requirements are fulfilled.

APPENDIX A

Requirements Verification

for

Transfer Piping

1 SCOPE

This appendix documents how the requirements listed in the Project Development Specification (PDS) for the Transfer Piping (HNF-SD-W314-PDS-001) are satisfied for the new process lines that will be installed by Project W-314 in the 241-AN Tank Farm.

2 APPLICABLE DOCUMENTS

For a list of the applicable documents, refer to the appropriate PDS.

3 REQUIREMENTS

3.1 Item Definition

No requirements are listed in this section.

3.2 Characteristics

3.2.1 Performance Characteristics

The primary and secondary transfer piping shall meet the performance requirements stated in this section.

3.2.1.1 Confine Waste within Transfer Piping. (FFBD Function 3.1.5) After the transfer pump has started, the waste transfer system shall confine the waste during transfers.

3.2.1.1.1 Corrosion/Erosion Allowance. The primary transfer piping shall support an interior corrosion/erosion allowance of 0.01 mm per year (0.4 mils per year) for the life of the system.

Verification: (Analysis)

[X] Met	[ ] Not Met	[ ] N/A

The transfer piping pressure design per ASME B31.3 accounts for the corrosion allowance. The requirement is verified by Calculations W314-P-053, W314-P-068, and W314-P-072.

3.2.1.1.2 Reynolds Number. The primary transfer piping shall be capable of transferring the waste at a Reynolds number greater than or equal to 20,000.

Verification: (Analysis)

[X] Met	[ ] Not Met	[ ] N/A

The piping cannot meet this requirement for unbounded maximum Reynolds numbers. The requirement depends on the transfer pump capacity, the transfer route pressure drop, the viscosity, and the specific gravity of the waste to be transferred. With the new 3-in transfer lines, a transfer from the AN-Farm to the AP-Farm would meet this

requirement with a flow rate of 140 gpm for waste with a specific gravity of 1.4 and viscosity of 10 centipoise (Ref. WHC-SD-WM-TI-750, page A-212). These parameters are used as the design point for Project W-314. However, Calculation W314-P-101 verifies this requirement for several other transfer routes and corresponding flow parameters.

3.2.1.1.3 Head Loss. The primary transfer piping shall have a head loss no greater than 10 meters per 100 meters (or 10 feet per 100 feet) of equivalent length.

Verification: (Analysis)

[X] Met	[ ] Not Met	[ ] N/A

The "resistance coefficients K" for the transfer piping system components are used in calculating the equivalent length of straight pipe according to Crane Technical Paper 410, *Flow of Fluids* (Crane). The above requirement is for the equivalent length that includes all the piping components. The pressure drop per equivalent length 100 feet of 3 inch, Schedule 40 steel pipe according to Crane is 2.24 psi for a 150 gpm flow rate of water. The prorated pressure drop for a design flow rate of 140 gpm and corrected for a fluid of specific gravity 1.4 is 2.78 psi. This is equivalent to a head loss of 6.44 feet of water per 100 feet of 3 inch pipe which meets the above requirement.

3.2.1.1.4 Design Pressure. The primary transfer piping and new AZ Valve Pit drain piping (except lines WT-SNL-3150, WT-SLL-3160, and LIQW-702/SN-220), shall be capable of supporting a design pressure of 400 psig.

Verification: (Analysis)

[X] Met	[ ] Not Met	[ ] N/A

The primary transfer piping SN-630 and SN-636 will support a design pressure of 1000 psig. The pressure design for the transfer piping per ASME B31.3 is documented in Calculations W314-P-053 and W314-P-072. The new AZ Valve Pit drain piping is not in the scope of this package.

3.2.1.1.5 Not used

3.2.1.1.6 WT-SNL-3150 and WT-SLL-3160 Design Pressure. The primary piping for transfer lines WT-SNL-3150 and WT-SLL-3160 shall be capable of supporting a design pressure of 1490 psig.

Verification: (Analysis)

[X] Met	[ ] Not Met	[ ] N/A

The primary piping will support a design pressure of 1490 psig. The pressure design for the primary piping per ASME B31.3 is documented in Calculations W314-P-053 and W314-P-068.

3.2.1.1.7 LIQW-702/SN-220 Design Pressure. The primary piping for transfer line

LIQW-702/SN-220 shall be capable of supporting a design pressure of TBD psig.

Verification: (Analysis)

Met	Not Met	N/A
☐	☐	☒

Not applicable to this package. Transfer line LIQW-702/SN-220 is in the Phase 2 design.

3.2.1.1.8 Waste Temperature. The transfer piping system shall be capable of maintaining the temperature of the contents of the piping system such that the contents do not lose more than 11 °C (20 °F) during a worst case distance and flow transfer.

Verification: (Analysis)

Met	Not Met	N/A
☒	☐	☐

This requirement is met for new transfer lines. Verified by Calculation W314-P-006, *Inside Pit and Buried Pipeline Heat Loss Calculations.* This calculation shows that for a worst case transfer from the AN Tank Farm to the AP Tank Farm at 139 gpm the total temperature drop would be less than 10 °F.

The additional runs of piping added by this project that extend the W-058 cross-site transfer lines will result in a 1 °F to 2 °F additional temperature drop for a cross-site transfer to the AN Tank Farm. Based on the W-058 Calculation W-058-P-11, a 200 °F transfer at 139 gpm from SY to AN through the WT-SNL-3150 line will result in a temperature drop of about 28 °F and for a transfer through the WT-SLL-3160 line the temperature drop will be about 22 °F which is based on a 6 °F rise through the booster pump.

3.2.1.1.9 Chemical and Radionuclide Composition Limits. The transfer piping shall be compatible with the waste chemical composition ranges listed in Table 3-1 and the waste radionuclide concentrations in Table 3-2.

Table 3-1 Chemical Composition Range

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
As	0	0.0066	-	-
B	0	0.013	-	-
Ba	0	0.0004	0	0.0014
Bi	-	-	0	0.076
Ca	0.0014	0.1	0	0.17

Table 3-1 Chemical Composition Range (Continued)

Retrieved waste				
Species	DST		SST	
	Anion/cation		Anion/cation	
	min mol/L	max mol/L	min mol/L	max mol/L
Cd	0	0.0074	0	0.0007
Cr	0.0067	0.28	0.0001	0.091
Cu	0	0.02	-	-
Fe	0.0004	0.26	0.0057	0.89
Hg	0	2.8E-05	0	0.0001
K	0.044	0.55	0.0002	0.0095
La, Nd	0	0.0066	0	0.001
Mg	0.0004	0.046	-	-
Mn	0.0003	0.16	0.0009	0.41
Mo	0	0.0029	-	-
Na	1.6	10.7	1.6	7.1
Ni	0.0002	0.008	0	0.042
Pb	0	0.004	0	0.12
Pd, Rh	0	0.0063	-	-
Si(SiO2)	0.0024	0.028	0.0004	0.46
Ti	0	0.002	-	-
U	0	0.0092	-	-
Zr(ZrO2)	0	0.3	0	0.065
Acetate	-	-	0	0.0055
Citrate	0	0.03	0.0042	0.06
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
CO3	0.03	0.69	0.014	0.38
F	0.014	1	0.001	0.71
Fission product	0	0.0001	-	-
NO2	0.1	1.8	0.0086	0.83
NOX(NO3)	0.15	3.6	0.64	5.1

Table 3-1 Chemical Composition Range (Continued)

Retrieved waste				
Species	DST		SST	
	Anion/cation		Anion/cation	
	min mol/L	max mol/L	min mol/L	max mol/L
OH	0.24	4.4	0.25	6.9
PO4	0	0.4	0.0007	3.8
SO4	0.003	0.16	0.01	0.22
TOC	0	2	-	-

DST = Double-shell tank
EDTA = Ethylenediametraacetic acid
HEDTA = n-(hydroxyethyl)-Ethylenediametraacetic acid
SST = Single-shell tank
TOC = Total organic carbon

Table 3-2 Radionuclide Concentrations

Nuclide	Nuclide Concentrations (Bq/L)		
	(a)All liquids	(a)All solids	(b)W-314
14C	2.3E+05	1.6E+05	2.3E+05
60Co	9.5E+06	4.9E+08	1.7E+08
79Se	(c)	1.7E+04	1.7E+04
90Sr	1.1E+10	2.9E+12	9.6E+11
90Y	1.1E+10	2.9E+12	9.6E+11
99Tc	1.7E+07	1.2E+10	4.0E+09
106Ru	9.9E+02	7.2E+04	2.4E+04
125Sb	3.4E+04	1.8E+08	5.9E+07
129I	2.0E+04	6.4E+06	2.1E+06
134Cs	6.1E+06	9.4E+06	7.2E+06
137Cs	8.8E+10	1.0E+11	9.2E+10
144Ce	9.1E+00	3.4E+02	1.2E+02
147Pm	3.6E+07	(c)	3.6E+07
154Eu	2.4E+09	1.1E+10	5.2E+09
155Eu	5.9E+07	5.0E+06	5.9E+07
237Np	2.3E+05	9.9E+08	3.3E+08
238Pu	1.8E+06	1.9E+08	6.4E+07
239Pu(d)	3.6E+07	1.6E+09	5.5E+08

Table 3-2 Radionuclide Concentrations (Continued)

Nuclide	Nuclide Concentrations (Bq/L)		
	(a)All liquids	(a)All solids	(b)W-314
241Pu	2.6E+08	3.8E+09	1.4E+09
241Am	4.2E+07	1.1E+10	3.7E+09
242Cm	1.1E+01	2.0E+02	7.3E+01
244Cm	4.2E+05	6.1E+07	2.0E+07

(a) From Table 1a., Van Keuren, J. C., 1996, Tank Waste Compositions and Atmospheric Dispersion Coefficients for Use in Safety Analysis Consequence Assessments, WHC-SD-WM-SARR-016, Rev. 2, Westinghouse Hanford Company, Richland, Washington.
(b) W-314 values represent a bounding mixture for design of 67% liquid and 33% solid, except for 14C and 155Eu where the maximum liquid value was used as it is higher than the mix and for 79Se and 147Pm where data is not available.
(c) No available data.
(d) The 239Pu activity concentration also includes 240Pu.

Verification: (Analysis) [X] Met [ ] Not Met [ ] N/A

This requirement is verified by the use of ASTM A312 TP 304L Stainless Steel (SS) as the material of construction for the transfer piping components (Ref. Construction Specification W-314-C5, Section 15493, "Pipe Codes"). The 304L SS has a history of successful use and testing with the Hanford Site waste chemistry and was recommended as the material for the primary pipe according to the Internal Memo 7F540-94-019, June 10, 1994, *Projects W-058/W-028 Material of Construction Position Paper.* The waste composition listed in the WHC-SD-W058-FDC-001, Rev. 4 is the worst case inventory composition for the TWRS transfer system. The W-058 FDC specifies 304L SS as the primary pipe material of construction. Therefore, 304L SS will *meet the requirement for waste chemical composition.*

Metallic components of the transfer piping system are not affected by the radionuclide concentrations. The radiation requirements for the encasement leak detection system are addressed in Section 3.7.2.2.1.

3.2.1.1.10 Shielding. The transfer piping shall be provided with radiation shielding which shall meet the design objective to maintain exposure levels below an average of 0.5 mrem (5 microsieverts) per hour and as far below this average as is reasonably achievable. The goal for reasonably achievable is 0.05 mrem (0.5 microsieverts) per hour or less. Exposure rates shall be determined using the radionuclide concentrations listed under the W-314 column in Table 3-2 at a distance of 30 centimeters from any surface through which the radiation penetrates.

Verification: (Analysis) [X] [ ] [ ]

Met	Not Met	N/A

Verified by Calculation W314-P-016, *Soil Requirement for Covering a 3" by 6" Encased Waste Transferring Line.* The shielding meets the 0.5 mrem requirement. To meet the 0.05 mrem goal, the soil covering would have to be increased by approximately 9 inches. This increase would require more berming of the transfer lines. Under normal transfer conditions an operator is not standing 30 cm from the transfer route. Based on engineering judgement, it was determined that meeting the 0.5 mrem requirement is conservative due to the source term being worst case and exposure time being limited to transfers only. In addition, the 0.05 mrem goal will be met for a majority of the waste that will be transferred because its source term is not anticipated to be as high as the design case.

3.2.1.2 Confine Flush Within Transfer Piping. (FFBD Function 3.1.6) After the flush of the transfer system has started, the waste transfer system shall confine the flush water during the flush.

3.2.1.2.1 Waste Properties. The transfer piping shall be capable of confining flush water with the following properties:

- Volumetric flow rate of 151 - 530 L/min (40 - 140 gpm)
- Temperature of 12.8 - 66°C (55 - 150°F)
- pH of no less than 7 and maximum of 14.

Verification: (Analysis)

[X] Met	[ ] Not Met	[ ] N/A

The 3 inch, Schedule 40 steel pipe was shown to be capable of handling a flow rate of 140 gpm (Ref. Section 3.2.1.1.3). The transfer piping system is analyzed for a maximum design temperature of 200 °F and is documented in Calculations W314-P-053, W314-P-068, and W314-P-072. The pH value >= 7 is within the waste property pH range and the compliance for this requirement is the same as under Section 3.2.5.2.1.

3.2.1.3 Contain Leakage Within Transfer Piping Encasement. (FFBD Function 3.2.2)

3.2.1.3.1 Confine Leakage within Encasement. (FFBD Function 3.2.2.1)

3.2.1.3.1.1 Encasement Piping Design Pressure. The secondary containment (encasement) piping for the transfer piping (except lines WT-SNL-3150, WT-SLL-3160, and LIQW-702/SN-220) shall be capable of supporting a design pressure of 400 psig.

Verification: (Analysis)

[X] Met	[ ] Not Met	[ ] N/A

The encasement piping will support a design pressure of 400 psig. The pressure design is documented in Calculations W314-P-053 and W314-P-072.

3.2.1.3.1.2 Other Encasement Design Pressure. The secondary containment (encasement) piping for extensions transfer lines WT-SNL-3150 and WT-SLL-3160 and the new 241-AZ-VP drain line DR-100 shall be capable of supporting a design pressure of 50 psig.

Verification: (Analysis)

[X] Met	[ ] Not Met	[ ] N/A

The secondary containment for WT-SNL-3150 and WT-SLL-3160 will support a design pressure of 50 psig and is documented in Calculations W314-P-053 and W314-P-068. The drain line DR-100 is not part of this package.

3.2.1.3.1.3 Protection from Overpressure. WT-SNL-3150 and WT-SLL-3160 encasements shall be protected from overpressure.

Verification: (Analysis)

[X] Met	[ ] Not Met	[ ] N/A

The encasements are protected from over pressure by the installation of rupture disks, reference Drawings H-14-103335 and H-14-103339.

3.2.1.3.1.4 LIQW-702/SN-220 Encasement Design Pressure. The secondary containment (encasement) for transfer line LIQW-702/SN-220 shall be capable of supporting a design pressure of TBD psig.

Verification: (Analysis)

[ ] Met	[ ] Not Met	[X] N/A

Not applicable to this package. Transfer line LIQW-702/SN-220 is in the Phase 2 design.

3.2.2 Physical Characteristics

3.2.2.1 Buried Double Containment. The transfer lines shall be buried double-walled pipe (i.e., primary pipe within an encasement pipe).

Verification: (Analysis)

[X] Met	[ ] Not Met	[ ] N/A

A 3 inch primary pipe within a 6 inch encasement pipe is used for the new transfer piping as documented in Procurement Specification W-314-P3.

3.2.2.2 Transfer Line Slope. The transfer piping shall slope continuously in one direction at a minimum slope of 0.25% and a maximum slope of 10%.

Verification: (Analysis)

[X]	[ ]	[ ]

Met	Not Met	N/A

This requirement is verified by Drawings H-14-103236 through H-14-103238.

Verification: (Examination)

Met	Not Met	N/A
X		

This requirement was verified by the final as-built survey data submitted per W-314-C5, Section 15493, paragraph 1.2.2.3.

3.2.2.3 Releases of Hazardous Materials Due to a DBA. Releases of hazardous materials postulated to occur because of Design Basis Accidents (DBAs) shall be limited by designing the transfer line such that at least one confinement system remains fully functional following any credible DBA (i.e., unfiltered/unmitigated releases of hazardous levels of such materials shall not be allowed following such accidents).

Verification: (Analysis)

Met	Not Met	N/A
X		

This requirement is verified by Calculations W314-P-068 and W314-P-072. These Calculations perform a dynamic analysis of the transfer piping using the Safety Class or Safety Significant response spectra provided in HNF-SD-W314-PDS-001. The stress analysis results show that even with the applied seismic load the piping system is within the allowables of ASME B31.3 and, therefore, would remain functional.

3.2.2.4 Attenuation Features. Transfer line design shall provide attenuation features for postulated accidents (up to and including DBAs) that preclude offsite releases that would cause doses greater than the DOE 5400 series limits for public exposure. In addition, to the extent practical, such releases shall be maintained as low as reasonably achievable (ALARA).

Verification: (Analysis)

Met	Not Met	N/A
X		

To attenuate postulated accidents, the transfer piping encasement has been designed as a Safety Class or Safety Significant component (Ref. Section. 3.3.6.1.1). With enhanced weld NDE requirements (Ref. Construction Specification W-314-C5, Section 15493 and Procurement Specification W-314-P3). This will provide adequate assurance that any releases from the primary line will be contained. The transfer line was designed to maintain structural integrity following DBAs per Calculations W314-P-068 and W314-P-072.

3.2.2.5 Pipe Bends. Pipe bends (i.e. a minimum of five pipe diameters) are preferred to butt-welding elbows and shall be used where possible.

Verification: (Analysis)

X		

Met Not Met N/A

This requirement is verified by Drawings H-14-103267, H-14-103268, H-14-103269 & H-14-103271.

3.2.2.6 Primary Pipe Type. The primary piping shall be 3-inch, Schedule 40.

Verification: (Analysis) [X] Met [ ] Not Met [ ] N/A

A 3 inch Schedule 40 primary pipe is used for the new transfer piping as verified by Procurement Specification W-314-P3 and Construction Specification W-314-C5.

Verification: (Examination) [X] Met [ ] Not Met [ ] N/A

This requirement was verified by receipt inspection of the piping and in the CWPs W314-4L-025, W314-4L-026, W314-4L-027, and W314-4L-028 . Reference Procurement Specification W-314-P3.

3.2.2.7 Encasement Connections. Encasement (secondary containment) piping shall have connections to introduce dry air or nitrogen for pneumatic testing.

Verification: (Analysis) [X] Met [ ] Not Met [ ] N/A

This requirement is verified by Drawings H-14-103333 through H-14-103335.

3.2.2.8 Encasement Pressure Testing. The encasement pipe shall be capable of being isolated for periodic pressure testing.

Verification: (Analysis) [X] Met [ ] Not Met [ ] N/A

This requirement is verified by Drawings H-14-103333 through H-14-103335.

3.2.2.9 Encasement Maintenance. The encasement piping shall extend through the concrete wall of the pits to maintain secondary containment.

Verification: (Analysis) [X] Met [ ] Not Met [ ] N/A

This requirement is verified by Drawings H-14-103333 through H-14-103335.

3.2.2.10 Insulation. All transfer line encasements, except LIQW-702/SN-220, shall be foam insulated and jacketed with fiberglass-reinforced polyester resin (FRP) jacket.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

The requirement is documented in Procurement Specification W-314-P3.

3.2.2.11 Leak Detection. The cross-site extension lines, SNL-3150 and SLL-3160, shall use a continuous leak detection system with pull ports provided in the encasement pipe to match the existing cross-site transfer lines leak detection system. In addition, SLL-3160 shall utilize a leak detection system based on a pressure rise in the encasement. All other transfer piping shall use a low-point leak detection system.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

The cross-site extension lines SNL-3150 and SLL-3160 continuous leak detection systems are not included in this package. The line SLL-3160 pressure monitoring system is verified by Drawing H-14-103366. The low point encasement leak detectors included in this package are verified by Drawings H-14-103354 and H-14-103360.

3.2.3 Reliability

3.2.3.1 Design Life. The design life of the transfer piping shall be 35 years with the exception of the W-058 extension lines, WT-SLL-3160 and WT-SNL-3150, which shall have a design life of 40 years. Replaceable pit mechanical components shall have a design life of 12 years. Replaceable control system components located within a tank farm shall have a design life of 5 years and shall not cause a false or spurious alarm for an operating time of one year.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

This requirement is verified by Calculations W314-P-053, W314-P-068, and W314-P-072. In these analyses, the piping wall thickness is reduced by 0.014 in which is 0.4 mils/year over a 35-year design life.

3.2.3.2 Normal Operation. Normal operation of the cathodic protection system shall be 24 hours per day throughout the year.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

This design package is only providing bonding jumpers to electrically tie to the existing cathodic protection system (see Drawing H-14-103384). Electrically jumping the new

pipe stub outs into the existing cathodic protection system supports current operation of the system.

3.2.3.3 Probability of Leak Detection. The leak detection system shall be capable of detecting a leak with a probability of detection of 0.95 and a probability of false alarm of 0.05.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

The cross-site extension lines are monitored continuously with General Service leak detection cable. The probability of leak detection is based on a pit leak detector or pressure alarm system, which are installed by another package for SNL-3150 and SLL-3160.

The leak detection system availability based on a mean-time-to-repair of 4 hours and a mission time of 5 years is 0.9736 based on Calculation W314-I-055. The probability of a false alarm for the leak detection systems in a period of one year is 0.0135 per Calculation W314-I-058.

3.2.3.4 Fault Detection/Isolation. Designs shall provide for the detection and isolation of faults to systems, structures, and components as necessary in order to minimize the risks associated with faulty operation to plant, personnel and environment. Protection systems and associated instrumentation and controls shall be designed in accordance with DOE 6430.1A, Section 1660-99.0.2.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

Isolation: Each leak detection relay cabinet enclosure is equipped with a disconnect switch. This mechanical device will terminate power when activated manually. Each cabinet is also equipped with an internal dc power supply. This supply is energized from the enclosure power that terminates when the disconnect is operated. Detection: The encasement leak detection relay cabinets are supplied 120 volts from a circuit breaker panel. In the event a fault occurs anywhere in this circuit, the breaker would isolate all encasement leak detectors fed from this circuit. This design complies with the requirements of DOE Order 6430.1A, Section 1660-99.0.2 (Ref. FFS DOE 6430.1A Checklist).

3.2.4 Maintainability

3.2.4.1 Preventive or Corrective Maintenance. The buried portions of the transfer piping system shall require no preventive or corrective maintenance for the design life of the system.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

The transfer piping system is designed to the requirements for corrosion allowance,

double-walled pipe, minimum design life, and for seismic loads. Satisfying these requirements provides adequate assurance that no preventive or corrective maintenance will be required.

3.2.4.2 Corrective Maintenance. The replaceable components of the transfer piping system shall be designed to allow for corrective maintenance within 25 days.

Verification: (Analysis)

[X] Met	[ ] Not Met	[ ] N/A

The only replaceable component of the system is the encasement leak detection probe. The leak detection probe is a fabricated component and it is assumed that spares will be available on site to meet the 25-day requirement. In addition, the probe wire/cable has a special radiation resistant coating and spare cable should be maintained. The continuous leak detection cable is not anticipated to require replacement but can be replaced if required. It cannot be replaced within the 25 days.

3.2.4.3 Preventive Maintenance Frequency. The accessible components of the transfer piping system shall have a preventive maintenance frequency no less than annually.

Verification: (Analysis)

[X] Met	[ ] Not Met	[ ] N/A

The probes are capable of being removed from the top of the probe riser. See Drawing H-14-100982 for details of this design.

3.2.4.4 Maximum Time to Repair. The maximum time to repair the low point encasement leak detection system, excluding craft time to mobilize and enter tank farms, shall be equal to or less than 4 hours.

Verification: (Analysis)

[X] Met	[ ] Not Met	[ ] N/A

All components of the leak detection system, with the exception of the leak detection probes and probe wire, are commercially available, off-the-shelf items. It is assumed that spare components will be maintained on-site to support maintenance requirements. The design of the system allows for easy access to all components outside the pit. The probes inside the pits are also designed to allow for removal without the cover blocks being removed. With the current design and after setup time, the components can be replaced within a 3.90 hour time period as documented in Calculation W314-I-056.

3.2.4.5 Leak Detection Sensors Test. The low point encasement leak detection system sensors shall be testable in place by the addition of water. The encasement leak detection pressure alarm system shall be testable by addition of air or inert gas.

Verification: (Analysis) [X] [ ] [ ]

Met	Not Met	N/A

The low point encasement leak detection system can be tested in place by introducing water into the encasement. The water may be introduced into the encasement from a test riser for each waste transfer line, SN-630 and SN-636, shown on Drawings H-14-103347 and H-14-103348. For details on how the leak detection system is activated, refer to Section 3.7.2.1.1.

The encasement leak detection pressure alarm system can be tested in place by addition of air or inert gas via a test tee and isolation valve. See Drawing H-14-103367.

Verification: (Test)

Met	Not Met	N/A
[X]	[ ]	[ ]

This requirement was verified by ATPs RPP-9356 and RPP-9358.

3.2.4.6 Access Capability. Access capability shall be provided along the buried transfer piping route for periodic verification that no excavation is in progress within 15 feet of the transfer line, periodic radiological survey of the line in use to verify shielding is adequate, periodic access for herbicide spraying and inspection for continuity, and periodic capability to perform a civil survey of the berm to ensure no transfer line settling has occurred and that no erosion detrimental to access and shielding is occurring.

Personnel will have foot traffic access to the top of bermed section of buried transfer lines; vehicles will not have access to the top of the berm.

Verification: (Analysis)

Met	Not Met	N/A
[X]	[ ]	[ ]

The transfer lines are located within the AN Tank Farm. No berming is required. The Tank Farm grade is essentially flat with foot traffic access unrestricted and vehicular access restricted by the Tank Farm operating procedures only. Thus the transfer lines design complies with this requirement. Verification provided by the design package Drawings H-14-103236 through H-14-103238.

3.2.5 Environmental Conditions

The systems and components covered by this specification shall be compatible with the environmental conditions listed below, as applicable. Performance Category (PC) 3 is assigned to Safety Class (SC) and Safety Significant (SS) systems and PC1 is assigned to General Service (GS) systems. The design and analysis of loads associated with existing systems shall, as a minimum, be performed to the design requirements of the existing system.

3.2.5.1 Natural Environments

3.2.5.1.1 Ambient Air Temperature. The ambient air temperature range is 48.9°C (120°F) to -35.5°C (-32°F), and with a maximum 24 hour differential of 28.9°C (52°F).

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

Representative vendor information was reviewed to determine the leak or overpressure detection relay panel components complied with the given ambient temperature ranges. The ambient temperature verification data is summarized in Calculations W314-I-065 and W314-I-004. Based on the results of the temperature verification it was determined to add a heater to the leak or overpressure detection relay panel. Refer to Calculation W314-I-063 for heater sizing. By adding the heater, the temperature will not drop below the operating range for any device in the leak or overpressure detection relay cabinet.

3.2.5.1.2 Soil Temperature. The minimum soil temperatures below ground surface are:

1.3 cm (0.5 in):	-19.5 °C (-3.0 °F)
38 cm (15 in):	-8.8 °C (16.1 °F)
92 cm (36 in):	0.8 °C (33.5 °F)

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

The transfer piping system is below grade where the minimum ambient temperature is the same as the minimum soil temperature. The minimum soil temperature value is used in the piping flexibility analysis and is documented in Calculations W314-P-068 and W314-P-072.

3.2.5.1.3 Seismic Loads.

PC1 structures, systems, and components

Earthquake load design of PC1 SSCs shall comply with the UBC, Seismic Zone 2B, for standard occupancy facilities.

PC3 structures, systems, and components

Earthquake load design of PC3 SSCs shall use dynamic analysis and site-specific design response spectra listed in Table 3-3.

Transfer piping primary and encasement shall be designed and analyzed to PC3 loads.

Dynamic values used in the dynamic analysis shall not exceed those listed for Response Level 2 damping values in Table 3-4.

Table 3-3 Response Spectra

Horizontal Response Spectra "g"						
Frequency (Hertz)	Damping					
	0.50%	2%	5%	7%	10%	12%
100	0.26	0.26	0.26	0.26	0.26	0.26
33.3	0.26	0.26	0.26	0.26	0.26	0.26
13.3	0.57	0.48	0.41	0.38	0.36	0.35
10	0.77	0.59	0.47	0.43	0.38	0.36
5	1.04	0.76	0.58	0.52	0.45	0.42
3.3	0.98	0.72	0.54	0.48	0.42	0.39
2	0.74	0.55	0.41	0.37	0.33	0.30
1	0.45	0.34	0.26	0.23	0.21	0.19
0.5	0.22	0.17	0.13	0.12	0.11	0.10
0.25	0.08	0.06	0.05	0.05	0.04	0.04

Vertical Response Spectra "g"						
Frequency (Hertz)	Damping					
	0.50%	2%	5%	7%	10%	12%
100	0.18	0.18	0.18	0.18	0.18	0.18
33.3	0.18	0.18	0.18	0.18	0.18	0.18
13.3	0.60	0.46	0.37	0.33	0.30	0.28
10	0.66	0.49	0.37	0.33	0.29	0.27
5	0.60	0.44	0.33	0.30	0.26	0.24
3.3	0.48	0.36	0.27	0.24	0.21	0.19
2	0.32	0.24	0.18	0.16	0.14	0.13
1	0.19	0.14	0.11	0.10	0.09	0.08
0.5	0.14	0.11	0.08	0.07	0.07	0.06
0.25	0.06	0.05	0.04	0.03	0.03	0.03

Table 3-4 Response Level

	Damping (% of critical)
	Response Level 2
Demand/capacity ratio	~0.5 to 1.0
Welded and friction bolted metal structures	4

Table 3-4 Response Level (Continued)

	Damping (% of critical)
	Response Level 2
Bearing-bolted metal structures	7
Prestressed concrete structures without complete loss of prestress	5
Reinforced concrete structures	7
Masonry shear walls	7
Wood structures with nailed joints	10
Distribution systems	5
Massive low stressed components (pumps, motors, etc.)	3
Light welded instrument racks	3
Electrical cabinets and other equipment	4
Liquid containing metal tanks Impulsive mode	3
Liquid containing metal tanks Sloshing mode	0.5

a. Users are directed to HNF-IP-0842, Volume IV, Section 3.14, Rev. 0, Section 5.1.5.2 for a full discussion of damping and response levels.

Verification: (Analysis) [X] Met [ ] Not Met [ ] N/A

This requirement is verified for the piping by calculations W314-P-068 and W314-P-072. Calculations W314-C-029, Pump Pits 01A and 04A Structural Evaluation, and W314-C-030, Pump Pit Wall Evaluation.

3.2.5.1.4 Wind Loads.

For PC3 systems:

"Fastest Mile" wind velocity:	36 m/s (80 mi/h)
"Three Second Gust" wind velocity:	44 m/s (100 mi/h)
*Missile (horizontal):	50 x 100 mm (2 x 4 in.) Timber plank weighing 7 kg (15 lb) @ 22 m/s (50 mi/h). Maximum trajectory height = 9 m (30 ft).

*Note: for Safety Significant SSCs, the missile criteria does not apply.

For PC1 systems:

"Fastest Mile" wind velocity:	31 m/s (70 mi/h)
"Three Second Gust" wind velocity:	38 m/s (85 mi/h)

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

This requirement is verified by Calculations W314-C-008 and W314-C-046 for the encasement leak detection relay cabinets. The calculations show that the resulting load due to wind is very low and produces a design to protect from wind missiles. This requirement does not affect the design of the buried piping components.

3.2.5.1.5 Snow Loads. The ground snow loads are: 720 Pa (15 lb/square foot)

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

This requirement is verified by Calculation W314-C-008, *Miscellaneous Equipment Supports* for the encasement leak detection relay cabinets. The calculations show that the snow load for this relay cabinet material is minimal compared to the structural strength of the relay cabinet material and supporting frame assembly. This requirement does not affect the design of the buried piping components.

3.2.5.1.6 Relative Humidity. The relative humidity range is 0 to 100% (Rate of change is negligible).

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

The buried piping components are not affected by this requirement. All devices affected by relative humidity are located in a NEMA 4X rated enclosure as shown on Drawings H-14-100983 and H-14-103368. The enclosure will be sealed and rated for rain, sleet, dust, and hail. In addition, the operating limits of the trip amplifier, the repeater power supply and the switch operated relay are 5 - 95% RH. The humidity inside the enclosure is governed by the pressure and temperature inside and outside the enclosure. With the addition of a combination breather and drain (Refer to Drawings H-14-100983 and H-14-103368), the temperature and pressure inside the enclosure will equalize. Any additional build-up of condensation will drain out of the enclosure. Although the addition of the breather/drain cannot quantify what the humidity would be inside the enclosure if the humidity outside the enclosure was 100%, it will be less than 100% due to the heat produced inside the cabinet from normally energized equipment. In the case where the humidity inside the enclosure falls below 5% RH, the breather will allow moisture absorption from the outside environment which will raise the relative humidity inside the enclosure.

Engineering judgement with regards to relative humidity induced failure, is that electronic components would fail in a safe condition.

3.2.5.1.7 Surface Precipitation. The surface precipitation is 25 year, 24 hour, 4 cm (1.56

in).

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

The instrumentation components located outside the pits that would be affected by surface precipitation are protected by the leak detection relay enclosure or the pressure monitoring relay enclosure. The enclosures are designed as NEMA type 4X with gaskets to protect the components inside from dust, dirt, oil and water. In addition, the electrical junction boxes and field terminal boxes have been specified to NEMA 4 to provide the necessary protection against dust and water. The buried piping components are not affected by this requirement.

3.2.5.1.8 Hail Events. The hail diameter is less than or equal to 1.9 cm (0.75 in).

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

All components that could be affected by hail are located within NEMA rated enclosures. These enclosures will provide adequate protection against the hail event. The buried piping components are not affected by this requirement.

3.2.5.1.9 Sand and Dust. The sand/dust concentration is 0.177 gm/cubic meter with a typical size of 350 µm.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

All components that could be affected by sand and dust are located within NEMA rated enclosures. These enclosures will provide adequate protection against sand and dust. The buried piping components are not affected by this requirement.

3.2.5.1.10 Solar Radiation. The solar radiation range is between 4 Watts/square meter and 406 Watts/square meter.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

The leak detection relay enclosure, the pressure monitoring relay enclosure and the electrode holder are the only components directly exposed to solar radiation. The inside temperature of the leak detection and pressure monitoring enclosures is limited by the maximum operating temperature limit of the trip amplifier and repeater power supply of 60 °C. At a maximum solar radiation of 406 Watts/square meter, the temperature of the enclosure will increase significantly. However, Calculation W314-I-004 shows that with a maximum solar radiation of 406 Watts/square meter and a maximum ambient air

temperature of 120 °F, the increased temperature due to solar radiation will not exceed the trip amplifier's temperature limit. In addition, this calculation considered the heat generated inside the enclosure from normally energized components. It was concluded that the enclosure would still be below the operating maximum of 60 °C without the use of forced air moving through the cabinet. The buried piping components are not affected by this requirement.

3.2.5.1.11 Glaze. (See definition is Section 5.1) The glaze is 2.54 cm (1 in.).

Verification: (Analysis)

[X] Met	[ ] Not Met	[ ] N/A

All active components that glaze would affect are located inside an enclosure that is rated to protect against ice formation. In addition, Calculation W314-C-008 shows that as a design load, glaze (at 5.2 psf) does not affect the structural analysis of the enclosure. The rest of the buried piping components are not affected by this requirement.

3.2.5.1.12 Ashfall. A total combination load of snow fall and ash fall of 960 Pa (20 lb/square foot) shall be used.

Verification: (Analysis)

[X] Met	[ ] Not Met	[ ] N/A

All active components that would be affected by ash are located inside an enclosure that is rated to protect against dust. In addition, Calculation W314-C-008 shows that design loading due to an ashfall event would be negligible. The rest of the buried piping components are not affected by this requirements.

3.2.5.1.13 Dead Loads. Dead loads include the weights of all permanent materials and equipment, including the structure's own weight. Design dead loads shall include the weight of all permanent service equipment. Load calculations shall include an allowance for any loadings anticipated to be added at a later date. Initially assumed loads shall be revised so that the final design reflects the configuration shown on the drawings.

The unit weights of materials and construction assemblies for buildings and other structures shall be those given in ASCE 7-95. Where unit weights are neither established in that standard nor determined by test or analysis, the weights shall be determined from data in manufacturer drawings or catalogs.

Verification: (Analysis)

[X] Met	[ ] Not Met	[ ] N/A

This requirement is met by the design of the transfer piping utilizing the soil surcharge in its design per Calculations W314-P-068 and W314-P-072.

3.2.5.1.14 Creep and Shrinkage Forces. Concrete and masonry structures shall be

investigated for stresses and deformations induced by creep and shrinkage. For concrete and masonry structures, the minimum linear coefficient of shrinkage shall be assumed to be 0.0002 mm/mm, unless a detailed analysis is undertaken. The theoretical shrinkage displacement shall be computed as the product of the linear coefficient and the length of the member.

Verification: (Analysis)

Met	Not Met	N/A
☐	☐	☒

This requirement is not applicable to the transfer piping, which utilizes no structural concrete or masonry.

3.2.5.1.15 Load Combinations and Allowable Stresses. Load combinations, allowable stresses, and strength requirements for load conditions that include live load, dead load, snow load, and normal operating loads for all SSCs shall comply with the UBC or applicable system national codes and standards.

Load combinations, allowable stresses, and strength requirements for load conditions that include live load; dead load; snow load; normal operating loads; and Natural Phenomena Hazard (NPH) loads of extreme wind, earthquake, flood, and ashfall for all SSCs shall comply with DOE-STD-1020.

Load factors and load combinations for PC1 structures, systems, and components

Combine response from various loadings to determine the structural demand by using the UBC-specified load combination rules (e.g., load factors for ultimate strength design and unit load factors for allowable stress design).

Where:

DL = DEAD LOAD
LL = LIVE LOAD
RL = ROOF LIVE LOAD
S = SNOW LOAD
W = WIND LOAD
E = EARTHQUAKE
T = THERMAL
C = CREEP/SHRINKAGE

Allowable Stress (AS) Design: All Construction
AS = DL + LL + RL(or S)
AS = 0.75[DL + LL + W (or E)]
AS = 0.75[DL + LL + W + S/2]
AS = 0.75[DL + LL + S + W/2]

Ultimate Strength (U) Design: Reinforced Concrete
U = 1.4DL + 1.7LL + 1.7RL(or 1.7S)
U = 0.75[1.4DL + 1.7LL + 1.7W]
U = 1.05[DL + LL + E]
U = 0.9DL + 1.3W(or 1.4E)

U = 1.4[DL + T(or C)]
U = 0.75[1.4DL + 1.7LL + 1.4T(or 1.4C)]

Strength (S) Design: Steel (Load & Resistance Factor Design) S=1.4DL
S = 1.2DL + 1.6LL + 0.5(RL or S)
S = 1.2DL + 0.5LL(or 0.8W) + 1.6(RL or S)
S = 1.2DL + 1.3W + 0.5LL + 0.5(RL or S)
S = 1.2DL + 1.5E + 0.5LL(or .2S)
S = 0.9DL - 1.3W(or 1.5E)

Load factors and load combination for PC3 structures, systems, and components

Combine response from various loadings to determine structural demand as follows:

Where:

DL = DEAD LOAD
LL = LIVE LOAD
RL = ROOF LIVE LOAD
S = SNOW LOAD
W = WIND LOAD
E = EARTHQUAKE
A = ASHFALL
T = THERMAL
C = CREEP/SHRINKAGE

Allowable Stress (AS) Design:
AS = DL + LL + RL(or S)
AS = 0.62[DL + LL + RL(or S) + W + T(or C)]

for shear stress
AS = 0.71[DL + LL + RL(or S) + E(or A) + T(or C)]

for all stress other than sheer stress
AS = 0.59[DL + LL + RL(or S) + E(or A) + T(or C)]

Ultimate Strength (U) Design:
U = 1.4DL + 1.7LL + 1.7RL(or 1.7S)
U = 1.4[DL + T(or C)]
U = DL + LL + RL(or S) + W(or E or A) + T(or C)

Strength (S) Design: Steel (Load & Resistance Factor Design) S=1.4DL
S = 1.2DL + 1.6LL + 0.5(RL or S)
S = 1.2DL + 0.5LL + 1.6(RL or S)
S = DL + LL + RL(or S) + W(or E or A) + T

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

This requirement is verified by Calculations W314-C-008 and W314-C-033 as meeting

the requirements.

3.2.5.2 Induced Environments

3.2.5.2.1 Waste Properties. Materials used that come in contact with the waste shall be capable of safely handling waste with the following properties:

Specific Gravity	1 to 1.5
Viscosity	1 to 30 centipoise (Newtonian)
Miller Number	100 Maximum
pH	7 to 14
Temperature	10 to 93 °C (50 to 200 °F)
Solids Content	30 Vol. %
Particle Size	0.5 to 4000 microns

Note: 95% of total particles 0 to 50 microns
<5 percent of total particles 50 to 500 microns
<1 percent of total particles 500 to 4000 microns

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

The material of construction of the transfer piping component is ASTM A312 TP 304L Stainless Steel (SS) as referenced in the Pipe Codes of Construction Specification W-314-C5, Section 15493 and Procurement Specification W-314-P3. The 304L SS has a history of successful use and testing with the Hanford Site waste chemistry and was recommended as the material for the primary pipe according to the Internal Memo, 7F540-94-019, dated June 10, 1994, *Projects W-058/W-028 Material of Construction Position Paper.* The waste properties listed above are identical of those of Project W-058 and are the worst case for Project W-314.

In addition, the encasement leak detection probe, probe insulating cover, and wire covering may come in contact with the waste. Therefore, the probe cover is made of PEEK (Polyetheretherketone) filled with glass and graphite. PEEK is a high performance thermoplastic that resists continuous temperatures of up to 480 °F. It features excellent chemical resistance, and high tensile strength and moisture absorption. Due to the application of the probe and probe cover, the only requirements that need to be addressed are the pH range, from 60% sulfuric acid to 40% sodium hydroxide, and at high temperatures. With this percentage range, PEEK meets the pH requirement. The waste temperature is far below that of PEEK breakdown temperatures (at 480 °F). For this design, PEEK is the most suitable material with radiation tolerances well above that required to be used in this application, while remaining to be machinable. The probe cover is considered an insulator and will protect the probes from unnecessary contact of metallic devices.

The probe wire coating is made of Tefzel 280 or HT-2183 (DuPont) which exhibits some of the same properties as the probe cover. The wire insulation is approximately 5 inches from the bottom of the encasement pipe which is only 2 inches in diameter. In order for the leaking fluid to come in direct contact with the probe wire, pit floor would have to fill up beyond the height of the drain assembly and fill up the riser pipe. In the event the

waste does contact the coated probe cable, Tefzel 280 will not break down with a pH in this range as it is specified by the vendor to have an excellent base and acidic resistance. The temperature at which Tefzel breaks down is 270 °C, which is above the waste temperature requirement.

The probe is made of solid stainless steel that has stable metallic properties that will withstand all of the above requirements.

3.2.5.2.2 Radiation Tolerance

3.2.5.2.2.1 Inside Pit Radiation Level. Materials used that are located inside a pit shall be capable of operating in the following radiation environment:

3.2.5.2.2.1.1 Inside Pit Radiation Level (Non-HLW Contact).
Total accumulated dose: 1.0E+7 rads
Dose rate: 1.0E+7 mr/hr

Verification: (Analysis) [X] Met [ ] Not Met [ ] N/A

Transfer piping entering the pit is steel and not affected by this level of radiation.

3.2.5.2.2.1.2 Inside Pit Radiation Level (For Hardware in Contact with HLW).
Total accumulated dose: 6.0E+7 rads
Dose rate: 1.0E+7 mr/hr

Verification: (Analysis) [X] Met [ ] Not Met [ ] N/A

The instrument cable in the pit has good radiation resistance per manufacturer's data. This gives the cable a design life expectancy equivalent to the design life expectancy of pressure transducers AN04D-WT-PE-101 and AN04D-WT-PE-102 which is 12 years.

3.2.5.2.2.2 Background Radiation Level. Materials used that are located outside a pit, above grade, shall be capable of operating in the following radiation environment:

total accumulated dose:	4.4 rad/year
dose rate:	0.5 mrem/hour

Verification: (Analysis) [X] Met [ ] Not Met [ ] N/A

All equipment outside the pit is protected in a metal enclosure and based on representative manufacturer information, will not break down at this radiation level. In addition, the equipment is similar to equipment that has previously been used in the tank farms without any adverse affects.

3.2.5.2.3 Live Loads. The transfer piping shall be designed for an AASHTO H20-44 wheel loading or a 110 ton wheeled Grove crane in the tank farm area.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

This requirement is met as documented in Calculations W314-P-068 and W314-P-072.

3.2.5.2.4 Encasement Temperature. The encasement piping design temperature shall be 180 °F except for LIQW-702/SN-220 which shall be TBD °F.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

The encasement design temperatures of 180 °F is documented in the calculations W314-P-068 and W314-P-072.

3.2.6 Transportability

Not applicable to this specification.

3.2.7 Flexibility and Expansion

Each system design shall, to the maximum extent practicable, provide sufficient flexibility to accommodate for programmatic changes or operation modifications.

Verification: (Analysis)

[ ]	[ ]	[X]
Met	Not Met	N/A

Not applicable to this package. No specific future programmatic or operational considerations have been identified.

3.3 Design and Construction

3.3.1 Materials, Processes, and Parts

3.3.1.1 DOE 6430.1A Requirements. The transfer piping system shall meet the applicable design and construction requirements contained in DOE 6430.1A.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

Compliance with DOE 6430.1A is documented by FFS DOE 6430.1A Checklist. Specifically, the transfer system meets the following design and construction requirements of DOE 6430.1A:

- Design of the transfer piping system to ASME B31.3 (see Section 3.3.1.2) with the additional enhancements (Ref. FFS Checklist, W314-DOE6430-AN200E-P-1, Attachment 1) meets the requirement of DOE 6430.1A, Section 1300-3.2.

- The use of double-walled piping (see Section 3.2.2.1) and encasement leak detection meets the requirements of DOE 6430.1A, Sections 1300-7.4 and 1323-5.2.

- Designing the transfer system such that at least one confinement system remains fully functional following any credible DBA (see Section. 3.2.2.3) and providing attenuation features for postulated accidents (see Section 3.2.2.4) meets the requirements of DOE 6430.1A, Sections 1300-1.4.2 and 1323-5.2.

- Constructing the transfer system of fully welded piping (see Section 3.3.1.5) meets the requirement of DOE 6430.1A, Sections 1323-5.2 and 1540-99.0.6.

3.3.1.2 ASME B31.3 Requirements. The primary and encasement piping, except PUREX nozzles, shall meet the applicable design and construction requirements contained in ASME B31.3.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

Verified by incorporating this requirement in the Construction Specification W-314-C5, Section 15493, Procurement Specification W-314-P3 and Calculations W314-P-068 and W314-P-072.

Verification: (Examination)

[X]	[ ]	[ ]
Met	Not Met	N/A

This requirement was verified by examination during receiving inspection and/or construction CWPs W314-4L-025, W314-4L-026, W314-4L-027, and W314-4L-028.

3.3.1.3 BNL 52361 Requirements. The buried piping shall be designed in accordance with the guidelines provided in BNL 52361.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

Chapter 7 of BNL 52361 stipulates load conditions to be considered for the design of buried piping. These guidelines are satisfied by using the soil module in the Autopipe program. Both the primary and the encasement pipes are modeled and the applicable load conditions are entered into the Autopipe program. This is documented in the Calculations W314-P-068 and W314-P-072.

3.3.1.4 ACI-318 Requirements. All concrete work shall meet the applicable design and

construction requirements contained in ACI-318.

Verification: (Analysis)

Met	Not Met	N/A
☐	☐	☒

This requirement is not applicable as there is no structural concrete used in the transfer piping.

Verification: (Examination)

Met	Not Met	N/A
☐	☐	☒

This requirement is not applicable as there is no structural concrete used in the transfer piping.

3.3.1.5 Transfer Piping Construction. The buried portion of the transfer piping shall be fully welded construction.

Verification: (Analysis)

Met	Not Met	N/A
☒	☐	☐

This requirement is verified by Construction Specification W-314-C5, Section 15493 and Procurement Specification W-314-P3.

Verification: (Examination)

Met	Not Met	N/A
☒	☐	☐

This requirement was verified by examination during construction CWPs W314-4L-025, W314-4L-026, W314-4L-027, and W314-4L-028.

3.3.1.6 Backfill Materials. Buried piping must be provided with a backfill material that is a noncorrosive, porous, homogeneous substance that is carefully installed so that the backfill is placed completely around the piping and compacted to ensure that the piping is fully and uniformly supported. Controlled density fill (CDF) will be used under and up to horizontal centerline of transfer pipe system.

Verification: (Analysis)

Met	Not Met	N/A
☒	☐	☐

The transfer lines will be backfilled with controlled density fill as detailed on Drawing H-14-103232, to the spring line of the pipe and compacted bedding material above the CDF per Construction Specification W-314-C5, Section 02220.

Verification: (Examination) ☒ ☐ ☐

Met Not Met N/A

This requirement was verified during construction and documented in CWPs W314-4L-009 and W314-4L-010.

3.3.1.7 Contaminated Soil Policy. Contaminated soil, displaced during excavation activities, shall be returned to the ground in the general vicinity of the original excavation, unless this creates ALARA concerns in the general area.

Verification: (Analysis) [X] Met [ ] Not Met [ ] N/A

Construction Specification W-314-C5, Section 02220 allows for reuse of excavated soil per Construction Engineers direction.

Verification: (Examination) [X] Met [ ] Not Met [ ] N/A

This requirement was verified during construction and documented in CWPs W314-4L-009 and W314-4L-010.

3.3.1.8 Instrumentation and Test Connections. Taps for instrumentation and test connections shall be made on the top of the pipe.

Verification: (Analysis) [X] Met [ ] Not Met [ ] N/A

Instrumentation taps are shown on Drawing H-14-103335.

3.3.1.9 NACE RP0169-92 Requirements. The cathodic protection system shall be designed in accordance with the guidelines provided in NACE RP0169-92.

Verification: (Analysis) [X] Met [ ] Not Met [ ] N/A

This requirement is verified by Calculation W314-E-011 and placement of a NACE stamp and signature on the drawing.

3.3.1.10 Requirements for Leak Detection System. The encasement leak detection system shall comply with NFPA 70, UL 508A, and DOE 6430.1A, Div. 16.

Verification: (Analysis) [X] Met [ ] Not Met [ ] N/A

Compliance with UL 508A and NFPA 70 are verified by Construction Specification,

W-314-C5, Section 13440 Paragraph 3.1 and Section 16400 Paragraph 3.2.1.1 and Procurement Specification W314-P6, Section 3.5.4. ANSI C2 deals with the requirements for utilities of which this package has none. Compliance with DOE 6430.1A is verified by FFSs DOE 6430.1A checklist.

3.3.1.11 Electrical Materials. Electrical materials and equipment shall be UL or FM tested, with label attached, for the purpose intended, whenever such products are available. Where there are no UL or FM listed products of the type, testing and certification by another nationally recognized testing agency may be acceptable.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

Construction Specification W-314-C5, Section 13440, Paragraph 1.3.2 and 1.3.3 require components of the leak detection system to be UL or FM listed components. Procurement Specification W-314-P6, Section 4.2 requires components of the leak detection system to be UL or FM listed components. Additionally, if material or equipment is not UL or FM tested, other nationally recognized testing labs are allowed per DOE 6430.1A.

Verification: (Examination)

[X]	[ ]	[ ]
Met	Not Met	N/A

This requirement was verified by examination during receiving inspection for W-314-C5 and W-314-P6.

3.3.1.12 Electrical Equipment Enclosures. Electrical equipment enclosures shall be as a minimum NEMA Type 4, per NEMA ICS 6.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

Verified by incorporating this requirement in the Construction Specification W-314-C5, Section 16400, Paragraph 2.2.9, Procurement Specification W-314-P6, Section. 3.3.5 and Drawings H-14-100983, H-14-101341 and H-14-103368.

Verification: (Examination)

[X]	[ ]	[ ]
Met	Not Met	N/A

This requirement was verified by examination during receiving inspection for W-314-C5 and W-314-P6.

3.3.1.13 Optimization. During the design of facilities, optimization principles, as discussed in ICRP Publication 37, shall be utilized in developing and justifying facility design and physical controls.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

ICRP Publication 37 addresses techniques for use in the optimization of radiation protection based on cost-benefit analysis to various radiation levels. Project W-314 is upgrading existing facilities where the architecture is constrained, the operational practices are already in place, and the acceptable risk and detriment to individuals is already provided and the applicable radiation levels are listed as separate requirements in this specification.

3.3.1.14 Dome Loading. The equipment used for installation and maintenance shall comply with the DST dome loading constraints.

Verification: (Analysis)

[ ]	[ ]	[X]
Met	Not Met	N/A

If equipment is located outside a 20' exclusion zone around the DST, dome loading effects are mitigated. It is anticipated that no equipment associated with the transfer piping system installation or maintenance will be required within the exclusion zone. Compliance with this requirement will be verified by the customer and by the issuing of dome loading permits for locating the equipment from Tank Farm Engineering and Operations.

3.3.1.15 Primary Pipe Composition. The primary pipe shall be stainless steel.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

Piping installed by this project is stainless steel per Procurement Specification W-314-P3 and Construction Specification W-314-C5, Section 15493.

Verification: (Examination)

[X]	[ ]	[ ]
Met	Not Met	N/A

This was verified and documented per Construction Specification W-314-C5, Section 15493 and Procurement Specification W-314-P3 receipt inspection and Certified Test Report submittals.

3.3.2 Electromagnetic Radiation

3.3.2.1 Hand Held Radio Interference. Hand held radio and cell phone wattage frequency shall not interfere with leak detection system components at a distance of 1.0 m (3.3 ft).

Verification: (Analysis)

[X]	[ ]	[ ]

Met	Not Met	N/A

The electrical/electronic components are located in a stainless steel NEMA 4X rated enclosure. Based on prior operational experience and the voltages of the leak detection system, it is anticipated the shielding provided by the enclosure will be sufficient to protect the system from interference due to hand held radios or cell phones.

Verification: (Test)

Met	Not Met	N/A
[X]	[ ]	[ ]

This requirement was verified by ATPs RPP-9356 and RPP-9358.

3.3.2.2 Electromagnetic Force Interference. The low-point encasement leak detection system shall not be adversely affected by outside electromagnetic forces generated by a 60 horsepower, 480 Vac, induction type motor operating at frequencies between 0 and 60 hertz and located 1 meter away from the leak detection system.

Verification: (Analysis)

Met	Not Met	N/A
[X]	[ ]	[ ]

Any 60hp or larger motor is to be located above the encasement riser box.

Any electromagnetic interference (EMI) to the signals located inside the probe riser will be shielded by the probe riser.

Any EMI to the signals located outside the probe riser next to the motor are shielded either by a grounded metal enclosures or conduit. In addition the cabling is shielded with metal (aluminum) foil which is also grounded to the electrical system ground in the 241-AN-271 building.

The grounded shielding drains away any stray induced currents caused by the motor electromagnetic field.

3.3.3 Identification and Marking

3.3.3.1 Equipment Labeling. New equipment and/or modifications to existing equipment shall be labeled in a standardized format in accordance with the tank farm labeling program as specified in HNF-IP-0842, Volume II, Section 6.1, "Tank Farm Operations Equipment Labeling," Rev. 0e.

Verification: (Analysis)

Met	Not Met	N/A
[X]	[ ]	[ ]

This requirement is verified by the fact that the new H-14 drawings were prepared using equipment numbering formats provided by CHG. In addition, Construction Specification W-314-C5, Section 13440, Paragraph 2.2.4 specifies that labeling will be by CHG OCM per their existing procedures.

Verification: (Examination) [X] Met [ ] Not Met [ ] N/A

This requirement was verified by examination during field verification and documented in the field verification packages.

3.3.3.2 Reserved for Future Use

3.3.3.3 Operations and Maintenance Drawings. Operations and maintenance drawings (as-built H-14 essential drawings) shall be prepared as the system master drawings showing as-built configuration changes in accordance with HNF-IP-0842, Volume II, Section 6.1, "Tank Farm Operations Equipment Labeling," Rev. 0e.

Verification: (Analysis) [ ] Met [ ] Not Met [X] N/A

The compliance with this requirement will take place and be verified at the end of construction.

Verification: (Examination) [X] Met [ ] Not Met [ ] N/A

This requirement was verified by examination at completion of construction and is documented in the field verification packages.

3.3.4 Workmanship

The design of the transfer piping shall determine and specify appropriate levels of workmanship for the fabrication and installation of the piping according to the requirements of ASME B31.3.

Verification: (Analysis) [X] Met [ ] Not Met [ ] N/A

This requirement is verified by Construction Specification W-314-C5, Section 15493 and Procurement Specification W-314-P3.

3.3.5 Interchangeability

All like equipment (e.g., sensors, alarm lights, etc.) shall have interchangeable parts.

Verification: (Analysis) [X] Met [ ] Not Met [ ] N/A

This requirement is verified by the fact that all like equipment in this design package and

other design packages for W-314 will be of identical make and model and, therefore, have interchangeable parts. The equipment that are identical and identified as Safety Class or Safety Significant can be used in a non-safety class application but a non-safety class item can not be used as a Safety Class item until special qualifications are performed on the item.

3.3.6 Safety

3.3.6.1 Nuclear Safety

3.3.6.1.1 Safety Classification

3.3.6.1.1.1 Safety Classification for Encasement Pipe. The encasement pipe is identified as Safety Significant (SS) structures, systems and components (SSCs). The safety function of the encasement pipe is to ensure that a leak in the primary waste transfer system piping is directed to a waste transfer associated structure.

Verification: (Analysis)

[X] Met	[ ] Not Met	[ ] N/A

The encasement piping is purchased from a qualified supplier or as a commercial grade item in Procurement Specification W-314-P3 and Construction Specification W-314-C5. The completed system is tested for leak tightness and surveyed for proper slope in Construction Specification W-314-C5.

3.3.6.1.1.2 Safety Classification for Primary Pipe. The primary pipe for the transfer lines is identified as General Service (GS) structures, systems and components (SSCs).

Verification: (Analysis)

[X] Met	[ ] Not Met	[ ] N/A

The piping is procured from a qualified supplier, analyzed for Safety Class or Safety Significant loading, and constructed with enhanced NDE requirements in Procurement Specification W-314-P3 and Construction Specification W-314-C5 respectively.

3.3.6.1.1.3 Safety Classification for Cross-Site Slurry Lines Encasement Pressure Alarm. The cross-site slurry line SLL-3160 encasement pressure alarm system shall be identified as SS. The safety function of the pressure alarm system is to detect a pressure buildup in the encasement that would cause a waste release if the encasement failed.

Verification: (Analysis)

[X] Met	[ ] Not Met	[ ] N/A

Components of the encasement pressure alarm system are procured from qualified suppliers or are tested to ensure they meet the critical characteristics identified in the commercial grade item analysis. See Construction Specifications W-314-C5, Section 13440 and Procurement Specifications W-314-P28 and W-314-P30.

3.3.6.1.1.3.1 Leak During Transfer. The Cross-site Slurry Encasement Pressure Alarm (CSEPA) System, in conjunction with the MCS, shall shut down the waste transfer upon detection of a leak inferred from a high pressure sensed in the encasement.

Verification: (Analysis)

[X] Met	[ ] Not Met	[ ] N/A

When the set point of the encasement pressure alarm system is reached, the pressure switch high alarm output contacts will open. This de-energizes the high pressure relay. A signal is sent to the master pump shutdown system by opening contacts of the high pressure relay. The pressure monitoring circuitry is shown on Drawings H-14-103371 and H-14-103372.

3.3.6.1.1.3.2 CSEPA Interlocks. The CSEPA System, in conjunction with the MCS, shall have a failsafe interlock to shutdown any waste transfer operation.

Verification: (Analysis)

[X] Met	[ ] Not Met	[ ] N/A

Upon loss of power or loss of signal to the encasement pressure alarm system, the pressure switch loss of signal output contacts or the power failure switch output contacts will open. This de-energizes the power/signal failure relay. A signal is sent to the master pump shutdown system by opening contacts of the power/signal failure relay. The pressure monitoring circuitry is shown on Drawings H-14-103371 and H-14-103372.

3.3.6.1.1.3.3 Seismic Qualification. The CSEPA System components are not required to operate during or after a seismic event. No seismic qualification of components is required. The design of structures should be limited to UBC for performance category (PC) 1.

Verification: (Analysis)

[X] Met	[ ] Not Met	[ ] N/A

This requirement is verified by Calculation W314-C-008, *AN Misc. Equipment Supports*, which shows that the seismic induced loads result in stresses within the code allowables.

3.3.6.1.1.3.4 Loss of Power. The CSEPA System shall be fail safe on loss of power.

Verification: (Analysis)

[X] Met	[ ] Not Met	[ ] N/A

Upon loss of power to the encasement pressure alarm system, the power failure switch output contacts will open. This de-energizes the power/signal failure relay. A signal is sent to the master pump shutdown system by opening contacts of the power/signal

failure relay. The pressure monitoring circuitry is shown on Drawings H-14-103371 and H-14-103372.

3.3.6.1.1.3.5 Redundant Equipment. No single component of the CSEPA System shall prevent the CSEPA System from performing its intended safety function.

Verification: (Analysis)

[X] Met	[ ] Not Met	[ ] N/A

The encasement pressure alarm system consists of two completely redundant pressure alarm stations and two completely redundant pressure tranducers. See Drawings H-14-103371 and H-14-103372.

3.3.6.1.1.3.6 Redundant Wiring. The CSEPA System redundant wiring shall be separated unless one of the following conditions is met. 1) The failure of the wiring results in a fail-safe condition (i.e. the failure is detectable), or 2) the failure can be shown by analysis to occur less that 1E-06 times per year.

Verification: (Analysis)

[X] Met	[ ] Not Met	[ ] N/A

This requirement is verified by RPP-5831.

3.3.6.1.1.3.7 Isolation of Wiring. The CSEPA System safety significant wiring shall be isolated from the non-safety significant wiring unless one of the following conditions is met. 1) The failure of the wiring results in a fail-safe condition (i.e. the failure is detectable), or 2) the failure can be shown by analysis to occur less that 1E-06 times per year.

Verification: (Analysis)

[X] Met	[ ] Not Met	[ ] N/A

This requirement is verified by RPP-5831.

3.3.6.1.1.3.8 Commercial Grade Components. Commercial grade components used for Safety Class or Safety Significant service shall be procured from a qualified vendor or be dedicated using the commercial grade dedication process.

Verification: (Analysis)

[X] Met	[ ] Not Met	[ ] N/A

This requirement is verified by W-314-C5, Section 13440, Paragraph 2.3, W-314-P28, Section 3.4, and W-314-P30, Section 3.4.

3.3.6.1.1.4 Safety Classification for Rupture Disks. The rupture disks for the cross-site lines SNL-3150 and SLL-3160 encasement overpressure protection shall be identified as SS.

The safety function is to protect the environment from a release due to overpressuring the encasement.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

The rupture disks are procured from a qualified supplier. See Construction Specification W-314-C5, Section 13440.

3.3.6.1.2 Flammable Gas Hazardous Environment. The components of the encasement leak detection system installed in ex-tank intrusive or waste intrusive locations shall be intrinsically safe, designed to meet NFPA 70 Class I, Division 1, Group B criteria for hazardous locations.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

The leak detection relay is approved by FM as intrinsically safe. The leak detector itself meets the criteria for a Simple Apparatus as defined by the NEC and therefore needs no approval. A Simple Apparatus is a device that will neither generate nor store more than 1.2 volts, 0.1 amperes, 25 milliwatts, or 20 microjoules. Therefore, this is an intrinsically safe circuit and is accepted by the NEC for use in a Class I, Division 1 or 2, Group B location.

3.3.7 Human Performance/Human Engineering

The following human factors criteria shall apply to the encasement leak detection system as applicable.

3.3.7.1 Control Devices. Each control device shall be in accordance with NUREG 0700, Section 6.4 and MIL-STD-1472E, Section 5.4.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

This requirement is verified by Calculation W314-I-002, *Human Factor Analysis Pit Leak Detection Warning Lights.*

3.3.7.2 Warning Systems. Warning systems shall be in accordance with the general guidelines found in MIL-STD-1472E, Section 5.3. Auditory signal guidelines shall be in accordance with NUREG 0700, Section 6.2.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

This requirement is verified by Calculation W314-I-002, *Human Factor Analysis Pit Leak*

Detection Warning Lights.

3.4 Documentation

3.4.1 Document Control

Records, documents, and document control pertinent to design functions shall be in accordance with HNF-PRO-224 and HNF-IP-0842, Volume XI, Section 3.5, Rev. 0a.

Verification: (Analysis) [X] Met [ ] Not Met [ ] N/A

The overall record management for identification and storage of drawings, calculations, and specifications pertinent to design functions were performed according to HNF-PRO-224 and HNF-IP-0842, Volume 11, Section 3.5.

Verification: (Examination) [X] Met [ ] Not Met [ ] N/A

TBD CHG.

3.4.2 Drawings Preparation

Drawings shall be prepared according to the formats set forth in HNF-PRO-242, Rev. 1, *Engineering Drawing Requirements* for drawings produced prior to June 15, 1999 and RPP-PRO-709, Rev. 0, *Preparation and Control Standards for Engineering Drawings* for drawings produced after June 15, 1999. After January 24, 2001 use HNF-IP-0842, Volume IV, Section 4.31, Rev. 0a.

Verification: (Analysis) [X] Met [ ] Not Met [ ] N/A

H-Series Drawings were prepared and released per ECN W314-4L-002 dated April 23, 2001 in accordance with the guidelines set forth in HNF-PRO-709, Rev. 1.

3.5 Logistics

3.5.1 Maintenance

3.5.1.1 Fully Remote Maintenance and Operation. Each system or portion of a system having radiation levels greater than 50 mrem/hr contact exposure shall be designed to be remotely maintained and operated or designed to require no maintenance and be remotely operated.

Verification: (Analysis) [ ] [ ] [X]

Met	Not Met	N/A

This requirement is not applicable as the buried transfer piping system is designed to require no preventive or corrective maintenance.

3.5.1.2 Limited Contact Maintenance and Operation. Each system or portion of a system having radiation levels greater than 0.1 mrem/hr to less than or equal to 50 mrem/hr shall be designed for limited contact maintenance and operation.

Verification: (Analysis)

Met	Not Met	N/A
☐	☐	☒

This requirement is not applicable as the buried transfer piping system is designed to require no preventive or corrective maintenance.

3.5.1.3 Full Contact Maintenance and Operation. Each system or portion of a system having radiation levels less than or equal to 0.1 mrem/hr shall be designed for full contact maintenance and operation.

Verification: (Analysis)

Met	Not Met	N/A
☒	☐	☐

Each leak detection or pressure monitoring relay panel is accessible at a maximum of 6 ft. above grade. See Drawings H-14-100983 and H-14-103368. Each active component in the relay circuit can be replaced and adjusted by accessing through the panel door.

3.5.1.4 Impressed Current Sources. The sources of impressed current for the cathodic protection system shall have the capability of being tested every two (2) months.

Verification: (Analysis)

Met	Not Met	N/A
☐	☐	☒

Not applicable to this package.

3.5.1.5 Cathodic Protection System Effectiveness Monitoring. The cathodic protection system shall have the capability of being checked annually.

Verification: (Analysis)

Met	Not Met	N/A
☐	☐	☒

Not applicable to this package.

3.5.1.6 Slurry Line Maintenance. The cross-site slurry line SLL-3160 encasement monitoring system shall be functionally tested and calibrated remotely without a pit entry.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

The portions of the cross-site slurry line SLL-3160 encasement pressure monitoring system that require functional testing and calibration are located outside the 241-AN-04D Slurry Receiver Pit, therefore, no pit entry is required. See Drawing H-14-103366.

3.5.2 Supply

3.5.2.1 Parts and Components. The system design shall, to the greatest extent practicable, use readily available parts and components.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

All components in the leak detection systems, and pressure monitoring systems, except the leak detection probes, are off the shelf items and can be readily purchased from off site suppliers.

3.5.3 Facilities and Facility Equipment

Not applicable to this specification.

3.6 Personnel and Training

The transfer piping system shall be designed for operation by personnel possessing qualifications in accordance with DOE 5480.20A, Chapter IV, and trained in accordance with Chapter I.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

The design package was prepared with the assumption that the operating personnel are qualified according to DOE 5480.20. The package includes equipment, fittings, and materials already installed and operated throughout the Hanford Site. No new material or technology was introduced which would require additional training or special skill of the operating personnel.

3.7 Major Component Characteristics

3.7.1 Encasement Corrosion Protection System

3.7.1.1 Performance Characteristics

3.7.1.1.1 Make Transfer System Compatible with Existing Cathodic Protection System. (FFBD Function 3.1.7) Installation of the insulated piping system shall not adversely affect the

existing Cathodic Protection system in the area. Additional bonding jumpers shall be provided for the new transfer pipelines around the valve/pump pits as required. Installation of the non insulated LIQW-702/SN-220 shall be protected by the existing cathodic protection system for the two existing lines LIQW-702 and SN-220.

3.7.1.1.1.1 Voltage Measurements. The voltage measurements at each existing test station shall indicate a negative (cathodic) potential of at least 850 mV relative to a saturated copper/copper sulfate reference electrode, or a minimum of 100 mV of cathodic polarization between the structure surface and a stable reference electrode contacting the electrolyte.

Verification: (Analysis)

Met	Not Met	N/A
☐	☐	☒

This requirement is not applicable. This design package is only providing bonding jumpers to electrically jumper the new pipe stub-outs to the existing cathodic protection system and no joints are part of the design.

3.7.1.2 Physical Characteristics

3.7.1.2.1 Connections at Joints. Connections at joints shall ensure electrical continuity except where insulating joints are installed. Insulating joints shall be used to electrically isolate protected sections from unprotected sections and from neighboring metallic structures as required.

Verification: (Analysis)

Met	Not Met	N/A
☐	☐	☒

This requirement is not applicable. This design package is only providing bonding jumpers to electrically jumper the new pipe stub-outs to the existing cathodic protection system and no joints are part of the design.

Verification: (Examination)

Met	Not Met	N/A
☐	☐	☒

Not applicable to this package.

3.7.2 Encasement Low Point Leak Detection System

3.7.2.1 Performance Characteristics

3.7.2.1.1 Monitor Encasement Low Point Level. (FFBD Function 3.2.2.2.1) A low-point leak detection system with requirements specified below shall be installed for all interfarm transfer lines except SNL-3150 and SLL-3160.

3.7.2.1.1.1 Leak Detection Time. The leak detection system shall detect the presence of a leak within twenty-four hours (See Section 5.1 for a definition of a leak).

Verification: (Analysis)

Met	Not Met	N/A
X		

The upgraded encasement leak detection system is designed such that a conductivity probe is installed in the low point of the encasement to detect the presence of liquid when it reaches the probe. The encasement drains to a 2" drain trap. There has been an informal agreement between CHG and the Washington State Department of Ecology that the maximum allowable quantity of leakage that is necessary to detect in 24 hours is 10 gallons or less. Calculation W314-I-053 shows that the placement of the probes at the center of a 2" diameter drain pipe will detect a quantity of slightly over 1 gallon. The 10 gallons in 24 hours corresponds to a leak rate of 0.0028 gallons per minute. Any rate less than that may not be detected in the 24 hour period.

3.7.2.1.1.2 Leak Detection Signal. The leak detection system shall monitor for liquids in the encasements during a waste transfer and shall provide a signal when a leak volume is detected.

Verification: (Analysis)

Met	Not Met	N/A
X		

The low-point encasement leak detection system monitors for liquids continuously, both when there is a transfer in progress and when there is no transfer in progress, as long as power is applied to the system. Any liquid that enters the encasement pipe will flow to the lowest point (the drain) and be held up by the seal loop in the drain jumper. When the liquid reaches a height of 6-1/2 in. maximum from the bottom of the encasement riser pipe section, the probe electrical circuit is completed. The alarm light is activated by the leak detection relay and a signal to the MPSS is initiated. See Calculation W314-I-053 for setting the probe height. The leak detection circuitry is shown on Drawings H-14-103358 and H-14-103363.

3.7.2.1.1.3 Monitoring Frequency. The monitoring frequency of the leak detection system shall be continuous.

Verification: (Analysis)

Met	Not Met	N/A
X		

The low-point encasement leak detection system monitors for leaks within the encasements. This is accomplished with the use of a continuously energized leak detection relay and conductivity probe. Upon failure of power to the leak detection relay or probe circuit, an alarm is activated so operators can respond. The leak detection circuitry is shown on Drawings H-14-103358 and H-14-103363.

3.7.2.1.1.4 Response Time. The required response time of the low-point leak detection system shall be instantaneous (See Section 5.1 for a definition of instantaneous response time).

Verification: (Analysis)

X		

Met	Not Met	N/A

The low-point leak detection system is continuously monitoring for leaks. When a leak is detected, the contacts of the leak detection relay will close and instantaneously initiate the local alarm light. The active components that would primarily contribute to the response time are the components that change state, i.e., the leak detection relay and the latching coil relay. Calculation W314-I-054 verified leak detection system response time to be 0.525 seconds. A signal is also sent to the master pump shutdown system by opening contacts of the leak detection relay and de-energizing the first of a series of trip relays within the master pump shutdown logics. The leak detection circuitry is shown on Drawings H-14-103358 and H-14-103363.

3.7.2.1.1.5 Leak Detection System Wiring. The wiring between the low-point leak detection system sensor and control panel shall be electrically supervised. (See Definition of "electrically supervised" in Section 5.0.)

Verification: (Analysis)

Met	Not Met	N/A
[X]	[ ]	[ ]

Supervision for the wiring between the probes and the leak detection control panel is performed by the trip amplifier. This device monitors the voltage (at the probes) and is located in the leak detection control panel. Upon loss of probe voltage or wire failure, the trip amplifier will activate the local alarm and initiate a signal to the master pump shutdown system. The leak detection circuitry is shown on Drawings H-14-103358 and H-14-103363.

Verification: (Test)

Met	Not Met	N/A
[X]	[ ]	[ ]

This requirement was verified by ATPs RPP-9356 and RPP-9358.

3.7.2.1.1.6 Leak Detectors Provided. The following low point encasement leak detectors located on the following transfer lines shall be provided during Phase 2 of Project W-314:

PHASE 2 ENCASEMENT LOW POINT LEAK DETECTOR REPLACEMENTS:

FARM	LINE #
AN	DR-368
AP	SL-509
AP	SL-510
AP	SL-609
AP	SL-610
AW	SL-167
AW	SL-168
AW	SN-220

AW	SN-269
AW	SN-270
AW	DR-334
AW	DR-335
AW	DR-631
AY	None
AZ	None
SY	None
244-S DCRT	SNL-5350

Verification: (Analysis) ☐ Met ☐ Not Met ☒ N/A

Not applicable to this package. The Phase 2 encasement low point detector replacements are not in the scope of the AN Farm to 200 East Waste Transfer System design package.

3.7.2.1.1.7 Abandoned Leak Detectors. The following encasement leak detectors shall be deactivated and abandoned in place during Phase 2 of Project W-314:

PHASE 2 ENCASEMENT LEAK DETECTOR DEACTIVATIONS:

FARM	LEAK DETECTOR #
AN	LDE-147
AN	LDE-148
AN	LDK-150
AN	LDK-151
AP	LDE-206
AP	LDE-223
AW	LDE-175
AW	LDE-182
AW	LDE-183
AW	LDE-188
AW	LDE-212
AW	LDE-213
AW	LDE-214
AW	LDE-314
AY	None
AZ	LDE-4507
AZ	LDE-4508

SY	None
244-S DCRT	LDE-V522
244-S DCRT	LDE-V560
244-S DCRT	LDE-V561

Verification: (Analysis)

Met	Not Met	N/A
☐	☐	☒

Not applicable to this package. The Phase 2 encasement leak detector deactiviations are not in the scope of the AN Farm to 200 East Waste Transfer System design package.

3.7.2.1.2 Monitor for Encasement Low Point Leak Detector Malfunction. (FFBD Function 3.2.2.2.2) After the waste transfer system is up and operating and after the administrative lock has been removed, the MCS shall monitor for an encasement low point leak detector malfunction. The MCS shall notify the operator(s) when a leak detector malfunction occurs.

3.7.2.1.2.1 Loss of Power. Loss of power to the leak detection system shall provide an output signal to the local alarm and MCS.

Verification: (Analysis)

Met	Not Met	N/A
☒	☐	☐

The leak detection probe circuit voltage is monitored at the probe by the trip amplifier. Upon loss of power to the leak detector relay the probe voltage will no longer be present. The trip amplifier will sense the loss of voltage at the probe created by the power failure of the leak detector relay and initiate the local alarm and provide an output signal to the MPS system. The leak detection circuitry is shown on Drawings H-14-103358 and H-14-103363. Since the system does not require backup power per design direction loss of power to the leak detection relay cabinet would not provide a local alarm, but an output signal would be provided to the MPS system.

Verification: (Test)

Met	Not Met	N/A
☒	☐	☐

This requirement was verified by ATPs RPP-9356 and RPP-9358.

3.7.2.1.2.2 Detected Failure. A detected failure in the low-point leak detection system shall provide a local alarm and an output signal to the MCS.

Verification: (Analysis)

Met	Not Met	N/A
☒	☐	☐

The leak low-point detection system is designed to initiate the local alarm and master

pump shutdown given the following failures. The first failure is the leak detector relay failure. Upon failure of the leak detector relay, the probe voltage will no longer be present and the shutdown signal will be generated from the trip amplifier as verified by section 3.7.2.1.1.5. The second failure is the probe wire and wire connectors failing. Upon failure of any leak detection probe wire or connector, the local alarm and the signal to the master pump shutdown system is activated. In addition to these failures, the local warning light and the signal to the master pump shutdown system will also activate upon failure of the trip amplifier and the failsafe relay. The leak detection circuitry is shown on Drawings H-14-103358 and H-14-103363.

Verification: (Test)

[X]	[ ]	[ ]
Met	Not Met	N/A

This requirement was verified by ATPs RPP-9356 and RPP-9358.

3.7.2.1.2.3 Operation Test. The encasement low point leak detection system shall perform an operation test of itself when commanded by the MPS System. The test shall include alarm, circuitry, and sensor functions of the leak detection system.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

The leak detection relay cabinet was designed with two general purpose relays used for testing. The selector switch is used for two operations. The first operation is for testing the leak detection relay by simulating leak in the pit with the addition of a 8.2 kohm resistor between the probes from the leak detection relay cabinet. The second test is to interrupt (open) the leak detection sensing circuit at the leak detection relay cabinet and verify the leak detection failsafe circuit is operational. The leak detection circuitry is shown on Drawings H-14-103358 and H-14-103363.

Verification: (Test)

[X]	[ ]	[ ]
Met	Not Met	N/A

This requirement was verified by ATPs RPP-9356 and RPP-9358.

3.7.2.1.3 Activate Local LDSTA Encasement Low Point Leak Detection Alarm. (FFBD Function 3.2.2.2.3) After a leak or leak detector malfunction is detected, the encasement low point leak detection system shall activate a local alarm. The local LDSTA alarm shall stay activated until the alarm clears.

3.7.2.1.3.1 Warning Lights. The local LDSTA alarm shall be a warning light for the encasement leak detection systems. The alarm shall identify where the leak or malfunction has occurred. Each warning light location shall be determined from Human Factors Analysis.

Verification: (Analysis)

[X]	[ ]	[ ]

Met	Not Met	N/A

This requirement is verified by Calculation W314-I-002, *Human Factor Analysis Pit Leak Detection Warning Lights.*

3.7.2.1.3.2 Alarm Reset. The reset of the local LDSTA alarm for the encasement leak detection system shall be automatic when the alarm clears.

Verification: (Analysis)

Met	Not Met	N/A
☐	☒	☐

The requirements of HNF-SD-W314-PDS-001, Rev. 3 were met. This requirement was revised in HNF-SD-W314-PDS-001, Rev. 4 to delete the latching function in the leak detector station. The deletion of the latching function is planned as part of the MPS Start-up and Turnover package. The reset/acknowledgment of the local alarm can be activated locally at the LDSTA or PASTA cabinet and from HMI locations. This is accomplished by operating the reset switch. The local alarm can also be reset by the MPS system. This is accomplished from a PLC (Programmable Logic Controller) output signal generated from the HMI to the leak detection latch relay reset. The leak detection circuitry is shown on Drawings H-14-103358 and H-14-103363.

Verification: (Test)

Met	Not Met	N/A
☐	☒	☐

The requirements of HNF-SD-W314-PDS-001, Rev. 3 were verified by ATPs RPP-9356 and RPP-9358.

3.7.2.1.3.3 Operation of Local LDSTA Alarm. The local LDSTA alarm for the encasement low-point leak detection system shall operate as follows:

- Immediately upon detecting a leak or a malfunction, the local LDSTA alarm shall flash and the MCS shall be activated and produce an audible signal.
- After the local LDSTA alarm is acknowledged by an operator located at the MCS HMI, the local alarm shall remain flashing until recovery occurs.
- When recovery occurs (the leak or malfunction has been corrected), the local LDSTA alarm shall cease.

Actual methods used to accomplish MCS functions above are described in the MCS PDS.

Verification: (Analysis)

Met	Not Met	N/A
☐	☒	☐

The requirements of HNF-SD-W314-PDS-001, Rev. 3 were met. This requirement was revised in HNF-SD-W314-PDS-001, Rev. 4 to delete the latching function in the leak detector station. The deletion of the latching function is planned as part of the MPS Start-up and Turnover package. As stated in the analysis of section requirement

3.7.2.1.1.2, the local alarm consisting of a local flashing (strobe) light and a horn operated by the MPS system is instantaneously activated. For the second requirement, the local warning light will remain flashing until the latch coil of the latch relay is reset. The reset coil can be activated from the HMI by generating a signal to the leak detection latch relay reset. The latching relay will only reset providing contacts on the leak detector relay are in a state not representing a leak within the encasement. If liquid is still present within the encasement, the local warning light will continue to flash even if the reset coil is energized from the HMI. For the last requirement, the local alarm light will cease to illuminate only upon recovery of the leaking condition within the encasement. Upon recovery and acknowledgment, the local alarm (strobe light) will cease to illuminate. The leak detection circuitry is shown on Drawings H-14-103358 and H-14-103363.

Verification: (Test)

Met	Not Met	N/A
☐	☒	☐

The requirements of HNF-SD-W314-PDS-001, Rev. 3 were verified by ATPs RPP-9356 and RPP-9358.

3.7.2.1.4 Activate Remote Low Point Encasement Leak Detector Alarm. (FFBD Function 3.2.2.2.4)

3.7.2.1.4.1 MCS Alarm Activation. An MCS alarm shall be activated whenever an encasement low point Leak Detector detects a leak.

Verification: (Analysis)

Met	Not Met	N/A
☐	☐	☒

Not applicable to this package. The MCS is installed in the MPS Package.

3.7.2.1.4.2 Fail Safe Circuit. The circuit carrying the alarm signal shall be fail safe.

Verification: (Analysis)

Met	Not Met	N/A
☐	☐	☒

Not applicable to this package. The MCS is installed in the MPS Package.

Verification: (Test)

Met	Not Met	N/A
☐	☐	☒

Not applicable to this package. The MCS is installed in the MPS Package.

3.7.2.1.4.3 Circuit Load. The circuit carrying the alarm signal shall be less than 50 volts.

Verification: (Analysis)

☐	☐	☒

Met	Not Met	N/A

Not applicable to this package. The MCS is installed in the MPS Package.

Verification: (Test)

Met	Not Met	N/A
☐	☐	☒

Not applicable to this package. The MCS is installed in the MPS Package.

3.7.2.1.5 Activate Remote Encasement Leak Detector Malfunction Alarm. (FFBD Function 3.2.2.2.5)

3.7.2.1.5.1 MCS Alarm Activation. An MCS alarm shall be activated when an encasement low point Leak Detector malfunctions.

Verification: (Analysis)

Met	Not Met	N/A
☐	☐	☒

Not applicable to this package. The MCS is installed in the MPS Package.

3.7.2.1.5.2 Fail Safe Circuit. The circuit carrying the alarm signal shall be fail safe.

Verification: (Analysis)

Met	Not Met	N/A
☐	☐	☒

Not applicable to this package. The MCS is installed in the MPS Package.

Verification: (Test)

Met	Not Met	N/A
☐	☐	☒

Not applicable to this package. The MCS is installed in the MPS Package.

3.7.2.1.5.3 Circuit Load. The circuit carrying the alarm signal shall be less than 50 volts.

Verification: (Analysis)

Met	Not Met	N/A
☐	☐	☒

Not applicable to this package. The MCS is installed in the MPS Package.

Verification: (Test)

Met	Not Met	N/A
☐	☐	☒

Not applicable to this package. The MCS is installed in the MPS Package.

3.7.2.2 Physical Characteristics

3.7.2.2.1 Encasement Low Point Leak Detector Minimum Requirements. The encasement leak detector components exposed to the encasement environment shall be designed to meet the following minimum requirements:

a. Design Temperature	10 to 93 °C (50 to 200 °F)
b. Design Pressure	400 psig
c. Radiation	6.0E+05 mSv/hr (6.0E+07 mrad/hr)

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

The components subject to the effects of waste are the probe, probe cover, and wire coating. The probe cover is made of PEEK (Polyetheretherketone) filled with glass and graphite. PEEK is a high performance thermoplastic that resists continuous temperatures of up to 480 °F. It features excellent chemical resistance, plus high tensile strength and wear resistance. In addition, PEEK resists abrasion, radiation and exhibits low moisture absorption. The waste temperature is far below that of PEEK breakdown temperatures (at 480 °F). For this design, PEEK is the most suitable material with radiation tolerances well above that required to be used in this application, while remaining to be machinable. The probe cover is considered to be an insulator and will protect the probes from unnecessary contact of metallic devices.

The probe wire coating is made of Tefzel 280 or HT-2183 (DuPont) which exhibits some of the same properties as the probe cover. In the event the waste does come in contact with the coated probe cable, Tefzel 280 will not break down. The temperature at which Tefzel breaks down is 270 °C, which is above the waste temperature requirement.

The probe is made of solid stainless steel that has stable metallic properties that will withstand all of the above requirements.

The electrode holder and plug is pressure rated for 2000 psi up to 200 °F.

3.7.3 Transfer Piping Sitework

3.7.3.1 Performance Characteristics. Not Applicable.

3.7.3.1.1 Site Transfer Piping. (FFBD Function 3.2.5)

3.7.3.1.1.1 Soil Support. The site soils shall support the 200E Waste Transfer System transfer lines and its major components.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

A site soil investigation performed by Dames & Moore indicates the soils will support the

waste transfer system lines and major components.

3.7.3.1.1.2 Site Soil Settlement Requirement. The site soils and CDF located below and immediately around the 200E Waste Transfer System transfer lines and its major components shall limit differential settlements to maintain minimum specified transfer lines slopes and assure that the lines are self-draining.

Verification: (Analysis)

[X] Met	[ ] Not Met	[ ] N/A

A site soil investigation performed by Dames & Moore indicates the soils will support the waste transfer system lines and major components.

3.7.3.1.1.3 Soil Cover Over Transfer Lines. Soil cover over the transfer lines shall be adequate in combination with other engineered controls to protect the transfer lines from those man-induced external events specified in the Addendum to HNF-SD-WM-SAR-067, *Tank Waste Remediation System Final Safety Analysis Report*, Rev. 2-E, as applicable to the 200E Waste Transfer System.

Verification: (Analysis)

[X] Met	[ ] Not Met	[ ] N/A

This requirement is satisfied by details shown on Drawing H-14-103232 and Calculation W314-P-016.

3.7.3.1.1.4 Access Control Fencing. Access control to radiological and hazardous waste areas shall be provided by fencing consistent with existing fencing for RPP operations.

Verification: (Analysis)

[X] Met	[ ] Not Met	[ ] N/A

Construction Specification W-314-C5, Section 02831 and Drawings H-14-103233 and H-14-103242 direct fencing installation to satisfy this requirement.

3.7.3.2 Physical Characteristics

3.7.3.2.1 Disturbed Areas Stabilized. All areas disturbed by construction shall be stabilized subsequent to construction.

Verification: (Analysis)

[X] Met	[ ] Not Met	[ ] N/A

Construction Specification W-314-C5, Section 02220 and the design drawings provide for stabilization.

Verification: (Examination) [X] Met [ ] Not Met [ ] N/A

This requirement was verified during construction and documented in CWPs W314-4L-09 and W314-4L-10.

3.7.3.2.2 Buried Piping Marking. Three-inch wide detectable plastic sheet marker tape shall be placed continuously above the transfer pipes in the backfill or berm soils. Route markers which extend 60 inches above grade shall be provided at a minimum of every 150 feet along the pipe line and at every change in direction to post the location of the underground transfer lines that are outside the Tank Farm fencing. A system of monuments and bench marks shall be provided along the pipeline routes.

Verification: (Analysis) [X] Met [ ] Not Met [ ] N/A

This requirement is met in Construction Specification W-314-C5, Section 02220 and by details on Drawing H-14-103232.

3.7.4 Encasement Overpressure Protection System

3.7.4.1 Performance Characteristics

3.7.4.1.1 Protect for Encasement Overpressure. (FFBD Function 3.2.2.5) After the waste transfer system is up and operating, a rupture disk shall burst allowing the contents of the encasement to drain to a waste tank whenever the encasement pressure reaches a pressure of 60 psig. The intent of this function is to de-pressurize the transfer lines encasement.

3.7.4.1.1.1 Cross-site Extension Line Encasements. The cross-site extension lines SNL-3150 and SL-3160 encasements shall be equipped with a rupture disk designed to burst at 60 psig.

Verification: (Analysis) [X] Met [ ] Not Met [ ] N/A

This is verified by Construction Specification W-314-C5, Section 13440, Data Sheets DS-1 and DS-2.

3.7.4.1.1.2 Rupture Disk Size. The rupture disk size shall be 2 inches.

Verification: (Analysis) [X] Met [ ] Not Met [ ] N/A

This is verified by Construction Specification W-314-C5, Section 13440, Data Sheets DS-1 and DS-2.

3.7.4.1.1.3 Rupture Disk Capacity. The rupture disk capacity shall be determined by utilizing method of calculation defined in ASME Section VIII.

Verification: (Analysis) [X] Met [ ] Not Met [ ] N/A

This capacity shall be determined by the rupture disk manufacturer as required by Construction Specification W-314-C5, Section 13440, Data Sheets DS-1 and DS-2.

3.7.4.1.1.4 Waste and Flush Properties. Use waste properties per Section 3.2.5.2 and flush properties per Section 3.2.1.2.1.

Verification: (Analysis) [X] Met [ ] Not Met [ ] N/A

This is verified by Construction Specification W-314-C5, Section 13440, Data Sheets DS-1 and DS-2.

3.7.4.1.1.5 Rupture Disk Drainage. Rupture disk for waste line SLL-3160 shall drain to waste tank AN104.

Verification: (Analysis) [X] Met [ ] Not Met [ ] N/A

This requirement is verified by P&ID Drawing H-14-103331.

3.7.4.1.1.6 Line SNL-3150 Rupture Disk Drainage. Rupture disk for waste transfer line SNL-3150 shall drain to waste tank AN101 via Pump Pit AN01A.

Verification: (Analysis) [X] Met [ ] Not Met [ ] N/A

This requirement is verified by P&ID Drawing H-14-103327.

3.7.4.2 Physical Characteristics

3.7.4.2.1 Physical Characteristics for Encasement Overpressure Protection System. The encasement overpressure protection system is subject to the same characteristics as the encasement piping system. See Section 3.7.6.2.1 for requirements.

Verification: (Analysis) [X] Met [ ] Not Met [ ] N/A

The pressure transducer is specified to meet the above environmental requirements.

See Procurement Specification W-314-P28, Data Sheet DS-1.

3.7.5 Encasement Rupture Disk Indication System

3.7.5.1 Performance Characteristics

3.7.5.1.1 Monitor for Encasement Rupture Disk. (FFBD Function 3.2.2.3.4) After the waste transfer system is up and operating and after the administrative lock has been removed, the Burst Disk Indication system shall monitor for burst disks protecting the encasement piping systems.

3.7.5.1.1.1 Rupture Disk Monitoring. The burst disk indication system shall monitor for the presence of a burst rupture disk located in the encasement cross-site transfer line SLL-3160.

Verification: (Analysis)

[X] Met	[ ] Not Met	[ ] N/A

The burst disk indication system monitors for a burst disk. Upon disk rupture, the burst disk indicator strip is severed, disrupting the electric current through the strip. The rupture disk alarm monitor then transmits a signal to the MPS System. See Drawing H-14-103373 for rupture disk monitoring circuitry.

3.7.5.1.1.2 Monitoring Frequency. The monitoring frequency of the burst disk indication system shall be continuous.

Verification: (Analysis)

[X] Met	[ ] Not Met	[ ] N/A

The rupture disk alarm monitor continuously monitors for a burst disk as long as power is applied to the system. See Drawing H-14-103373 for the rupture disk monitor circuit diagram.

3.7.5.1.1.3 Response Time. The required response time of the burst disk indication system shall be instantaneous (See Section 5.1 for a definition of instantaneous response time).

Verification: (Analysis)

[X] Met	[ ] Not Met	[ ] N/A

Immediately upon severing the burst disk indicator strip, the rupture disk alarm monitor transmits a signal to the MPS System. See circuit diagram on Drawing H-14-103373.

3.7.5.1.1.4 Loss of Power. Loss of power to the Burst Disk Indicator sensor shall provide an output signal to the MCS.

Verification: (Analysis) [X] [ ] [ ]

Met	Not Met	N/A

Upon loss of power to the burst disk indicator the burst disk output signal will be activated. See circuit diagram on Drawing H-14-103373.

3.7.5.1.1.5 Output Signal. An open circuit in the burst disk indicator system wiring shall provide an output signal to MCS.

Verification: (Analysis)

Met	Not Met	N/A
X		

Just as in the case of severing the burst disk indication strip (See Section 3.7.5.1.1.1) an open circuit at another point in the loop will provide an output signal to the MPS System.

3.7.5.1.1.6 System Operation Test. The encasement burst disk indicator system shall perform an operation test of itself when commanded by the MCS. The test shall include alarm, circuitry, and sensory functions of the burst disk indicator system.

Verification: (Analysis)

Met	Not Met	N/A
	X	

Not applicable to this package. This requirement is no longer an MCS function.

3.7.5.1.2 Activate Remote Burst Disk Alarm. (FFBD Function 3.2.2.3.5) After a burst disk or burst disk indicator malfunction is detected, the burst disk indicator system shall activate the MCS. The activation shall remain until acknowledged by the operator(s).

3.7.5.1.2.1 Burst Rupture Disk Display. The burst rupture disk alarm shall be displayed by the MCS.

Verification: (Analysis)

Met	Not Met	N/A
		X

Not applicable to this package. The MCS is installed in the MPS Package.

3.7.5.1.2.2 Alarm Reset/Acknowledgement. The reset/acknowledgement of the burst disk alarm shall be accomplished by the MCS.

Verification: (Analysis)

Met	Not Met	N/A
		X

Not applicable to this package. The MCS is installed in the MPS Package.

3.7.5.2 Physical Characteristics

3.7.5.2.1 Burst Disk Indication System Physical Characteristics. For components of the encasement burst disk indication system subject to the encasement environment. See Section 3.7.6.2.1 for physical characteristics.

Verification: (Analysis)

[X] Met	[ ] Not Met	[ ] N/A

This requirement is verified by Construction Specification W-314-C5, Section 13440, Data Sheet DS-1.

3.7.5.2.2 Burst Disk Indication System Environmental Limits. Components of the encasement burst disk indication system subjected to the environment of an instrument building shall be designed to meet the following requirements:

a. Temperature 0 to 40 °C (32 to 104 °F)
b. Humidity 0 to 90%
c. Earthquake see Section 3.2.5.1.3

Verification: (Analysis)

[X] Met	[ ] Not Met	[ ] N/A

The rupture disk monitor is located in the instrument building. The temperature and humidity requirements are verified by Construction Specification W-314-C5, Section 13440, Data Sheet DS-1. The rupture disk alarm monitor is general service and is mounted per the manufacturer's instructions.

3.7.6 Encasement Pressure Rise Leak Detection System

3.7.6.1 Performance Characteristics

3.7.6.1.1 Monitor Encasement Pressure. (FFBD Function 3.2.2.3.1) Transfer Line SLL-3160 shall use a rise in encasement pressure detection system for detecting a leak with the requirements specified below.

3.7.6.1.1.1 Minimum Pressure. The encasement pressure alarm system shall monitor the pressure between atmosphere and the pressure of the encasement during pre-operational encasement line testing.

Verification: (Analysis)

[X] Met	[ ] Not Met	[ ] N/A

The encasement pressure monitoring system measures the gage pressure in the encasement within the range of 0 to 75 psig. The encasement line is tested at a pressure of 62.5 psig which is well within the range of the pressure monitoring system. See Procurement Specification W-314-P28, Data Sheet DS-1 and Drawings H-14-103367, H-14-103371, and H-14-103372.

3.7.6.1.1.2 Encasement Pressure Alarm System Signal. The encasement pressure alarm system shall monitor for pressure during a waste transfer and shall provide a signal when a pressure of 10 psig is detected.

Verification: (Analysis) [X] Met [ ] Not Met [ ] N/A

The pressure monitoring system is continuously monitoring for an increase in pressure above the set point of 10 psig. When the set point is reached, the pressure switch high alarm output contacts will open. This de-energizes the high pressure relay. The high pressure relay activates the local alarm light and the automatic MPS shutdown signal is initiated. The pressure monitoring circuitry is shown on Drawings H-14-103371 and H-14-103372.

3.7.6.1.1.3 Encasement Pressure Monitoring. The leak detection system shall monitor for a rise in pressure in the encasements during a waste transfer and shall provide a signal when a build-up in encasement pressure is detected.

Verification: (Analysis) [X] Met [ ] Not Met [ ] N/A

The encasement pressure alarm system for line SLL-3160 monitors for pressure continuously, both when there is a transfer in progress and when there is no transfer in progress, as long as there is power applied to the system. When the pressure reaches 10 psig, the local alarm is activated, and the automatic MPS shutdown signal is initiated. See Drawings H-14-103371 and H-14-103372 for pressure alarm circuitry.

3.7.6.1.1.4 Monitoring Frequency. The monitoring frequency of the leak detection system shall be continuous.

Verification: (Analysis) [X] Met [ ] Not Met [ ] N/A

The encasement pressure alarm system for line SLL-3160 monitors the pressure continuously. This is accomplished with the use of a pressure transmitter and a 4-20 mA signal that is continuously monitored by the pressure alarm switch. If at any time the 4-20 mA signal ceases to exist, the local alarm is activated. See Drawings H-14-103371 and H-14-103372 for pressure alarm circuitry.

3.7.6.1.1.5 Response Time. The required response time of the encasement pressure rise leak detection system shall be instantaneous (See Section 5.1 for a definition of instantaneous response time).

Verification: (Analysis) [X] [ ] [ ]

Met	Not Met	N/A

The pressure monitoring system is continuously monitoring for an increase in pressure above the set point of 10 psig. When the set point is reached, the pressure switch high alarm output contacts will open. This de-energizes the high pressure relay. The high pressure relay activates the local alarm light and sends a signal to the MPS System. Calculation W314-I-061 verified pressure monitoring system response time to be 0.635 seconds. The pressure monitoring circuitry is shown on Drawings H-14-103371 and H-14-103372.

3.7.6.1.1.6 Leak Detection System Wiring. The wiring between the low-point leak detection system sensor and control panel shall be electrically supervised. (See Definition of "electrically supervised" in Section 5.0.)

Verification: (Analysis)

Met	Not Met	N/A
[X]	[ ]	[ ]

Supervision for the wiring between the pressure transmitter and the pressure alarm station is performed by the pressure switch. This device monitors the voltage across the 150 ohm resistor and is located in the pressure alarm station. Upon loss of the 4-20 ma signal from the pressure transmitter, the pressure switch will activate the local alarm and initiate the master pump shutdown system. The pressure monitoring circuitry is shown on Drawings H-14-103371 and H-14-103372.

3.7.6.1.2 Monitor for Encasement Pressure Monitor Malfunction. (FFBD Function 3.3.2.2.2) After the waste transfer system is up and operating and after the administrative lock has been removed, the MCS shall monitor for an encasement pressure monitor malfunction. The MCS shall notify the operator(s) when an encasement pressure monitor malfunction occurs.

3.7.6.1.2.1 Loss of Power. Loss of power to the encasement pressure monitor system shall provide an output signal to the local alarm and MCS.

Verification: (Analysis)

Met	Not Met	N/A
[X]	[ ]	[ ]

Loss of power to the repeater power supply or the pressure switch will open the low pressure/power failure contacts on the pressure switch. This will de-energize the low pressure/power failure relay. The low pressure/power failure relay activates the local alarm light and sends a signal to the MPS system. See Drawings H-14-103371 and H-14-103372 for pressure monitoring circuitry. Loss of power to the pressure monitoring system cabinet would not provide a local alarm, but an output signal would be provided to the MPS system.

3.7.6.1.2.2 Detected Failure. A detected failure in the encasement pressure rise leak detection system shall provide a local alarm and an output to the MCS.

Verification: (Analysis)

[X]	[ ]	[ ]

Met	Not Met	N/A

The pressure monitoring system is designed to initiate the local alarm and MPS system upon failure of power to the repeater power supply, power to the pressure switch, or power to the C or E relays. Wire or connector failures in the 4-20 mA signal loop will provide a local alarm and provide an output to the MPS system as verified in Section 3.7.2.1.1.7. The pressure alarm circuitry is shown on Drawings H-14-103371 and H-14-103372.

3.7.6.1.2.3 Operation Test. The encasement pressure rise leak detection system shall perform an operation test of itself when commanded by the MCS. The test shall include alarm, circuitry, and sensor functions of the pressure monitoring system.

Verification: (Analysis)

Met	Not Met	N/A
[X]	[ ]	[ ]

The pressure alarm station was designed with two general purpose relays used for testing. The A relay is used to simulate high pressure. The B relay is used to simulate power failure. The pressure alarm circuitry is shown on Drawings H-14-103371 and H-14-103372.

3.7.6.1.3 Activate Local Encasement Pressure Rise Alarm. (FFBD Function 3.2.2.3.3) *After a leak or leak detector malfunction is detected, the leak detection system shall activate a local PASTA alarm. The encasement pressure rise alarm shall stay activated until acknowledged by the operator(s).*

3.7.6.1.3.1 Warning Lights. The local PASTA alarm shall be a warning light for the encasement leak detection systems. The alarm shall identify where the leak or malfunction has occurred. Each warning light location shall be determined from Human Factors Analysis.

Verification: (Analysis)

Met	Not Met	N/A
[X]	[ ]	[ ]

This requirement is verified by Calculation W314-I-002, *Human Factor Analysis Pit Leak Detection Warning Lights.*

3.7.6.1.3.2 Alarm Reset. The reset of the local PASTA alarm for the encasement pressure rise leak detection system shall be automatic when the alarm clears.

Verification: (Analysis)

Met	Not Met	N/A
[X]	[ ]	[ ]

The reset of the local alarm is automatic after the alarm clears. The pressure alarm circuitry is shown on Drawings H-14-103371 and H-14-103372.

3.7.6.1.3.3 Operation of Local Alarm. The local PASTA alarm for the encasement pressure rise leak detection system shall operate as follows:

- Immediately upon detecting a rise in encasement pressure or a malfunction, the local PASTA alarm shall flash and the MCS shall be activated and produce an audible signal.
- After the local alarm is acknowledged by an operator located at a MCS HMI, the local PASTA alarm shall remain flashing until recovery occurs.
- When recovery occurs (the pressure rise or malfunction has been corrected), the local PASTA alarm shall cease.

Actual methods used to accomplish MCS functions above are described in the MCS PDS.

Verification: (Analysis)

Met	Not Met	N/A
[X]	[ ]	[ ]

As stated in the analysis of section requirement 3.7.6.1.1.3, the local alarm consisting of a local flashing (strobe) light and a horn operated by the MPS system is instantaneously activated. If high pressure is still present within the encasement, the local warning light will continue to flash even if the alarm is acknowledged from the HMI. For the last requirement, the local alarm light will cease to illuminate only upon recovery of the overpressure condition within the encasement. Upon recovery, the local alarm (strobe light) will cease to illuminate. The pressure alarm circuitry is shown on Drawings H-14-103371 and H-14-103372.

3.7.6.1.4 Activate Remote Encasement High Pressure Alarm. (FFBD Function 3.2.2.3.7)

3.7.6.1.4.1 Alarm Activation. An MCS alarm shall be activated when an encasement pressure monitor detects a rise in pressure.

Verification: (Analysis)

Met	Not Met	N/A
[ ]	[ ]	[X]

Not applicable to this package. The MCS is installed in the MPS Package.

3.7.6.1.4.2 Fail Safe Circuit. The circuit carrying the alarm signal shall fail safe.

Verification: (Analysis)

Met	Not Met	N/A
[ ]	[ ]	[X]

Not applicable to this package. The MCS is installed in the MPS Package.

3.7.6.1.4.3 Circuit Load. The circuit carrying the alarm signal shall be less than 50 volts.

Verification: (Analysis)

Met	Not Met	N/A
[ ]	[ ]	[X]

Not applicable to this package. The MCS is installed in the MPS Package.

3.7.6.1.4.4 Safety Classification. This function shall be identified as Safety Significant.

Verification: (Analysis)

Met	Not Met	N/A
☐	☐	☒

Not applicable to this package. The MCS is installed in the MPS Package.

Verification: (Test)

Met	Not Met	N/A
☐	☐	☒

Not applicable to this package. The MCS is installed in the MPS Package.

3.7.6.1.5 Activate Remote Encasement Pressure Monitor Malfunction Alarm. (FFBD Function 3.2.2.3.6)

3.7.6.1.5.1 Alarm Activation. An MCS alarm shall be activated when an encasement pressure monitor malfunctions.

Verification: (Analysis)

Met	Not Met	N/A
☐	☐	☒

Not applicable to this package. The MCS is installed in the MPS Package.

3.7.6.1.5.2 Fail Safe Circuit. The circuit carrying the alarm signal shall fail safe.

Verification: (Analysis)

Met	Not Met	N/A
☐	☐	☒

Not applicable to this package. The MCS is installed in the MPS Package.

3.7.6.1.5.3 Circuit Load. The circuit carrying the alarm signal shall be less than 50 volts.

Verification: (Analysis)

Met	Not Met	N/A
☐	☐	☒

Not applicable to this package. The MCS is installed in the MPS Package.

3.7.6.1.5.4 Safety Classification. This function shall be identified as Safety Significant.

Verification: (Analysis)

Met	Not Met	N/A
☐	☐	☒

Not applicable to this package. The MCS is installed in the MPS Package.

Verification: (Test)

Met	Not Met	N/A
☐	☐	☒

Not applicable to this package. The MCS is installed in the MPS Package.

3.7.6.2 Physical Characteristics

3.7.6.2.1 Encasement High Pressure Alarm System Components. The encasement high pressure alarm system components exposed to the encasement environment shall be designed to meet the following minimum requirements.

a. Design Temperature	10 to 93 °C (50 to 200 °F)
b. Design Pressure	50 psig
c. Radiation	6.0E+05 mSv/hr (6.0E+07 mrad/hr)
d. Piping Code Requirements	ASME B31.3

Verification: (Analysis)

Met	Not Met	N/A
☒	☐	☐

The pressure transducer is specified to meet the above environmental requirements. See Procurement Specification W-314-P28, Data Sheet DS-1.

3.7.7 Continuous Leak Detection System

3.7.7.1 Performance Characteristics

3.7.7.1.1 Monitor Continuous Leak Detection. (FFBD Function 3.2.2.4) Transfer lines SNL-3150 and SLL-3160 shall use the continuous leak detection system specified in Section 3.7.7.2.2.

3.7.7.1.1.1 System Performance. The continuous leak detection system performance shall be the same as the existing cross-site Continuous Leak Detection System.

Verification: (Analysis)

Met	Not Met	N/A
☒	☐	☐

This requirement is met as documented in Procurement Specification W-314-P26.

3.7.7.2 Physical Characteristics

3.7.7.2.1 Cross-Site Encasement Leak Detector Minimum Requirements. The cross-site encasement leak detection system components exposed to the encasement environment shall be designed to meet the following minimum requirements:

a. Design Temperature	10 to 93 °C (50 to 200 °F)

b. Design Pressure 50 psig
c. Radiation 6.0E+05 mSv/hr (6.0E+07 mrad/hr)
d. Piping Code Requirements ASME B31.3

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

Vendor cables for leak detection have no exposed metal and are designed for radioactive and corrosive chemical applications.

3.7.7.2.2 Continuous Leak Detection Requirement. The continuous leak detection system for cross-site transfer lines SNL-3150 and SLL-3160 shall be PermAlert AGW-Gold/RT cable.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

This requirement is met as documented in Procurement Specification W-314-P26.

4 SYSTEM QUALIFICATION PROVISIONS

4.1 General

The Project W-314 QAPP (HNF-SD-W314-QAPP-001) defines the quality assurance requirements for this project.

Table 4-1 listed verifications may be performed in conjunction with QAPP verifications. Inspections as defined in 4.2 shall be conducted during the design and development of each system to provide assurance of compliance with the requirements of this PDS.

4.1.1 Responsibility for Inspections

The design contractor shall be responsible for the performance of all inspections for each system developed in accordance with this PDS. Inspections shall be conducted at the contractor facilities or the facilities of his choice with the approval of the procuring authority. The procuring authority reserves the right to witness or perform the specified inspections.

4.1.2 Special Tests and Examinations

Not applicable to this specification.

4.2 Quality Conformance Inspections.

Qualification shall be performed on System hardware representative of the approved production design. Qualification of the System to assure compliance with the requirements of Section 3 shall be by examination, demonstration, test, and/or analysis, as defined herein. Test program data may be used to assure compliance with requirements.

a. Examination is an element of inspection consisting of investigation, without the use of

special laboratory appliances or procedures, to determine compliance with requirements. This method is intended to be construction related and consists of examination of documents and construction activities.

b. Demonstration is an element of inspection that is limited to readily observable functional operation to determine compliance with requirements. This element of inspection does not require the use of special equipment or sophisticated instrumentation. This method is intended to be utilized for any mock-up testing.

c. Test is an element of inspection that employs technical means including (but not limited to) the evaluation of functional characteristics by use of special equipment or instrumentation, simulation techniques, and the application of established principles and procedures to determine compliance with requirements. The analysis of data derived from test is an integral part of this inspection. This method is intended to be utilized for any acceptance testing in the field.

d. Analysis is an element of inspection, taking the form of the processing of accumulated results and conclusions, intended to provide proof that verification of a requirement(s) has been accomplished. The analytical results may be comprised of a compilation of interpretation of existing information or derived from lower level examinations, tests, demonstrations, or analyses.

The environmental capability of equipment shall be demonstrated by appropriate testing, analysis, and operating experience, or other methods that can be supported by auditable documentation, or a combination of these methods.

5 NOTES

5.1 Definitions

5.1.1 Local Alarm

A local alarm is an alarm located at or near the point of measurement (e.g., the leak detector local alarm would be at or near the pit where the sensor is).

5.1.2 Instantaneous Response Time

The time allowed for the leak detection system to produce an output signal after it has detected a leak. The time is defined as 1 second.

5.1.3 Equivalent Length

The equivalent length is the actual length of piping plus the friction loss of all valves and fittings in the system expressed in terms of equivalent feet of piping.

5.1.4 Leak

Leaks are established for each specific project at the Hanford Site. Each project must demonstrate to the Washington State Department of Ecology that the proposed system meets state regulations. The leak that will be detected by the W-314 leak detection system is

established as a minimum of 10 gallons in 24 hours.

5.1.5 Glaze

Glaze is a coating of ice formed when rain or drizzle freezes on contact with any surface that has a temperature that is below freezing.

5.1.6 Electrically Supervised Wiring

Electrically supervised wiring means that the continuity of wiring interconnecting system components is monitored. If continuity is not detected, a signal or alarm is initiated identifying that condition.

5.2 Acronym List

AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
ALARA	As Low As Reasonably Achievable
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
BCR	Baseline Change Request
BIO	Basis for Interim Operation
BNL	Brookhaven National Laboratory
BPV	Boiler Pressure Vessel
CDR	Conceptual Design Report
CFR	Code of Federal Regulations
CHG	CH2M HILL Hanford Group, Inc.
CSEPA	Cross-site Slurry Encasement Pressure Alarm
DBA	Design Basis Accident
DOE	Department of Energy
DRD	Design Requirements Document
DST	Double Shell Tank
EDTA	Ethylenediametraacetic Acid
FFBD	Functional Flow Block Diagram
FM	Factory Mutual
HEDTA	N-(hydroxyethyl)-ethylenediaminetriacetic Acid
HSRCM	Hanford Site Radiological Control Manual
LDSTA	Leak Detection Station
MCS	Monitoring and Control System
MWTF	Multi-Function Waste Tank Facility
NACE	National Association of Corrosion Engineers
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NUREG	Nuclear Regulatory Reports
PASTA	Pressure Alarm Station
PC	Performance Category
PDC	Project Design Concept
PDS	Project Development Specification
PICD	Project Interface Control Document
PNNL	Pacific Northwest National Laboratory

PUREX	Plutonium Uranium-Extraction
RAS	Requirements Analysis Sheet
SpG	Specific Gravity
SSC	Structures, Systems and Components
SST	Single Shell Tank
TEDE	Total Effective Dose Equivalent
TFC	Tank Farm Contractor
TOC	Total Organic Carbon
TWRS	Tank Waste Remediation System
UL	Underwriters Laboratory
USQs	Unreviewed Safety Questions
WAC	Washington State Administrative Code

5.3 Applicable Documents

National codes and standards will be identified within Section 2, Applicable Documents, of the PDS without dates or revision numbers. Government documents and Hanford site standards will be identified by the effective date or revision number.

APPENDIX B

Requirements Verification

for

Valve Pit Manifold

1 SCOPE

This appendix documents how the requirements listed in the Project Development Specification (PDS) for the Valve Manifold (HNF-SD-W314-PDS-002) are satisfied for the new valve manifolds that will be installed by Project W-314 for Pump Pits 241-AN-01A and 241-AN-04A and the 241-AN-04D Slurry Receiver Pit.

2 APPLICABLE DOCUMENTS

For a list of the applicable documents, refer to the appropriate PDS.

3 REQUIREMENTS

3.1 Item Definition

No requirements are listed in this section.

3.2 Characteristics

3.2.1 Performance Characteristics

The valve manifold piping system and the piping in 214-AN-04D Slurry Receiver Pit and components shall meet the performance requirements stated in this section.

3.2.1.1 Confine Waste Within Valve Manifolds and Jumpers. (FFBD Function 3.1.1) After the transfer pump has started, the piping system shall confine the waste during transfers.

3.2.1.1.1 Corrosion/Erosion. The piping system components shall support a corrosion/erosion allowance of 0.01 mm per year (0.4 mil per year) for the life of the system.

Verification: (Analysis)

[X] Met	[ ] Not Met	[ ] N/A

There were no valve manifolds provided in this package. There were three encasement drain jumpers provided. The drain jumpers are not exposed to waste during transfers unless a leak develops in the process piping. The drain jumper and valve materials and wall thickness are the same as the transfer piping and therefore satisfy the corrosion allowance by comparison.

3.2.1.1.2 Reynolds Number. The piping system components shall be capable of transferring the waste at a Reynolds number greater than or equal to 20,000.

Verification: (Analysis)

[ ] Met	[ ] Not Met	[X] N/A

This requirement is not applicable because there are no valve manifolds in this design

package.

3.2.1.1.3 Head Loss. The valve manifold/jumper piping system shall have a head loss no greater than 10 meters per 100 meters (10 feet per 100 feet) of equivalent length of 3 in Sch 40 pipe.

Verification: (Analysis)

Met	Not Met	N/A
☐	☐	☒

This requirement is not applicable because there are no valve manifolds in this design package.

3.2.1.1.4 Design Pressure. The valve manifold/jumper piping system components shall be capable of supporting a design pressure of 400 psig. For interconnecting piping that have design pressures exceeding 400 psig, it is the owner/operator responsibility to verify that the most severe condition of coincidental internal pressure and temperature expected during service does not exceed the design conditions of the valve manifold.

Verification: (Analysis)

Met	Not Met	N/A
☒	☐	☐

There are no valve manifolds in this design package.

The drain jumper components are selected based on industry pressure ratings equal to or exceeding the design pressure of 400 psig and the requirement will be verified by hydrostatically testing the completed jumper assembly according to ASME B31.3 at 600 psig (Reference Drawings H-14-103339 through H-14-1033341 and Construction Specification W-314-C5, Section 15493, Appendix A.

Also, this requirement is verified by incorporating it in the Procurement Specification W-314-P22 Ball Valves. Therefore, the valves will be required to meet all applicable codes and standards for a design pressure of 400 psig.

3.2.1.1.5 WT-SLL-3160 Design Pressure. The connection of WT-SLL-3160 to Riser 10 on tank 241-AN-104 shall be capable of supporting a design pressure of 10.27 Mpa (1490 psi) up to and including the last point of isolation prior to entry into the riser.

Verification: (Analysis)

Met	Not Met	N/A
☒	☐	☐

This requirement is documented by Calculations W314-P-053 and W314-P-049 and Procurement Specifications W-314-P3, W-314-P5 and Construction Specification W-314-C5.

3.2.1.1.6 WT-SLL-3160 Encasement Design Pressure. The WT-SLL-3160 line encasement shall have a design pressure of 50 psig and a design temperature of 180 °F.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

The WT-SLL-3160 line encasement has a design pressure of 50 psig and a design temperature of 180 °F as specified in Procurement Specification W-314-P3 and Construction Specification W-314-C5.

3.2.1.1.7 Temperature Maintenance. The valve manifold/jumper piping system components, as part of the waste transfer system, shall be capable of maintaining the temperature of the contents such that the temperature drop through the piping in the pit does not exceed 2 °C (3 °F) during a waste transfer.

Verification: (Analysis)

[ ]	[ ]	[X]
Met	Not Met	N/A

This requirement is not applicable because there are no valve manifolds in this design package.

3.2.1.1.8 Compatibility with Waste. The piping system components shall be capable of withstanding the liquid waste chemical composition ranges listed in Table 3-2 and the waste radionuclide concentrations listed under the W-314 column in Table 3-3.

Table 3-2 Chemical Composition Range

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
As	0	0.0066	-	-
B	0	0.013	-	-
Ba	0	0.0004	0	0.0014
Bi	-	-	0	0.076
Ca	0.0014	0.1	0	0.17
Cd	0	0.0074	0	0.0007
Cr	0.0067	0.28	0.0001	0.091
Cu	0	0.02	-	-
Fe	0.0004	0.26	0.0057	0.89
Hg	0	2.8E-05	0	0.0001
K	0.044	0.55	0.0002	0.0095

Table 3-2 Chemical Composition Range (Continued)

Retrieved waste				
Species	DST		SST	
	Anion/cation		Anion/cation	
	min mol/L	max mol/L	min mol/L	max mol/L
La, Nd	0	0.0066	0	0.001
Mg	0.0004	0.046	-	-
Mn	0.0003	0.16	0.0009	0.41
Mo	0	0.0029	-	-
Na	1.6	10.7	1.6	7.1
Ni	0.0002	0.008	0	0.042
Pb	0	0.004	0	0.12
Pd, Rh	0	0.0063	-	-
Si(SiO2)	0.0024	0.028	0.0004	0.46
Ti	0	0.002	-	-
U	0	0.0092	-	-
Zr(ZrO2)	0	0.3	0	0.065
Acetate	-	-	0	0.0055
Citrate	0	0.03	0.0042	0.06
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
CO3	0.03	0.69	0.014	0.38
F	0.014	1	0.001	0.71
Fission product	0	0.0001	-	-
NO2	0.1	1.8	0.0086	0.83
NOX(NO3)	0.15	3.6	0.64	5.1
OH	0.24	4.4	0.25	6.9
PO4	0	0.4	0.0007	3.8
SO4	0.003	0.16	0.01	0.22
TOC	0	2	-	-

DST = Double-shell tank
EDTA = Ethylenediametraacetic acid
HEDTA = n-(hydroxyethyl)-Ethylenediametraacetic acid
SST = Single-shell tank
TOC = Total organic carbon

Table 3-3 Radionuclide Concentrations

Nuclide	Nuclide Concentrations (Bq/L)		
	(a)All liquids	(a)All solids	(b)W-314
14C	2.3E+05	1.6E+05	2.3E+05
60Co	9.5E+06	4.9E+08	1.7E+08
79Se	(c)	1.7E+04	1.7E+04
90Sr	1.1E+10	2.9E+12	9.6E+11
90Y	1.1E+10	2.9E+12	9.6E+11
99Tc	1.7E+07	1.2E+10	4.0E+09
106Ru	9.9E+02	7.2E+04	2.4E+04
125Sb	3.4E+04	1.8E+08	5.9E+07
129I	2.0E+04	6.4E+06	2.1E+06
134Cs	6.1E+06	9.4E+06	7.2E+06
137Cs	8.8E+10	1.0E+11	9.2E+10
144Ce	9.1E+00	3.4E+02	1.2E+02
147Pm	3.6E+07	(c)	3.6E+07
154Eu	2.4E+09	1.1E+10	5.2E+09
155Eu	5.9E+07	5.0E+06	5.9E+07
237Np	2.3E+05	9.9E+08	3.3E+08
238Pu	1.8E+06	1.9E+08	6.4E+07
239Pu(d)	3.6E+07	1.6E+09	5.5E+08
241Pu	2.6E+08	3.8E+09	1.4E+09
241Am	4.2E+07	1.1E+10	3.7E+09
242Cm	1.1E+01	2.0E+02	7.3E+01
244Cm	4.2E+05	6.1E+07	2.0E+07

(a) From Table 1a., Van Keuren, J. C., 1996, Tank Waste Compositions and Atmospheric Dispersion Coefficients for Use in Safety Analysis Consequence Assessments, WHC-SD-WM-SARR-016, Rev. 2, Westinghouse Hanford Company, Richland, Washington.
(b) W-314 values represent a bounding mixture for design of 67% liquid and 33% solid, except for 14C and 155Eu where the maximum liquid value was used as it is higher than the mix and for 79Se and 147Pm where data is not available.
(c) No available data.
(d) The 239Pu activity concentration also includes 240Pu.

Verification: (Analysis)

[X] Met	[ ] Not Met	[ ] N/A

This requirement is verified by the use of ASTM A312 TP 304L Stainless Steel (SS) as the material of construction for the drain jumper components. The 304L SS has a history of successful use and testing with the Hanford Site waste chemistry and was recommended as the material for the primary pipe according to Internal Memo, 7F540-94-019, dated June 10, 1994, *Projects W-058/W-028 Material of Construction Position Paper.* The waste composition listed in WHC-SD-W058-FDC-001, Rev. 4 is the worst case inventory composition for the TWRS transfer system. The W-058 FDC specifies 304L SS as the primary pipe material of construction. Therefore, 304L SS will meet the requirement for waste chemical composition.

In addition, this requirement is verified by incorporating it in the Procurement Specification W-314-P22, *Ball Valves.* Therefore, the valves will be required to withstand the waste chemical composition ranges.

3.2.1.2 Position Manifold Valves. (FFBD Function 3.1.2) After the appropriate valve manifolds have been selected, the waste transfer system shall position the valves on the selected manifold.

3.2.1.2.1 Remote Valve Operation. The valve manifold/jumper valves shall be remote manually operated from above the pit cover blocks.

Verification: (Analysis)

[X] Met	[ ] Not Met	[ ] N/A

The design placed the manual operators above the cover blocks. See Drawings H-14-103349 and H-14-103350.

Verification: (Examination)

[X] Met	[ ] Not Met	[ ] N/A

This requirement was verified by examination during the performance of the ATPs RPP-9356 and RPP-9358.

3.2.1.3 Confine Flush in Valve Manifolds and Jumpers. (FFBD Function 3.1.3) During the flush of the waste transfer system, the piping system shall confine the flush water.

3.2.1.3.1 Compatibility with Flush Water. The piping system components shall be capable of confining flush water with the following properties:

- Volumetric flow rate of 151 - 530 L/min (40 - 140 gpm)
- Temperature of 12.8 - 66 °C (55-150 °F)
- pH range of no less than 7 and a maximum of 14.

Verification: (Analysis)

Met	Not Met	N/A
☐	☐	☒

This requirement is not applicable because there are no valve manifolds in this design package.

3.2.2 Physical Characteristics

3.2.2.1 Valve Piping System Features. The valve piping system shall have the following features:

a. Manual valve actuation from above the cover blocks (except for the encasement rupture disk isolation valve in 241-AN-04D Slurry Receiver Pit).
b. Valves shall be capable of being locked in position (except the WT-SLL-3160 block valve at Riser 10).

Verification: (Analysis)

Met	Not Met	N/A
☒	☐	☐

Manual operation of the valves was previously addressed (see Section 3.2.1.2.1). The locking capabilities of the valves are shown on Drawings H-14-103335 and H-14-103346.

3.2.2.2 Valve Extension Handles. The pit valves shall be manually operated with valve operating extension rods extending through the pit cover blocks (except for the encasement rupture disk isolation valve in 241-AN-04D Slurry Receiver Pit).

Verification: (Analysis)

Met	Not Met	N/A
☒	☐	☐

This requirement is verified by Drawings H-14-103333 and H-14-103334, *Jumper Arrangement Sections*, which show the extension rods extending above the pit cover blocks. In addition, the manual operators are shown on Drawings H-14-103335 and H-14-103346..

Verification: (Examination) ☒ ☐ ☐

Met	Not Met	N/A

This requirement was verified by examination during the performance of the ATPs RPP-9356 and RPP-9358.

3.2.2.3 PUREX Jumper Connector. The PUREX jumper connector assembly design will be in accordance with drawings H-2-32430 and H-2-32420. The pit nozzle shall be PUREX type design (reference drawings H-2-90185 and H-2-90186).

Verification: (Analysis)

Met	Not Met	N/A
[X]	[ ]	[ ]

The parts list of Drawings H-14-103337 through H-14-103341, *Jumper Assembly* calls out the required connector assembly drawings for fabrication. The required pit nozzle drawings are called out on the face of Drawings H-14-103347 and H-14-103348, *Modification Details.*

3.2.2.4 Jumper Manifold. Each jumper manifold shall have a valved nozzle to facilitate interface with the existing transfer piping system via flexible jumpers (Valve Pit 241-AP and the new 241-AZ-VP Valve Pit are excluded from this requirement).

Verification: (Analysis)

Met	Not Met	N/A
[ ]	[ ]	[X]

Not applicable to this package. This design package did not require a valved nozzle per client approval of Drawings H-14-103327 and H-14-103329.

3.2.2.5 Valve Position Indication System. The valve position indication system shall provide sufficient accuracy with respect to the actual valve position such that the selected flow path configuration is leak tight.

Verification: (Analysis)

Met	Not Met	N/A
[X]	[ ]	[ ]

The drain valves have stops and indication is provided by an indicator disk as shown on Drawing H-14-103346.

Verification: (Examination)

Met	Not Met	N/A
[X]	[ ]	[ ]

This requirement was verified by examination during the performance of the ATPs RPP-9356 and RPP-9358.

3.2.2.6 Not used

3.2.2.7 Valve Position Indicators. Indication of the valves position shall be visible when extension handles are removed.

Verification: (Analysis)

[X] Met	[ ] Not Met	[ ] N/A

Valve position is visible through the sleeve opening by observing the black stripe on the funnel, see Drawing H-14-103345.

Verification: (Examination)

[X] Met	[ ] Not Met	[ ] N/A

This requirement was verified and documented by examination per CWP W314-4L-024.

3.2.2.8 Valve Lock Capacity. The valve operators shall be capable of being locked in place by a padlock that has a bail diameter of 5/16" and a minimum closed length of 1.5 inches.

Verification: (Analysis)

[X] Met	[ ] Not Met	[ ] N/A

Each valve operator was specified to have locking capability per Drawing H-14-103335 and H-14-103346.

Verification: (Test)

[X] Met	[ ] Not Met	[ ] N/A

This requirement was verified by ATPs RPP-9356 and RPP-9358.

3.2.3 Reliability

3.2.3.1 Design Life of Valve Manifold. The design life of the valve manifold/jumper piping system components shall be 12 years. The design life of the WT-SLL-3160 piping system components shall be 40 years.

Verification: (Analysis)

[X] Met	[ ] Not Met	[ ] N/A

The drain jumper components are verified by similarity to the transfer piping. See Appendix A, Section 3.2.3.1.

3.2.3.2 Design Life of Cover Blocks. The design life of the cover blocks and the new 241-AZ-VP shall be 35 years.

Verification: (Analysis)

[ ]	[ ]	[X]

Met	Not Met	N/A

There are no new cover blocks provided in this package.

3.2.3.3 Design Life of Slurry Receiver Pit. The design life of the Slurry Receiver Pit, 241-AN-04D, shall be 40 years.

Verification: (Analysis)

Met	Not Met	N/A
☐	☐	☒

The slurry receiver pit is a plastic irrigation valve box, not a concrete pit.

3.2.3.4 Degree of Reliability. Valves shall be designed to operate properly following stagnant periods of up to one year.

Verification: (Analysis)

Met	Not Met	N/A
☒	☐	☐

The design requirement is verified by the Procurement Specification W-314-P22, Ball Valves. The specification stipulates that valves remain in operation for a minimum period of one thousand complete cycles and be designed to operate properly following periods of stagnant position of up to one year. This fact, along with the fact that the fluid composition and properties are provided in the procurement specification (Section 3.1), provides adequate assurance that this reliability requirement will be met.

3.2.3.5 Valve Life. Valves shall be capable of being operated up to 1000 cycles over its design life.

Verification: (Analysis)

Met	Not Met	N/A
☒	☐	☐

The design requirement is verified by the Procurement Specification W-314-P22, Ball Valves. The specification stipulates that valves remain in operation for a minimum period of one thousand complete cycles and be designed to operate properly following periods of stagnant position of up to one year. This fact, along with the fact that the fluid composition and properties are provided in the procurement specification (Section 3.1), provides adequate assurance that this reliability requirement will be met.

3.2.3.6 Fault Detection/Isolation. Designs shall provide for the detection and isolation of faults to systems, structures, and components as necessary in order to minimize the risks associated with faulty operation to plant, personnel and environment. Protection systems and associated instrumentation and controls shall be designed in accordance with DOE 6430.1A, Section 1660-99.0.2.

Verification: (Analysis)

☐	☐	☒

Met	Not Met	N/A

Section 1660-99.0.2 deals with Safety Class or Safety Significant protection systems and Safety Class or Safety Significant instrumentation and control systems. The valve pit manifold consists of piping, valve position sensors, and manual operators. None of these components are Safety Class or Safety Significant, and, therefore, this requirement is not applicable.

3.2.4 Maintainability

3.2.4.1 Corrective Maintenance. The repair or replacement of a failed components on the valve manifold/jumper shall be performed within 25 days.

Verification: (Analysis)

Met	Not Met	N/A
[X]	[ ]	[ ]

The repair and replacement of components requiring cover block removal (e.g., valves and connectors) are all integral parts of a jumper. Jumpers are treated as throwaway items and are not repaired. Therefore, a new jumper would be required. Although the components within the pits are designed and expected to last for the design life, if corrective maintenance is required within 25 days, a spare jumper would need to be on hand. The jumper could not be fabricated, tested and installed within the 25-day requirement. Per conversations with operations personnel, entry into a pit can require up to 14 days just to fill out the required paperwork. Approximately 7 days would be needed to remove/replace the cover blocks and install a new jumper. Therefore, based on past experience with cover block removal and assuming that a spare jumper is available the 25-day requirement can be met.

3.2.4.2 Preventive Maintenance. The design of the valve manifold/jumper system shall ensure no preventive maintenance requiring pit entry.

Verification: (Analysis)

Met	Not Met	N/A
[X]	[ ]	[ ]

The drain jumpers are designed for installation with a remote operated wrench. In addition, the valves are designed for actuation from above the cover blocks. These facts, along with the fact that the jumper components are designed to last the design life without any required preventive maintenance (see Procurement Specification W-314-P22, *Ball Valves*) provide adequate assurance that pit entry will not be required for preventive maintenance.

3.2.5 Environmental Conditions

The systems and components covered by this specification shall be compatible with the environmental conditions listed below, as applicable. Performance Category (PC) 3 is assigned to Safety Class (SC) and Safety Significant (SS) systems and PC1 is assigned to General Service (GS) systems. The design and analysis of loads associated with existing systems shall,

as a minimum, be performed to the design requirements of the existing system.

3.2.5.1 Natural Environments

3.2.5.1.1 Ambient Air Temperature. The ambient air (outside the pit) temperature range is 48.9°C (120°F) to -35.5°C (-32°F), and with a maximum 24 hour differential of 28.9°C (52°F).

Verification: (Analysis) [X] Met [ ] Not Met [ ] N/A

The requirement is incorporated in the Procurement Specification W-314-P22, *Ball Valves*, Section 3.3. The gasket for the PUREX connector is made of Kynar which can handle temperatures as low as -40 °F and as high as 300 °F.

The concrete cover blocks and metallic components are not affected by this requirement as they are not restrained, thus free to move.

3.2.5.1.2 Soil Temperature. The minimum soil temperatures below ground surface are:

1.3 cm (0.5 in):	-19.5 °C (-3.0 °F)
38 cm (15 in):	-8.8 °C (16.1 °F)
92 cm (36 in):	0.8 °C (33.5 °F)

Verification: (Analysis) [X] Met [ ] Not Met [ ] N/A

The drain jumpers are located below grade in the valve pits. The minimum expected temperature in the valve pit with the cover blocks installed is the minimum soil temperature 0.8 °C (33.5 °F). The soil temperatures will not affect the drain jumper or its valve operation.

3.2.5.1.3 Seismic Loads.

PC1 structures, systems, and components

Earthquake load design of PC1 SSCs shall comply with the UBC, Seismic Zone 2B, for standard occupancy facilities.

PC3 structures, systems, and components

Earthquake load design of PC3 SSCs shall comply with DOE-STD-1020 by using dynamic analysis and site-specific design response spectra listed in Table 3-4.

New process pits and new cover blocks shall be designed, analyzed, procured, and constructed to PC3 requirements. Revisions to and investigations of existing process pits and cover blocks shall be done to PC3 requirements.

Calculate elastic seismic response, Ds, by dynamic analysis using Response Level 2 damping values from Table 3-5.

Table 3-4 Response Spectra

Horizontal Response Spectra "g"						
Frequency (Hertz)	Damping					
	0.50%	2%	5%	7%	10%	12%
100	0.26	0.26	0.26	0.26	0.26	0.26
33.3	0.26	0.26	0.26	0.26	0.26	0.26
13.3	0.57	0.48	0.41	0.38	0.36	0.35
10	0.77	0.59	0.47	0.43	0.38	0.36
5	1.04	0.76	0.58	0.52	0.45	0.42
3.3	0.98	0.72	0.54	0.48	0.42	0.39
2	0.74	0.55	0.41	0.37	0.33	0.30
1	0.45	0.34	0.26	0.23	0.21	0.19
0.5	0.22	0.17	0.13	0.12	0.11	0.10
0.25	0.08	0.06	0.05	0.05	0.04	0.04

Vertical Response Spectra "g"						
Frequency (Hertz)	Damping					
	0.50%	2%	5%	7%	10%	12%
100	0.18	0.18	0.18	0.18	0.18	0.18
33.3	0.18	0.18	0.18	0.18	0.18	0.18
13.3	0.60	0.46	0.37	0.33	0.30	0.28
10	0.66	0.49	0.37	0.33	0.29	0.27
5	0.60	0.44	0.33	0.30	0.26	0.24
3.3	0.48	0.36	0.27	0.24	0.21	0.19
2	0.32	0.24	0.18	0.16	0.14	0.13
1	0.19	0.14	0.11	0.10	0.09	0.08
0.5	0.14	0.11	0.08	0.07	0.07	0.06
0.25	0.06	0.05	0.04	0.03	0.03	0.03

Table 3-5 Response Level

	Damping (% of critical)
	Response Level 2
Demand/capacity ratio	~0.5 to 1.0
Welded and friction bolted metal structures	4
Bearing-bolted metal structures	7
Prestressed concrete structures without complete loss of prestress	5
Reinforced concrete structures	7
Masonry shear walls	7
Wood structures with nailed joints	10
Distribution systems	5
Massive low stressed components (pumps, motors, etc.)	3
Light welded instrument racks	3
Electrical cabinets and other equipment	4
Liquid containing metal tanks Impulsive mode	3
Liquid containing metal tanks Sloshing mode	0.5

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

This requirement is verified by Calculations W314-C-029, *Pump Pits 01A and 04A Structural Evaluation*, W314-C-030, *Pump Pit Wall Evaluation*, and W314-C-008, *AN Misc. Equipment Supports*, which show that the seismic induced loads result in stresses within the code allowables.

3.2.5.1.4 Wind Loads.

For PC3 systems:

"Fastest Mile" wind velocity: 36 m/s (80 mi/h)

"Three Second Gust" wind velocity: 44 m/s (100 mi/h)

*Missile (horizontal): 50 x 100 mm (2 x 4 in.) Timber plank weighing 7 kg (15 lb) @ 22 m/s (50 mi/h). Maximum trajectory height = 9 m (30 ft).

*Note: for Safety Significant SSCs, the missile criteria does not apply.

For PC1 systems:

"Fastest Mile" wind velocity: 31 m/s (70 mi/h)
"Three Second Gust" wind velocity: 38 m/s (85 mi/h)

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

This requirement is verified by Calculation W314-C-008, *Miscellaneous Equipment Supports for the Encasement Leak Detection Relay Cabinets*. The calculation shows that since the surface areas of the valve handle are small, the resulting load due to wind is negligible. This requirement does not affect the cover blocks and all inside pit components.

3.2.5.1.5 Snow Loads. The ground snow loads are: 720 Pa (15 lb/square foot)

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

This requirement is verified by Calculations W314-C-029, *Pump Pits 01A and 04A Pit Structural Evaluation* where 20 lb/square foot is input as a design load on the cover blocks. The valve extension handle has insignificant horizontal area and, therefore, snow loads would be negligible. Inside pit components are not affected by this requirement.

3.2.5.1.6 Relative Humidity. The relative humidity range is 0 to 100% (Rate of change is negligible).

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

This requirement is documented in Procurement Specification W-314-P22, *Ball Valves*. This requirement does not affect the design of cover blocks or the metallic components inside the pit.

3.2.5.1.7 Surface Precipitation. The surface precipitation is 4 cm (1.56 in) in a 24 hour period.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

The components within the pits are not affected by this requirement.

3.2.5.1.8 Hail Events. The hail diameter is less than or equal to 1.9 cm (0.75 in).

Verification: (Analysis) [X] [ ] [ ]

Met	Not Met	N/A

This requirement is verified by the fact that this size of a hail event will have no affect on the concrete cover blocks (Ref. Drawings H-14-103318, H-14-103319, and H-14-103323). The components within the pit are not affected by this requirement.

3.2.5.1.9 Sand and Dust. The sand/dust concentration is 0.177 gm/cubic meter with a typical size of 350 µm.

Verification: (Analysis)

Met	Not Met	N/A
[X]	[ ]	[ ]

This requirement does not affect the design of cover blocks and all inside pit components.

3.2.5.1.10 Solar Radiation. The solar radiation range is between 4 Watts/square meter and 406 Watts/square meter.

Verification: (Analysis)

Met	Not Met	N/A
[X]	[ ]	[ ]

Based on their materials of construction and/or their location this requirement will not affect the cover blocks, the design of valve extension handles and all inside pit components.

3.2.5.1.11 Glaze. (See definition is Section 5.1) The glaze is 2.54 cm (1 in.).

Verification: (Analysis)

Met	Not Met	N/A
[X]	[ ]	[ ]

As far as a design load, this requirement does not affect the design of the cover blocks, the valve extension handles, and all inside pit components. However, operation personnel would have problems walking on the cover blocks.

3.2.5.1.12 Ashfall. A total combination load of snow fall and ash fall of 960 Pa (20 lb/square foot) shall be used.

Verification: (Analysis)

Met	Not Met	N/A
[X]	[ ]	[ ]

This requirement is verified in Calculations W314-C-029, *Pump Pits Structural Evaluation*. This analysis increased the live load by 100 lb/square foot to account for miscellaneous loading such as an ashfall event (20 lb/square foot). The valve extension handles have insignificant horizontal area and, therefore, ashfall loads would be negligible. In addition, the inside pit components are not affected by this requirement.

Calculations W314-C-008, *AN Misc. Equipment Supports* and W314-C-033, *AN and WTS Wind Missile Shield*, include this requirement in their analysis.

3.2.5.1.13 Dead Loads. Dead loads include the weights of all permanent materials and equipment, including the structure's own weight. Design dead loads shall include the weight of all permanent service equipment. Load calculations shall include an allowance for any loadings anticipated to be added at a later date. Initially assumed loads shall be revised so that the final design reflects the configuration shown on the drawings.

The unit weights of materials and construction assemblies for buildings and other structures shall be those given in ASCE 7-95. Where unit weights are neither established in that standard nor determined by test or analysis, the weights shall be determined from data in manufacturer drawings or catalogs.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

This requirement is verified by Calculation W314-C-029, *Pump Pits 01A and 04A Structural Evaluation*. The pit structural evaluation only includes the weight of the concrete since the support steel weight is small compared with that of the concrete.

3.2.5.1.14 Thermal Forces. The design of structures shall include the effects of stresses and movements resulting from variations in temperature. Structures shall be designed for movements resulting from the maximum seasonal temperature change. The design shall provide for the lags between air temperatures and the interior temperatures of massive concrete members or structures. Consideration shall be given to passive soil loading resulting from thermal growth of subgrade structures.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

The cover block design provides for this movement by providing clearances between the pit walls and cover blocks and between the cover blocks as shown on Drawings H-14-103318 and H-14-103319. The cover blocks will move at the same rate as the pit walls.

3.2.5.1.15 Creep and Shrinkage Forces. Concrete and masonry structures shall be investigated for stresses and deformations induced by creep and shrinkage. For concrete and masonry structures, the minimum linear coefficient of shrinkage shall be assumed to be 0.0002 mm/mm, unless a detailed analysis is undertaken. The theoretical shrinkage displacement shall be computed as the product of the linear coefficient and the length of the member.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

This requirement is verified by Calculation W314-C-029, *Pump Pits 01A and 04A Pit Structural Evaluation*, and provided for by the reinforcing steel.

3.2.5.1.16 Load Combinations and Allowable Stresses. Load combinations, allowable stresses, and strength requirements for load conditions that include live load, dead load, snow load, and normal operating loads for all SSCs shall comply with the UBC or applicable system national codes and standards.

Load combinations, allowable stresses, and strength requirements for load conditions that include live load; dead load; snow load; normal operating loads; and Natural Phenomena Hazard (NPH) loads of extreme wind, earthquake, flood, and ashfall for all SSCs shall comply with DOE-STD-1020.

Load factors and load combinations for PC1 structures, systems, and components

Combine response from various loadings to determine the structural demand by using the UBC-specified load combination rules (e.g., load factors for ultimate strength design and unit load factors for allowable stress design).

Where:

DL = DEAD LOAD
LL = LIVE LOAD
RL = ROOF LIVE LOAD
S = SNOW LOAD
W = WIND LOAD
E = EARTHQUAKE
T = THERMAL
C = CREEP/SHRINKAGE

Allowable Stress (AS) Design: All Construction
AS = DL + LL + RL(or S)
AS = 0.75[DL + LL + W (or E)]
AS = 0.75[DL + LL + W + S/2]
AS = 0.75[DL + LL + S + W/2]

Ultimate Strength (U) Design: Reinforced Concrete
U = 1.4DL + 1.7LL + 1.7RL(or 1.7S)
U = 0.75[1.4DL + 1.7LL + 1.7W]
U = 1.05[DL + LL + E]
U = 0.9DL + 1.3W(or 1.4E)
U = 1.4[DL + T(or C)]
U = 0.75[1.4DL + 1.7LL + 1.4T(or 1.4C)]

Strength (S) Design: Steel (Load & Resistance Factor Design) S=1.4DL
S = 1.2DL + 1.6LL + 0.5(RL or S)
S = 1.2DL + 0.5LL(or 0.8W) + 1.6(RL or S)
S = 1.2DL + 1.3W + 0.5LL + 0.5(RL or S)
S = 1.2DL + 1.5E + 0.5LL(or .2S)
S = 0.9DL - 1.3W(or 1.5E)

Load factors and load combination for PC3 structures, systems, and components

Combine response from various loadings to determine structural demand as follows:

Where:

DL = DEAD LOAD
LL = LIVE LOAD
RL = ROOF LIVE LOAD
S = SNOW LOAD
W = WIND LOAD
E = EARTHQUAKE
A = ASHFALL
T = THERMAL
C = CREEP/SHRINKAGE

Allowable Stress (AS) Design:
AS = DL + LL + RL(or S)
AS = 0.62[DL + LL + RL(or S) + W + T(or C)]

for shear stress
AS = 0.71[DL + LL + RL(or S) + E(or A) + T(or C)]

for all stress other than sheer stress
AS = 0.59[DL + LL + RL(or S) + E(or A) + T(or C)]

Ultimate Strength (U) Design:
U = 1.4DL + 1.7LL + 1.7RL(or 1.7S)
U = 1.4[DL + T(or C)]
U = DL + LL + RL(or S) + W(or E or A) + T(or C)

Strength (S) Design: Steel (Load & Resistance Factor Design) S=1.4DL
S = 1.2DL + 1.6LL + 0.5(RL or S)
S = 1.2DL + 0.5LL + 1.6(RL or S)
S = DL + LL + RL(or S) + W(or E or A) + T

Verification: (Analysis)

[X] Met	[ ] Not Met	[ ] N/A

This requirement is verified by Calculation W314-C-029, *Pump Pits 01A and 04A Structural Evaluation*, and meets the requirements.

3.2.5.2 Induced Environments

3.2.5.2.1 Waste Properties. Materials used that come in contact with the waste shall be capable of safely handling waste with the following properties:

Specific Gravity	1 to 1.5
Viscosity	1 to 30 centipoise (Newtonian)
Miller Number	100 Maximum

pH	7 to 14
Temperature	10 to 93 °C (50 to 200 °F)
Solids Content	30 Vol. %
Particle Size	0.5 to 4000 microns

Note: 95% of total particles 0 to 50 microns
<5 percent of total particles 50 to 500 microns
<1 percent of total particles 500 to 4000 microns

Verification: (Analysis) [X] Met [ ] Not Met [ ] N/A

The material of construction of the drain jumper components is ASTM A312 TP 304L Stainless Steel (SS). The 304L SS has a history of successful use and testing with the Hanford Site waste chemistry and was recommended as the material for the primary pipe according to the Internal Memo 7F540-94-019, June 10, 1994, *Projects W-058/W-028 Material of Construction Position Paper*. The waste properties listed above are identical to those of Project W-058 and are the worst case for the W-314 transfer.

In addition, this requirement is incorporated in the Procurement Specification W-314-P22, *Ball Valves*.

The cover blocks and pit interior are protected with special protective coating. The special protective coatings ability to resist the above requirements will be verified by vendor data submittals.

3.2.5.2.2 Radiation Tolerance

3.2.5.2.2.1 Inside Pit Radiation Level. Materials used that are located inside a pit shall be capable of operating in the following radiation environment:

3.2.5.2.2.1.1 Inside Pit Radiation Level (Non-HLW Contact).
Total accumulated dose: 1.0E+7 rads
Dose rate: 1.0E+7 mr/hr

Verification: (Analysis) [X] Met [ ] Not Met [ ] N/A

Materials selected for use inside the pit are unaffected by this level of radiation as documented in published industry data. The majority of components are steel. The special protective coatings used have radiation resistance data provided in applicable submittal data.

3.2.5.2.2.1.2 Inside Pit Radiation Level (For Hardware in Contact with HLW).
Total accumulated dose: 6.0E+7 rads
Dose rate: 1.0E+7 mr/hr

Verification: (Analysis) [ ] [X] [ ]

Met	Not Met	N/A

This requirement has been incorporated in the Procurement Specification W-314-P22, *Ball Valves.* The valve seats and body gasket are KYNAR or PEEK and will meet the total accumulated dose. Metallic components of the manifold system are not affected by the inside pit radiation level.

The valve seat and gasket on the PUREX connector assemblies will be fabricated from Kynar or PEEK that has a radiation resistance of up to 1E+09 rads per manufacturer's published literature. The valve seat backup 'O' ring for PBM valves reworked per W-314-P22 is EPR material which has a published radiation resistance rating of 1E+07 rads. The radiation rating does not meet the specified maximum. Failure of this component would result in increased seat leakage. Use of this material was recommended by the supplier as the best available for the application. The 'O' rings are replaceable and may have to be replaced if excessive valve leakage is experienced.

The cover blocks and pit interior are protected with special protective coating. The special protective coatings ability to resist the above requirements will be verified by vendor data submittals.

3.2.5.2.2.2 Background Pit Radiation Level. Materials used that are located outside a pit shall be capable of operating in the following radiation environment:

total accumulated dose:	4.4 rad/year
dose rate:	0.5 mrem/hour

Verification: (Analysis)

Met	Not Met	N/A
[X]	[ ]	[ ]

All equipment outside the pit is protected in a metal enclosure and based on representative manufacturer information, will not break down at this radiation level. In addition, the equipment is similar to equipment that has previously been used in the tank farms without any adverse affects.

3.2.6 Transportability

Not applicable to this specification.

3.2.7 Flexibility and Expansion

Each system design shall, to the maximum extent practicable, provide sufficient flexibility to accommodate for programmatic changes or operation modifications.

Verification: (Analysis)

Met	Not Met	N/A
[ ]	[ ]	[X]

No valve manifolds were provided in this design package.

3.3 Design and Construction

3.3.1 Materials, Processes, and Parts

3.3.1.1 Design and Construction Requirements. The valve piping system shall meet the applicable design and construction requirements contained in DOE Order 6430.1A, HS-BS-0084, ASME B31.3, and UCRL-15910.

Verification: (Analysis)

Met	Not Met	N/A
[X]	[ ]	[ ]

The design requirements of ASME B31.3 are verified by incorporating these into Construction Specification W-314-C5, Section 15493, Appendix A, and Procurement Specification W-314-P22, *Ball Valves.* The requirements of HS-BS-0084, *Jumper Fabrication*, are verified by incorporating the relevant sections of this document into Appendix A of Construction Specification W-314-C5. Compliance with the DOE Order 6430.1A is verified by FFS DOE 6430.1A Checklist, W314-DOE6430-AN200E-P-1.

3.3.1.2 Cover Blocks Design and Construction Requirements. The new pits and cover blocks shall meet the applicable design and construction requirements contained in DOE Order 6430.1A, ACI-318, ACI-349, UCRL-15910, AISC, and ASCE 7.

Verification: (Analysis)

Met	Not Met	N/A
[X]	[ ]	[ ]

The cover blocks were originally designed to Safety Class or Safety Significant requirements, DOE Order 6430.1A establishes the listed codes as the basis for design and construction of the cover blocks. Therefore, the use of these codes in Calculation W314-C-029, *Pump Pits 01A and 04A Structural Evaluation* and Construction Specification W-314-C5, Section 03300 satisfies this requirement. Specifically, ACI-318, ACI-349, and UCRL-15910 are referenced in Calculation W314-C-029. In addition, the snow and live loads are from ASCE 7 as referenced on Page 2 of the same calculation. No structural steel on the cover blocks is Safety Class, therefore, there is no specific reference to AISC in the calculation. Compliance with all of the requirements of DOE 6430.1A is verified by FFS DOE 6430.1A Checklist. Finally, the coverblocks and pits have been reclassified to general service.

3.3.1.3 Valve Position Sensor System. The valve position sensor systems shall comply with NFPA 70 in accordance with DOE Order 6430.1A, Section 1600.

Verification: (Analysis)

Met	Not Met	N/A
[ ]	[ ]	[X]

No valve manifolds were provided in this design package.

3.3.1.4 Electrical Materials and Equipment. Electrical materials and equipment shall be UL or FM tested, with label attached, for the purpose intended, whenever such products are available.

Where there are no UL or FM listed products of the type, testing and certification by another nationally recognized testing agency may be acceptable.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

This requirement is verified by FFS DOE 6430.1A Checklist, and by incorporating this requirement in Construction Specification W-314-C5, Section 13440, Paragraph 1.3.2 and Section 16400, Paragraph 1.3.1 and Procurement Specification W-314-P6, Section 4.2.

3.3.1.5 Field Control Equipment. Field control equipment shall comply with the NEMA ICS standards and UL 508A in accordance with DOE Order 6430.1A, Section 1640-2.5.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

This requirement is verified by incorporating it in Construction Specification W-314-C5, Section 13440, Paragraph 2.2.7 and Procurement Specification W-314-P6, Section 3.5.5 requires compliance to UL 508A instead of UL 508 because UL 508 as referenced in DOE 6430.1A, Section 1640-2.5 applies to motor controllers only. The design engineer applied UL 508A to this design package. For compliance with DOE Order 6430.1A, Div. 16, refer to FFS DOE Order 6430.1A, Div. 16 Checklist.

3.3.1.6 Corrosion Resistance. All components of the valve manifold piping system including manifold supports, but excluding the PUREX connector assemblies, should be exterior corrosion resistant (e.g., coated with suitable corrosion resistant materials).

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

Except the PUREX connector assemblies, all components of the drain jumpers, including supports, are made of stainless steel and do not require additional coating for corrosion protection. This is verified on the jumper fabrication Drawings H-14-103339 through H-14-103341. Jumper Fabrication specification, HS-BS-0084 states that the carbon steel components of the connector assemblies shall not be painted. This is because the connector assembly consists of several components such as threads and pins whose functions would be affected by the painting.

3.3.1.7 Two-Way Full Ported Valves. Two-way valves shall be full ported and designed for isolation service in accordance with ANSI B16.34.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

This is documented in Procurement Specification W-314-P22, *Ball Valves.*

3.3.1.8 Three-Way Full Ported Valves. Three-way valves shall be full ported, designed in accordance with ANSI B16.34 and seat closure tested per MSS-SP-61 or API 598. For seat closure test there shall be no leakage from the flow side to the isolated port for each flow position.

Verification: (Analysis)

Met	Not Met	N/A
[X]	[ ]	[ ]

This requirement is verified by incorporating it in the Procurement Specification W-314-P22, *Ball Valves*. The valves are certified by the vendor to meet ANSI B16.34 and are tested to API-6D standards, which exceeds the requirements of MSS-SP-61 and API-598. The test results are documented in the vendor information file.

3.3.1.9 Optimization. During the design of facilities, optimization principles, as discussed in ICRP Publication 37, shall be utilized in developing and justifying facility design and physical controls.

Verification: (Analysis)

Met	Not Met	N/A
[X]	[ ]	[ ]

ICRP Publication 37 addresses techniques for use in the optimization of radiation protection based on cost-benefit analysis to various radiation levels. Project W-314 is upgrading existing facilities where the architecture is constrained, the operational practices are already in place, and the acceptable risk and detriment to individuals is already provided and the applicable radiation levels are listed as separate requirements in this specification.

3.3.2 Electromagnetic Radiation

3.3.2.1 Interference. Hand held radio and cell phone wattage frequency shall not interfere with electrical/electronic components at a distance of one meter.

Verification: (Analysis)

Met	Not Met	N/A
[ ]	[ ]	[X]

There were no valve manifolds provided in this package. Therefore, there were no valve position switches added by this package.

Verification: (Test)

Met	Not Met	N/A
[ ]	[ ]	[X]

There were no valve manifolds provided in this package. Therefore, there were no valve position switches added by this package.

3.3.2.2 Electromagnetic Force Interference. The valve position system shall not be adversely affected by outside electromagnetic forces generated by a 60 horse power, 480 Vac, induction type motor operating at frequencies between 0 and 60 hertz and located 1 meter away from the leak detection system.

Verification: (Analysis)

Met	Not Met	N/A
X		

The motor will be located above the pit cover blocks.

Any EMI to the signals located outside the pit above the cover blocks next to the motor are shielded either by a grounded metal enclosure or conduit. In addition the cabling is shielded with metal (aluminum) foil which is also grounded to the electrical system ground in the 241-AN-271 building.

The grounded shielding drains away any stray induced currents caused by the motor electromagnetic field.

3.3.3 Identification and Marking

3.3.3.1 Labeling. New equipment and/or modifications to existing equipment shall be labeled in a standardized format in accordance with HNF-IP-0842, Volume II, Section 6.1, "Tank Farm Operations Equipment Labeling," Rev. 0d.

Verification: (Analysis)

Met	Not Met	N/A
X		

This requirement is verified by the fact that the new H-14 drawings were prepared using equipment numbering formats provided by CHG. In addition, Construction Specification W-314-C5, Section 13440, Paragraph 2.2.4 specifies that labeling will be by CHG OCM per their existing procedures.

Verification: (Examination)

Met	Not Met	N/A
X		

This requirement was verified by examination at the end of construction during the as-built field verification.

3.3.3.2 Reserved for Future Use

3.3.3.3 Operations and Maintenance Drawings. Operations and maintenance drawings (as-built H-14 essential drawings) shall be prepared as the system master drawings showing as-built configuration changes in accordance with HNF-IP-0842, Volume II, Section 6.1, "Tank Farm Operations Equipment Labeling," Rev. 0e.

Verification: (Analysis)

		X

Met	Not Met	N/A

The compliance with this requirement will take place and be verified at the end of construction.

Verification: (Examination)

Met	Not Met	N/A
X		

This requirement was verified by examination at the end of construction and is documented in the field verification packages.

3.3.3.4 Valve Extension Handle Identification. Valve extension handles shall be uniquely identified.

Verification: (Analysis)

Met	Not Met	N/A
X		

Valve extension handle marking is specified on Drawing H-14-103346.

Verification: (Examination)

Met	Not Met	N/A
X		

This requirement was verified by examination during the performance of the ATPs RPP-9356 and RPP-9358.

3.3.4 Workmanship

3.3.4.1 Valve Pit Piping Workmanship. The design of the valve piping system shall determine and specify appropriate levels of workmanship for the fabrication and installation of the manifold according to the requirements of ASME B31.3, except PUREX connectors.

Verification: (Analysis)

Met	Not Met	N/A
X		

This requirement is verified by incorporating it in Construction Specification W-314-C5, Section 15493.

3.3.4.2 Cover Blocks and New Pits Workmanship. The design of the cover blocks and new pits shall determine and specify appropriate levels of workmanship for the fabrication and installation of the cover blocks and new pits according to the requirements of ACI-301, Section 1 through 5 and ACI-318, Part 3.

Verification: (Analysis)

		X

Met	Not Met	N/A

This requirement is not applicable as no new pits or cover blocks are provided.

3.3.5 Interchangeability

All like equipment (valves, position sensors, etc.) shall have interchangeable parts.

Verification: (Analysis)

Met	Not Met	N/A
X		

This requirement is met by the fact that all like equipment in this design package and other design packages for W-314 will be of identical make and model as much as possible and, therefore, have interchangeable parts.

3.3.6 Safety

3.3.6.1 Nuclear Safety

3.3.6.1.1 Safety Classification. The cover blocks and new pits are identified as general service items for the structures, systems, and components (SSCs). The cover blocks and new pits shall be designed to PC3 criteria for NPH loadings.

Verification: (Analysis)

Met	Not Met	N/A
X		

This requirement is verified by Calculations W314-C-029, *Pump Pits 01A and 04A Structural Evaluation*, and W314-C-030, *Pump Pit Wall Evaluation* that incorporate safety design criteria per DOE 6430.1A (Ref. Section 3.3.1.2). Per customer direction, CHG Letter CHG-0100435, dated January 25, 2001, the pits and cover blocks have been reclassified to general service and the drawings and construction specification W-314-C5 reflect this change.

3.3.6.1.2 Flammable Gas Hazardous Environment. The components of the valve position sensor systems installed in the tank intrusive locations, shall be intrinsically safe, designed to meet NFPA 70 Class I, Division 1, Group B criteria for hazardous locations.

Verification: (Analysis)

Met	Not Met	N/A
		X

This requirement is not applicable as there are no valve position sensor systems installed in the tank intrusive locations.

3.3.7 Human Performance/Human Engineering

3.3.7.1 Control Devices. Each control device shall be in accordance with NUREG 0700,

Section 6.4 and MIL-STD-1472E, Section 5.4 in accordance with DOE 6430.1A, Section 1300-12.4.7.

Verification: (Analysis)

Met	Not Met	N/A
☐	☐	☒

This requirement is not applicable to this design package since there are no control devices associated with the valve pit manifold.

3.3.7.2 Display Devices. Each display device shall be in accordance with NUREG 0700, Section 6.5 and MIL-STD-1472E, Section 5.2 in accordance with DOE 6430.1A, Section 1300-12.4.6.

Verification: (Analysis)

Met	Not Met	N/A
☐	☐	☒

This requirement is not applicable to this design package since there are no display devices associated with this package.

3.3.7.3 Valve Actuator Handwheel. Each valve actuator shall be designed to produce the required operating torque with a maximum rim pull of 80 lbs on the handwheel.

Verification: (Analysis)

Met	Not Met	N/A
☐	☐	☒

Not applicable to this package since there are no valve actuators.

Verification: (Demonstration)

Met	Not Met	N/A
☐	☐	☒

This requirement is not applicable as there are no valve actuators in this package.

3.4 Documentation

3.4.1 Document Control

Records, documents, and document control pertinent to design functions shall be in accordance with HNF-PRO-224 and HNF-IP-0842, Volume XI, Section 3.5, Rev. 0a.

Verification: (Analysis)

Met	Not Met	N/A
☒	☐	☐

The overall record management for identification and storage of drawings, calculations, and specifications pertinent to design functions were performed according to

HNF-PRO-224 and HNF-IP-0842, Volume 11, Section 3.5.

Verification: (Examination)

[X]	[ ]	[ ]
Met	Not Met	N/A

TBD CHG.

3.4.2 Drawings Preparation

Drawings shall be prepared according to the formats set forth in HNF-PRO-242, Rev. 1, *Engineering Drawing Requirements* for drawings produced prior to June 15, 1999 and RPP-PRO-709, Rev. 0, *Preparation and Control Standards for Engineering Drawings* for drawings produced after June 15, 1999. After January 24, 2001 use HNF-IP-0842, Volume IV, Section 4.31, Rev. 0a.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

H-Series Drawings were prepared and released per ECN W314-4L-002 dated April 23, 2001 in accordance with the guidelines set forth in HNF-PRO-709, Rev. 1.

3.5 Logistics

3.5.1 Maintenance

3.5.1.1 Fully Remote Maintenance and Operation. Each system or portion of a system having radiation levels greater than 50 mrem/hr contact exposure shall be designed to be remotely maintained and operated or designed to require no maintenance and be remotely operated.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

The drain jumpers are designed for installation with a remote operated wrench. In addition, the valves are designed for actuation from above the cover blocks. Also, the components within the pit are designed to require no preventive maintenance (Ref. Section 3.2.4.2).

3.5.1.2 Limited Contact Maintenance and Operation. Each system or portion of a system having radiation levels greater than 0.1 mrem/hr to less than or equal to 50 mrem/hr shall be designed for limited contact maintenance and operation.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

The drain jumpers are designed for installation with a remote operated wrench. In

addition, the valves are designed for actuation from above the cover blocks. Also, the components within the pit are designed to require no preventive maintenance (Ref. Section 3.2.4.2).

3.5.1.3 Full Contact Maintenance and Operation. Each system or portion of a system having radiation levels less than or equal to 0.1 mrem/hr shall be designed for full contact maintenance and operation.

Verification: (Analysis)

[X] Met	[ ] Not Met	[ ] N/A

The only portion of the system that requires full contact maintenance and operation is above the cover blocks. All components above the cover block are accessible for full contact maintenance and operation.

3.5.1.4 Dome Loading Constraints. The equipment used for installation and maintenance must comply with the DST dome loading constraints.

Verification: (Analysis)

[ ] Met	[ ] Not Met	[X] N/A

If equipment is located outside a 20' exclusion zone around the DST, dome loading effects are mitigated. Compliance with this requirement will be verified by the calculation by the customer and by the issuing of dome loading permits for locating the equipment from Tank Farm Engineering and Operations.

3.5.1.5 Valve Maintenance. Valves shall be maintenance free with up to 1000 cycles over a design life of 12 years.

Verification: (Analysis)

[X] Met	[ ] Not Met	[ ] N/A

The design requirement is documented in Procurement Specification W-314-P22, *Ball Valves*. The specification stipulates that valves remain in operation for a minimum period of one thousand complete cycles and be designed to operate properly following periods of stagnant position of up to one year. Previous Hanford experience provides adequate assurance that this reliability requirement can be met.

3.5.2 Supply

3.5.2.1 Parts and Components. The system design shall, to the greatest extent practicable, use readily available parts and components.

Verification: (Analysis) [X] [ ] [ ]

Met	Not Met	N/A

To the greatest extent practicable, the parts and components used are standard off-the-shelf items. It is not anticipated that such items cannot be found to fulfill the requirements.

3.5.3 Facilities and Facility Equipment

New Hanford Site remote operation wrenches shall be developed for installation/removal of the PUREX Jumper Connector Assembly.

Verification: (Analysis)

Met	Not Met	N/A
[X]	[ ]	[ ]

This requirement is documented in Procurement Specifications W-314-P2 and W-314-P10 for remote operated wrenches.

3.6 Personnel and Training

The valve pit piping system, cover blocks, and valve position sensor systems, shall be designed for operation by personnel possessing qualifications in accordance with DOE 5480.20A, Chapter IV, and trained in accordance with Chapter 1.

Verification: (Analysis)

Met	Not Met	N/A
[X]	[ ]	[ ]

The design package was prepared with the assumption that the operating personnel are qualified according to DOE 5480.20. The package includes equipment, fittings, and materials similar to those already installed and operated throughout the tank farms. No new material or technology was introduced which would require additional training or special skill of the operating personnel.

3.7 Major Component Characteristics

3.7.1 New Process Pits and Cover Blocks

3.7.1.1 Performance Characteristics

3.7.1.1.1 Confine Waste Leakage within the Transfer Associated Structures. (FFBD Function 3.2.1)

3.7.1.1.1.1 Transfer Line Equipment. The process pit(s) shall support transfer line equipment located in and above the pits, nozzles where transfer lines terminate at the pit sidewalls, and the cover blocks.

Verification: (Analysis)

[X]	[ ]	[ ]

Met	Not Met	N/A

This requirement is verified by Calculation W314-C-029, *Pump Pit Wall Evaluation*, that investigates the piping loads supported by the pit walls.

3.7.1.1.1.2 Equipment in Process Pits. The process pit(s) and cover blocks shall enclose the valve pit piping system and pit leak detection equipment.

Verification: (Analysis)

Met	Not Met	N/A
[X]	[ ]	[ ]

This requirement is verified by nature of the design of the new pit and cover blocks shown on Drawings H-14-103318 and H-14-103319.

3.7.1.1.1.3 Process Pit Liner. The process pit(s) with liners/special protective coatings shall provide leaktight secondary confinement.

Verification: (Analysis)

Met	Not Met	N/A
[X]	[ ]	[ ]

For existing pits this requirement will be verified by CHG Quality Control. Required repairs for existing pits and installation in new pits of SPC will be in accordance with Construction Specification W-314-C5, Section 09855.

Verification: (Examination)

Met	Not Met	N/A
[X]	[ ]	[ ]

This requirement was verified during construction and documented in CWPs W314-4L-014 and W314-4L-015.

3.7.1.1.1.4 Release of Contamination. The process pit(s) and cover blocks shall confine release of any aerosol spray of a product leak from the valve manifold within the valve or pump pit. Compressible gasket shall be used between cover block and top of pit to prevent leakage.

Verification: (Analysis)

Met	Not Met	N/A
[X]	[ ]	[ ]

This requirement is verified by Drawing H-14-103323.

3.7.1.1.1.5 Leak Detection Equipment Location. The process pit(s) shall provide a low-point location in the floor for the pit leak detection equipment.

Verification: (Analysis)

[X]	[ ]	[ ]

Met	Not Met	N/A

This requirement is verified by existing Drawing H-2-71912.

3.7.1.1.1.6 Low-Point Drain System. The process pit(s) shall provide a low-point drain system to return accumulated liquids, leakage from the primary confinement system, and wash-down liquids to a Double-Shell Tank.

Verification: (Analysis)

Met	Not Met	N/A
X		

This requirement is verified by existing Drawing H-2-71912.

3.7.1.1.1.7 Radiation Shielding. The process pit(s) and cover blocks, including penetrations, shall provide adequate shielding for facility workers located on top of the cover blocks and adjacent to the process pits during normal operations and maintenance. The radiation shielding shall meet the design objective to maintain exposure levels below an average of 0.5 mrem (5 microsieverts) per hour and as far below this average as is reasonably achievable. The goal for reasonably achievable is 0.05 mrem (5 microsieverts) per hour or less.

Verification: (Analysis)

Met	Not Met	N/A
	X	

This requirement is verified by Calculation W314-P-050, *Shielding Analysis*. The 241-AN-01A and 04A pump pits are existing and per Calculation W314-P-050 will exceed the 0.5 mrem/hr criteria.

3.7.1.1.1.8 Cover Block Rain Intrusion. The cover blocks shall be designed to limit intrusion of rain water or snow melt into the process pits.

Verification: (Analysis)

Met	Not Met	N/A
		X

There are no new cover blocks provided in this package.

3.7.1.1.1.9 Protective Coating. New process pit(s) shall be equipped with stainless steel liners that extend to the bottom of the cover blocks. All other exposed surfaces and the cover blocks shall have a special protective coating to protect the structural secondary confinement by providing a barrier between the interior exposed surfaces of the pit and cover blocks and any waste present in the pit due to leaks, spill, or intrusion. 241-AN-04D Slurry Receiver Pit shall be protected by SPC on exposed surfaces.

Verification: (Analysis)

Met	Not Met	N/A
X		

For existing cover blocks SPC requirement is included in Construction Specification

W-314-C5, Section 09855.

Verification: (Examination)

Met	Not Met	N/A
X		

Stainless steel liner and SPC requirement was verified by examination during construction and documented in CWPs W314-4L-014 and W314-4L-015.

3.7.1.1.1.10 Low-Point Drain System Capabilities. The drain system shall have the ability to drain accumulated leakage within 24 hours.

Verification: (Analysis)

Met	Not Met	N/A
X		

The drain has a check valve for automatic drainage at a certain liquid level and a removable plug for complete drainage. Complete drainage of the pit within 24 hours is achieved by operator response to the pit leak detector and operating the drain plug. Reference Drawing H-14-103352.

3.7.1.2 Physical Characteristics

3.7.1.2.1 Reinforced Concrete. New process pits and cover blocks shall be constructed of reinforced concrete and pits shall be below grade. Edges of the cover blocks shall be stepped to preclude radiation streaming.

Verification: (Analysis)

Met	Not Met	N/A
		X

This requirement is not applicable as no new pits or cover blocks are provided.

Verification: (Examination)

Met	Not Met	N/A
		X

This requirement is not applicable as no new pits or cover blocks are provided.

3.7.1.2.2 Process Pit Wall Nozzles. Process pits shall be equipped with sleeves for wall nozzles as required. Wall nozzles shall be PUREX type design (reference drawings H-2-90185 and H-2-90186).

Verification: (Analysis)

Met	Not Met	N/A
X		

New nozzles are specified on Drawings H-14-103347 and H-14-103348.

Verification: (Examination) ☐ Met ☐ Not Met ☒ N/A

The new nozzles were verified by examination per CWP W314-4L-003.

3.7.1.2.3 Process Pit Spare Nozzles. Sleeves for spare nozzles shall be installed in any new process pit, except for the new 241-AN-04D Slurry Receiver Pit.

Verification: (Analysis) ☐ Met ☐ Not Met ☒ N/A

Not applicable to this package. There are no new process pits except for 241-AN-04D in this package.

Verification: (Examination) ☐ Met ☐ Not Met ☒ N/A

Not applicable to this package. There are no new process pits except for 241-AN-04D in this package.

3.7.1.2.4 Grounding Systems. A grounding system shall be furnished for electrical equipment, structural components, valve pit liners, reinforcing steel, nozzles and other metallic equipment. This grounding system shall be interfaced to the appropriate tank farm grounding and cathodic protection systems.

Verification: (Analysis) ☒ Met ☐ Not Met ☐ N/A

This requirement is verified by Drawing H-14-103380.

3.7.1.2.5 Cover Blocks Penetrations. New cover blocks and existing cover blocks to be modified (see 3.1) shall be equipped with penetrations to facilitate operations and/or maintenance of manifold valves, pit drains, pit leak detection devices and transfer leak detection devices. Additionally, the penetrations shall provide for access to any other equipment in the pits requiring maintenance, pit wash down, gas sampling ports, and installation of support equipment (e.g., video cameras, etc.). A sufficient number of penetrations shall be provided to allow full visual inspection of the interior of the pits.

Verification: (Analysis) ☒ Met ☐ Not Met ☐ N/A

This requirement is verified by Drawings H-14-103318 and H-14-103319.

Verification: (Examination) ☒ ☐ ☐

Met	Not Met	N/A

This requirement was verified during construction and documented in CWPs W314-4L-017 and W314-4L-018.

3.7.1.2.6 Cover Blocks Rain Ingress. Cover blocks shall be sloped to drain off the top of the blocks and shall extend over the outside of the pit walls, except that the single piece cover block for 241-AN-04D Slurry Receiver Pit shall not be sloped.

Verification: (Analysis)

Met	Not Met	N/A
☐	☐	☒

There are no new cover blocks provided in this package.

3.7.1.2.7 Cover Blocks for Pump Pits. *The cover blocks for* 241-AZ-02A, 241-AZ-01A, 241-AY-01A, and 241-AY-02A Central Pump Pits, including penetrations shall be sealed to limit air infiltrations.

Verification: (Analysis)

Met	Not Met	N/A
☐	☐	☒

This requirement is not applicable to this package since no work is done in these Pump Pits by this package.

3.7.1.2.8 Gas Sampling Ports. Gas sampling ports shall be greater than 0.7 inch and less than 1.0 inch in diameter, located above the drain or center of the pit, flared on the bottom to minimize snagging of sample line during removal, and equipped with two bonding lugs for attachment to the portable sampler.

Verification: (Analysis)

Met	Not Met	N/A
☒	☐	☐

This requirement is verified by Drawings H-14-103318 and H-14-103319.

Verification: (Examination)

Met	Not Met	N/A
☒	☐	☐

This requirement was verified during construction and documented in CWPs W314-4L-017 and W314-4L-018.

3.7.1.2.9 Gas Sampling Ports Material. Gas sampling ports shall be constructed of low sparking, electrically conductive material, and shall be electrically bonded.

Verification: (Analysis)

☒	☐	☐

Met	Not Met	N/A

This requirement is verified by Drawings H-14-103318 and H-14-103319.

3.7.1.2.10 Gas Sampling Port Covers. Gas sampling ports shall have an electrically conductive, non-screw type cover that is electrically bonded to the port with a noninsulated conductor strong enough to act as a cover keeper.

Verification: (Analysis)

Met	Not Met	N/A
[X]	[ ]	[ ]

This requirement is verified by Drawings H-14-103318 and H-14-103319.

3.7.1.2.11 Lifting Mechanism. Cover blocks shall be supplied with lifting mechanisms on the top surface to facilitate handling with a crane. The maximum weight of new cover block shall be 16.5 ton.

Verification: (Analysis)

Met	Not Met	N/A
[ ]	[ ]	[X]

This requirement is not applicable as no new cover blocks are provided by this package.

Verification: (Examination)

Met	Not Met	N/A
[ ]	[ ]	[X]

This requirement is not applicable as no new cover blocks are provided by this package.

3.7.1.2.12 Cover Blocks Alignment. Cover blocks and pit walls shall be marked to facilitate alignment of the cover blocks.

Verification: (Analysis)

Met	Not Met	N/A
[ ]	[ ]	[X]

This requirement is not applicable as no new cover blocks are provided by this package.

Verification: (Examination)

Met	Not Met	N/A
[ ]	[ ]	[X]

This requirement is not applicable as no new cover blocks are provided by this package.

3.7.2 Valve Position Sensor Systems

3.7.2.1 Performance Characteristics

3.7.2.1.1 Monitor Valve Position. (FFBD Function 3.1.4) After the transfer system route has been setup, the transfer system shall monitor the limit positions of the valves on the valve jumper manifolds in the transfer route. This requirement does not apply to 241-AN-04D Slurry Receiver Pit.

3.7.2.1.1.1 Indicate Valve Limit Position. The waste transfer system jumper/manifold valves shall indicate valve limit position.

Verification: (Analysis)

Met	Not Met	N/A
☐	☐	☒

No monitored valves were added as part of this package.

3.7.2.1.1.2 Active Valve Indication. Each separate valve limit position shall be actively indicated.

Verification: (Analysis)

Met	Not Met	N/A
☐	☐	☒

No monitored valves were added as part of this package.

3.7.2.1.1.3 Valve Position Transmission. The valve position shall be transmitted to the Master Pump Shutdown system.

Verification: (Analysis)

Met	Not Met	N/A
☐	☐	☒

No monitored valves were added as part of this package.

3.7.2.1.1.4 Valve Position Indication Accuracy. The valve position indication system shall provide sufficient accuracy with respect to the actual valve position such that the selected flow path configuration is leak tight.

Verification: (Analysis)

Met	Not Met	N/A
☐	☐	☒

No monitored valves were added as part of this package.

3.7.2.2 Physical Characteristics

3.7.2.2.1 Hardware Proximity. The valve position sensing hardware, display, and transmitter as applicable shall be able to withstand the insertion and removal, turning, and overturning of the valve actuator handle and still operate properly.

Verification: (Analysis)

☐	☐	☒

Met	Not Met	N/A

No monitored valves were added as part of this package.

Verification: (Test)

Met	Not Met	N/A
☐	☐	☒

No monitored valves were added as part of this package.

3.7.2.2.2 Hardware Exposure to Environment. The valve position hardware, display, and transmitter, as applicable, shall be designed to perform in the environment on top of the cover block and withstand inadvertent physical abuse.

Verification: (Analysis)

Met	Not Met	N/A
☐	☐	☒

No monitored valves were added as part of this package.

3.7.2.2.3 Hardware Removability. The valve position hardware, display, and transmitter, as applicable, shall be designed to facilitate quick mechanical/electrical disconnect for ease of cover block removal and replacement.

Verification: (Analysis)

Met	Not Met	N/A
☐	☐	☒

No monitored valves were added as part of this package.

3.7.2.2.4 Hardware Capabilities. The valve position hardware to detect, display, and transmit valve position shall be located outside the pit.

Verification: (Analysis)

Met	Not Met	N/A
☐	☐	☒

No monitored valves were added as part of this package.

3.7.3 Pit Manifolds Sitework - New Pits

3.7.3.1 Performance Characteristics. Not Applicable.

3.7.3.1.1 Site Transfer Associated Structures. (FFBD Function 3.2.6)

3.7.3.1.1.1 Site Soils. The site soils shall support the major components of the new Valve Pits.

Verification: (Analysis)

☒	☐	☐

Met Not Met N/A

This requirement is verified by the Dames & Moore Soils Report.

3.7.3.1.1.2 Access Control Fencing. Access control to radiological and hazardous waste areas shall be provided by fencing consistent with existing fencing for RPP operations.

Verification: (Analysis) ☐ Met ☐ Not Met ☒ N/A

This requirement is not applicable as no new fence is added or existing fence revised.

3.7.3.1.1.3 Existing Lighting Extended. The existing area lighting system at the 241-AZ tank farm shall be extended to provide an adequate level of illumination for night-time operations at the new 241-AZ-VP Valve Pit. The lighting system shall provide a minimum average illumination of 54 lux (5 fc) with a maximum uniformity ratio of 5:1 average to minimum.

Verification: (Analysis) ☐ Met ☐ Not Met ☒ N/A

Not applicable to this package.

Verification: (Test) ☐ Met ☐ Not Met ☒ N/A

Not applicable to this package.

3.7.3.1.1.4 Lighting Control. Lighting control shall be furnished with a photocell override to ensure that lights are turned off during the day.

Verification: (Analysis) ☐ Met ☐ Not Met ☒ N/A

Not applicable to this package.

Verification: (Test) ☐ Met ☐ Not Met ☒ N/A

Not applicable to this package.

3.7.3.2 Physical Characteristics

3.7.3.2.1 Disturbed Areas Stabilized. All areas disturbed by construction shall be stabilized subsequent to construction.

Verification: (Analysis) [X] Met [ ] Not Met [ ] N/A

This requirement is verified by Construction Specification W-314-C5, Section 02220.

Verification: (Examination) [X] Met [ ] Not Met [ ] N/A

This requirement was verified during construction and documented in CWPs W314-4L-009 and W314-4L-010.

3.7.3.2.2 Pole-Mounted Luminaries. Pole-mounted banks of luminaries shall be used. Fixture lowering devices shall be provided for poles over 18m high. Existing electrical distribution system in the area shall be utilized to provide necessary power.

Verification: (Analysis) [ ] Met [ ] Not Met [X] N/A

Not applicable to this package.

Verification: (Examination) [ ] Met [ ] Not Met [X] N/A

Not applicable to this package.

3.7.3.2.3 Luminary Glare. Luminaries shall be shielded mercury vapor, or metal halide directed to minimize upward glare.

Verification: (Analysis) [ ] Met [ ] Not Met [X] N/A

Not applicable to this package.

Verification: (Examination) [ ] Met [ ] Not Met [X] N/A

Not applicable to this package.

3.7.4 Pit Drain Seal Assemblies

3.7.4.1 Performance Characteristics

3.7.4.1.1 Position Pit Drain Seal Assembly. (FFBD Function 3.1.8)

3.7.4.1.1.1 Twenty-four (24) Hour Holdup of Ten Gallons. The pit drain seal assembly shall provide a 24 hour holdup for ten gallons of liquid to activate a leak detector.

Verification: (Analysis)

[X] Met	[ ] Not Met	[ ] N/A

The pit drain seal assembly is designed to seal the drain and provide a minimum holdup of 10 gallons as documented on Drawings H-14-103352 and H-14-103353.

Verification: (Test)

[X] Met	[ ] Not Met	[ ] N/A

This requirement was verified during performance of the ATPs RPP-9350 and RPP-9352.

3.7.4.1.1.2 Vapor Seal. The pit drain seal assembly shall provide a vapor seal to prevent the tank vapor space pressure from offgassing into the pit and air in-leakage into the tank vapor space.

Verification: (Analysis)

[X] Met	[ ] Not Met	[ ] N/A

The pit drain seal assembly is designed with a check valve to provide a vapor seal as documented on drawings H-14-103352 and H-14-103353.

3.7.4.1.1.3 Retractable Drain Seal. The drain seal assembly shall be retractable to permit complete drainage of the pit and removable for gasket replacement.

Verification: (Analysis)

[X] Met	[ ] Not Met	[ ] N/A

This requirement is met as documented on Drawings H-14-103352 and H-14-103353.

Verification: (Demonstration)

[X] Met	[ ] Not Met	[ ] N/A

This requirement was verified during performance of the ATPs RPP-9350 and RPP-9352.

3.7.4.1.1.4 Drainage to the Tank. The pit drain seal assembly shall provide drainage into the tank to prevent a pit overflow condition.

Verification: (Analysis) [X] Met [ ] Not Met [ ] N/A

The design with the check valve prevents overflow of the pit as documented on drawings H-14-103352 and H-14-103353.

3.7.4.2 Physical Characteristics

3.7.4.2.1 Operation Above Cover Block. Operation, removal, and insertion of the drain seal assembly shall be from above the cover block.

Verification: (Analysis) [X] Met [ ] Not Met [ ] N/A

This requirement is met as documented on Drawings H-14-103352 and H-14-103353.

Verification: (Demonstration) [X] Met [ ] Not Met [ ] N/A

This requirement was verified during performance of the ATPs RPP-9350 and RPP-9352.

3.7.4.2.2 Visible Indication of Position. Visible indication shall be provided above the cover block at the drain seal assembly position (i.e., inserted or retracted).

Verification: (Analysis) [X] Met [ ] Not Met [ ] N/A

This requirement is met as documented on Drawings H-14-103352 and H-14-103353.

Verification: (Demonstration) [X] Met [ ] Not Met [ ] N/A

This requirement was verified during performance of the ATPs RPP-9350 and RPP-9352.

3.7.4.2.3 Configuration to Prevent Drain Plugging. Configuration of the drain seal assembly shall minimize the potential for drain line plugging in both the inserted and retracted positions.

Verification: (Analysis) [X] Met [ ] Not Met [ ] N/A

This requirement is met as documented on Drawings H-14-103352 and H-14-103353.

3.7.4.2.4 Electrical Grounding Jumper. The drain seal operator shall be provided with an electrical grounding jumper.

Verification: (Analysis) [X] Met [ ] Not Met [ ] N/A

This requirement is met as documented on Drawing H-14-103353.

Verification: (Examination) [X] Met [ ] Not Met [ ] N/A

The requirement was verified by examination and documented in Field Verification Package FVP-103353.

3.7.4.2.5 Configuration to Prevent Inadvertent Manipulation. Configuration of the drain seal assembly operator shall prevent inadvertent manipulation of the drain seal assembly beyond the retracted position.

Verification: (Analysis) [X] Met [ ] Not Met [ ] N/A

This requirement is met as documented on Drawing H-14-103353, Sheet 2, Detail 5.

4 SYSTEM QUALIFICATION PROVISIONS

4.1 General

The Project W-314 QAPP (HNF-SD-W314-QAPP-001) defines the quality assurance requirements for this project.

Table 4-1 listed verifications may be performed in conjunction with QAPP verifications. Inspections as defined in 4.2 shall be conducted during the design and development of each system to provide assurance of compliance with the requirements of this PDS.

4.1.1 Responsibility for Inspections

The design contractor shall be responsible for the performance of all inspections for each system developed in accordance with this PDS. Inspections shall be conducted at the contractor facilities or the facilities of his choice with the approval of the procuring authority. The procuring authority reserves the right to witness or perform the specified inspections.

4.1.2 Special Tests and Examinations

Not applicable to this specification.

4.2 Quality Conformance Inspections.

Qualification shall be performed on System hardware representative of the approved production design. Qualification of the System to assure compliance with the requirements of Section 3 shall be by examination, demonstration, test, and/or analysis, as defined herein. Test program data may be used to assure compliance with requirements.

a. Examination is an element of inspection consisting of investigation, without the use of special laboratory appliances or procedures, to determine compliance with requirements. This method is intended to be construction related and consists of examination of documents and construction activities.

b. Demonstration is an element of inspection that is limited to readily observable functional operation to determine compliance with requirements. This element of inspection does not require the use of special equipment or sophisticated instrumentation. This method is intended to be utilized for any mock-up testing.

c. Test is an element of inspection that employs technical means including (but not limited to) the evaluation of functional characteristics by use of special equipment or instrumentation, simulation techniques, and the application of established principles and procedures to determine compliance with requirements. The analysis of data derived from test is an integral part of this inspection. This method is intended to be utilized for any acceptance testing in the field.

d. Analysis is an element of inspection, taking the form of the processing of accumulated results and conclusions, intended to provide proof that verification of a requirement(s) has been accomplished. The analytical results may be comprised of a compilation of interpretation of existing information or derived from lower level examinations, tests, demonstrations, or analyses.

The environmental capability of equipment shall be demonstrated by appropriate testing, analysis, and operating experience, or other methods that can be supported by auditable documentation, or a combination of these methods.

5 NOTES

5.1 Definitions

5.1.1 Manifold

Remotely installed rigid piping systems inside a pit that transfer waste and flush water between nozzles.

5.1.2 Pit Nozzle

Rigid male connector anchored in the pit wall that provides a leak tight connection with the integral seal block attached to a manifold.

5.1.3 Equivalent Length

The actual length of piping plus the friction loss of all valves and fittings in the system expressed in terms of equivalent feet of piping.

5.1.4 Glaze

Coating of ice formed when rain or drizzle freezes on contact with any surface having a temperature that is below freezing.

5.2 Acronym List

ACI	American Concrete Institute
AISC	American Institute of Steel Construction
ALARA	As Low As Reasonable Achievable
ANSI	American National Standard Institute
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
BIO	Basis for Interim Operation
CDR	Conceptual Design Report
CFR	Code of Federal Regulations
DOE	Department of Energy
DRD	Design Requirements Document
DST	Double Shell Tank
EDTA	Ethylenediametraacetic acid
FDC	Functional Design Criteria
FFBD	Functional Flow Block Diagram
FM	Factory Mutual System
HEDTA	N-(hydroxyethyl)-ethylenediaminetriacetic acid
LLW	Low Level Waste
MTBF	Mean Time Between Failure
MWTF	Multi-Function Waste Tank Facility
N/A	Not applicable
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NUREG	Nuclear Regulatory Reports
PC	Performance Category
PDC	Project Design Concept
PDS	Project Development Specification
PHMC	Project Hanford Management Contract
PICD	Project Interface Control Document
PUREX	Plutonium-Uranium Extraction
RAS	Requirements Allocation Sheet
RPP	River Protection Project
SPC	Special Protective Coating
SpG	Specific Gravity
SST	Single Shell Tank
TFC	Tank Farm Contractor
TOC	Total Organic Carbon
TWRS	Tank Waste Remediation System
UCRL	University of California Research Laboratory
USSR	Upgrade Scope Summary Report

5.3 Applicable Documents

National codes and standards will be identified within Section 2, Applicable Documents, of the PDS without dates or revision numbers. Government documents and Hanford site standards will be identified by the effective date or revision number.

APPENDIX C

Requirements Verification

for

Pit Leak Detection

1 SCOPE

This appendix documents how the requirements that are listed in the Project Development Specification (PDS) for the Pit Leak Detection system (HNF-SD-W314-PDS-003) are satisfied for the new pit leak detection systems that will be installed by Project W-314 for Pump Pits 241-AN-01A and 241-AN-04A and the 241-AN-04D Slurry Receiver Pit.

2 APPLICABLE DOCUMENTS

For a list of the applicable documents, refer to the appropriate PDS.

3 REQUIREMENTS

3.1 Item Definition

No requirements are listed in this section.

3.2 Characteristics

3.2.1 Performance Characteristics

3.2.1.1 Detect Leaks in Transfer Associated Structures. (FFBD Function 3.2.3)

3.2.1.1.1 Monitor Pit for Leak. (FFBD Function 3.2.3.1) After the waste transfer system is up and operating and after the administrative lock has been removed, the pit leak detection system shall monitor for leaks from the primary piping system.

3.2.1.1.1.1 Leak Detection Response Time. The pit leak detection system shall detect the presence of a leak within twenty-four hours. (See Section 5.1 for definition of leak)

Verification: (Analysis)

[X] Met	[ ] Not Met	[ ] N/A

The upgraded pit leak detection system is designed such that a conductivity probe is installed in the low point of the pit to detect the presence of liquid when it reaches the probes. There has been an informal agreement between CHG and the Washington State Department of Ecology that the maximum allowable quantity of leakage that is necessary to detect in 24 hours is 10 gallons or less. Calculation W314-I-045 shows that the placement of the probes at .240 inch above the pit floor for Central Pump Pit 241-AN-01A and at 0.370 inch above the pit floor for Central Pump Pit 241-AN-04A will detect a quantity of 10 gallons. Calculation W314-I-047 shows that placement of the probes at 1 inch above the pit floor will detect a quantity of 10 gallons for slurry receiver pit 241-AN-04D. The 10 gallons in 24 hours corresponds to a leak rate of 0.0069 gallons/minute. Any leak rate less than that will not be detected in the 24-hour time period.

Verification: (Demonstration) [X] [ ] [ ]

Met Not Met N/A

This requirement is also verified by TWR-4663, *Acceptance Test Report for Leak Detection Mock-Up* and in the Construction Work Package W-314-RPP-03 for the AY spare leak detector stations that are similar to the stations in the AN to WTS design.

3.2.1.1.1.2 Continual Monitoring. The pit leak detection system shall monitor for liquids during a waste transfer and shall provide a signal when a leak is detected.

Verification: (Analysis) [X] Met [ ] Not Met [ ] N/A

The Pit Leak Detection System monitors for liquids continuously, both when there a transfer is in progress and when there is no transfer in progress, as long as power is applied to the system. Any liquid that enters the pit will flow to the lowest point (the drain) and be held up by the drain plug. When the liquid reaches the height of the probes the electrical circuit is completed, the alarm light is activated by the leak detection relay, and the automatic MPS shutdown signal is initiated. The MPS shutdown signal will first be connected into the existing MPS shutdown system and later connected into the new MPS system when installed at a later date. The leak detection circuitry is shown on Drawings H-14-103357, H-14-103362, and H-14-103370.

Verification: (Demonstration) [X] Met [ ] Not Met [ ] N/A

This requirement is also verified by TWR-4663, *Acceptance Test Report for Leak Detection Mock-Up* and in the Construction Work Package W-314-RPP-03 for the AY spare leak detector stations that are similar to the stations in the AN to WTS design.

3.2.1.1.1.3 System Sensors. Pit leak detection system sensors shall be positioned no higher than two inches above the floor in the lowest part of the pit or in a sump in the pit.

Verification: (Analysis) [X] Met [ ] Not Met [ ] N/A

The pit leak detection probes are not located directly over the low point of the pit (interference from the pit drain) but are located adjacent to the low point. The probes are to be located at a height of approximately 1/16 inch from the pit floor. See Drawings H-14-103355, H-14-103361, and H-14-103366 for more details on probe placement.

Verification: (Demonstration) [X] Met [ ] Not Met [ ] N/A

This requirement is also verified by TWR-4663, *Acceptance Test Report for Leak Detection Mock-Up* and in the Construction Work Package W-314-RPP-03 for the AY

spare leak detector stations that are similar to the stations in the AN to WTS design.

Verification: (Test)

[X]	[ ]	[ ]
Met	Not Met	N/A

This requirement was verified during performance of the ATPs RPP-9350 and RPP-9352.

3.2.1.1.1.4 Monitoring Frequency. The monitoring frequency of the pit leak detection system shall be continuous. (See Section 5.1 for definition of continuous)

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

The pit leak detection system monitors for leaks within the valve pit. This is accomplished with the use of a continuously energized leak detection relay and conductivity probes. Upon failure of power to the leak detection relay or probe circuit, an alarm is activated so operators can respond. The leak detection circuitry is shown on Drawings H-14-103357, H-14-103362, and H-14-103370.

3.2.1.1.1.5 Response Time. The required response time of the pit leak detection system shall be instantaneous. (See Section 5.1 for definition of instantaneous)

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

The leak detection system is continuously monitoring for leaks. When a leak is detected, the contacts of the leak detection relay will close and instantaneously initiate the local alarm light. The active components that would primarily contribute to the response time are the components that change state, i.e., the leak detection relay and the latching coil relay. Calculation W314-I-054 verified leak detection system response time to be 0.525 seconds. The leak detection circuitry is shown on Drawings H-14-103357, H-14-103362, and H-14-103370.

3.2.1.1.1.6 Supervision of Wiring. The wiring between the leak detection system sensor and control panel shall be electrically supervised.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

Supervision for the wiring between the probes and the leak detection control panel is performed by the trip amplifier. This device monitors the voltage (at the probes) and is located in the leak detection control panel. Upon loss of probe voltage or wire failure, the trip amplifier will activate the local alarm and initiate the master pump shutdown system. The leak detection circuitry is shown on Drawings H-14-103357, H-14-103362,

and H-14-103370.

Verification: (Demonstration) [X] Met [ ] Not Met [ ] N/A

This requirement is also verified by TWR-4663, *Acceptance Test Report for Leak Detection Mock-Up* and in the Construction Work Package W-314-RPP-03 for the AY spare leak detector stations that are similar to the stations in the AN to WTS design.

Verification: (Test) [X] Met [ ] Not Met [ ] N/A

This requirement was verified during performance of the ATPs RPP-9350 and RPP-9352.

3.2.1.1.2 Monitor for Pit Leak Detector Malfunction. (FFBD Function 3.2.3.2) After the waste transfer system is up and operating and after the administrative lock has been removed, the MCS shall monitor for a leak detector malfunction. The MCS shall notify the operator(s) when a leak detector malfunction occurs.

3.2.1.1.2.1 Loss of Power. Loss of power to the leak detection probes, shall provide an output signal to the local alarm and MCS.

Verification: (Analysis) [X] Met [ ] Not Met [ ] N/A

The leak detection probe circuit voltage is monitored at the probe by the trip amplifier. Upon loss of power to the leak detector relay, the probe voltage will no longer be present. The trip amplifier will sense the loss of voltage at the probe, initiate the local alarm and provide an output signal to the MPS System. The leak detection circuitry is shown on Drawings H-14-103357, H-14-103362, and H-14-103370. Since the system does not require backup power per design direction, loss of power to the leak detector relay cabinet would not provide a local alarm. An output signal would be provided to the MPS System.

Verification: (Demonstration) [X] Met [ ] Not Met [ ] N/A

This requirement is also verified by TWR-4663, *Acceptance Test Report for Leak Detection Mock-Up* and in the Construction Work Package W-314-RPP-03 for the AY spare leak detector stations that are similar to the stations in the AN to WTS design.

Verification: (Test) [X] [ ] [ ]

Met	Not Met	N/A

This requirement was verified during performance of the ATPs RPP-9350 and RPP-9352.

3.2.1.1.2.2 Detected Failure. A detected failure in the leak detection system shall provide an output signal to the local alarm and MCS.

Verification: (Analysis)

Met	Not Met	N/A
X		

The leak detection system is designed to initiate the local alarm and master pump shutdown given the following failures. The first failure is the leak detection relay failure. Upon failure of the leak detection relay, the probe voltage will no longer be present and the shutdown signal will be generated from the trip amplifier as verified by section 3.2.1.1.1.6. The second failure is the probe wire and wire connectors failing. Upon failure of any leak detection probe wire or connector, the local alarm and the master pump shutdown is activated. In addition to these failures, the local warning light and the master pump shutdown system will also activate upon failure of the trip amplifier and the failsafe relay. The leak detection circuitry is shown on Drawings H-14-103357, H-14-103362, and H-14-103370.

Verification: (Demonstration)

Met	Not Met	N/A
X		

This requirement is also verified by TWR-4663, *Acceptance Test Report for Leak Detection Mock-Up* and in the Construction Work Package W-314-RPP-03 for the AY spare leak detector stations that are similar to the stations in the AN to WTS design.

Verification: (Test)

Met	Not Met	N/A
X		

This requirement was verified during performance of the ATPs RPP-9350 and RPP-9352.

3.2.1.1.2.3 Operational Test. The leak detection system shall perform an operational test of itself when commanded by the MCS. The test shall include alarm, circuitry, and sensor functions of the leak detection system.

Verification: (Analysis)

Met	Not Met	N/A
X		

The leak detection relay cabinet was designed with two general purpose relays used for testing. The selector switch is used for two operations. The first operation is for testing the leak detection relay by simulating a leak in the pit with the addition of a 8.2 kohm

resistor between the probes from the leak detection relay cabinet. The second test is to interrupt (open) the leak detection sensing circuit at the leak detection relay cabinet and verify the leak detection failsafe circuit is operational. The leak detection circuitry is shown on Drawings H-14103357, H-14-103362, and H-14-103370.

Verification: (Demonstration) [X] Met [ ] Not Met [ ] N/A

This requirement is also verified by TWR-4663, *Acceptance Test Report for Leak Detection Mock-Up* and in the Construction Work Package W-314-RPP-03 for the AY spare leak detector stations that are similar to the stations in the AN to WTS design.

Verification: (Test) [X] Met [ ] Not Met [ ] N/A

This requirement was verified during performance of the ATPs RPP-9350 and RPP-9352.

3.2.1.1.3 Activate Local LDSTA Alarm (Pit Leak Detector). (FFBD Function 3.2.3.3) After a leak or leak detector malfunction is detected, the leak detection system shall activate a local LDSTA alarm. The local LDSTA alarm shall stay activated until acknowledged by the operator(s). (See Section 5.1 Definitions)

3.2.1.1.3.1 Warning Light. The local LDSTA alarm shall be a warning light. The light shall identify the pit where the leak or malfunction occurred. Each warning light location shall be determined from Human Factors Analysis.

Verification: (Analysis) [X] Met [ ] Not Met [ ] N/A

The design provides a warning light located on top of the leak detection relay cabinet. Calculation W314-I-002 analyses the human factors considerations that were used to determine the location of the light. For placement of the leak detection local alarm (strobe light), refer to Drawing H-14-100983. For reference of where the leak detection systems are located in relationship to the pits, see Drawings H-14-103354, H-14-103360, and H-14-103366.

Verification: (Test) [X] Met [ ] Not Met [ ] N/A

This requirement was verified during performance of the ATPs RPP-9350 and RPP-9352.

3.2.1.1.3.2 Local Alarm Reset. The reset/acknowledgement of the local LDSTA alarm shall be either from a MCS Human-Machine Interface (HMI) location or the local LDSTA leak detector

station.

Verification: (Analysis)

[X] Met	[ ] Not Met	[ ] N/A

The reset/acknowledgment of the local alarm can be activated locally at the leak detector station and from HMI locations. This is accomplished by operating the reset switch. The local alarm can also be reset by the MPS system. This is accomplished from a PLC (Programmable Logic Controller) output signal generated from the HMI to the leak detection latch relay reset. The leak detection circuitry is shown on Drawings H-14-103357, H-14-103362, and H-14-103370.

Verification: (Demonstration)

[X] Met	[ ] Not Met	[ ] N/A

This requirement is also verified by TWR-4663, *Acceptance Test Report for Leak Detection Mock-Up* and in the Construction Work Package W-314-RPP-03 for the AY spare leak detector stations that are similar to the stations in the AN to WTS design.

Verification: (Test)

[X] Met	[ ] Not Met	[ ] N/A

This requirement was verified during performance of the ATPs RPP-9350 and RPP-9352.

3.2.1.1.3.3 Local LDSTA Alarm Operation. The local LDSTA alarm shall operate as follows:

- Immediately upon detecting a leak or malfunction, the local LDSTA alarm shall flash and the MCS shall produce an audible alarm.
- After the local LDSTA alarm is acknowledged by an operator located at the MCS HMI, the local LDSTA alarm shall remain flashing until recovery occurs.
- After the alarm is acknowledged at the MCS HMI, the MCS audible signal shall be silenced.
- When recovery occurs (the leak or malfunction has been corrected), the local LDSTA alarm shall cease illuminating.

Verification: (Analysis)

[ ] Met	[X] Not Met	[ ] N/A

The requirements of HNF-SD-W314-PDS-003, Rev. 3 were met. This requirement was revised in HNF-SD-W314-PDS-003, Rev. 4 to delete the latching function in the leak detector station. The deletion of the latching function is planned as part of the MPS Start-up and Turnover package. As stated in the analysis of section requirement

3.2.1.1.1.5, the local alarm consisting of a local flashing (strobe) light and a horn operated by the MPS system is instantaneously activated. For the second requirement, the local warning light will remain flashing until the latch coil of the latch relay is reset. The reset coil can be activated from the HMI by generating a signal to the leak detection latch relay reset. The latching relay will only reset providing contacts on the leak detector are in a state not representing a leak condition within the valve pit. If liquid is still present within the valve pit, the local warning light will continue to flash even if the reset coil is energized from the HMI. The third requirement, after the alarm is acknowledged at the MPS system HMI, the MPS System audible signal shall be silenced, is not currently applicable to this package. For the last requirement, the local alarm light will cease to illuminate only upon recovery of the leaking condition within the valve pit and resetting the latch coil. The leak detection circuitry is shown on Drawings H-14-103357, H-14-103362, or H-14-103370.

Verification: (Demonstration)

Met	Not Met	N/A
☐	☒	☐

The requirements of HNF-SD-W314-PDS-003, Rev. 3 were verified by TWR-4663, *Acceptance Test Report for Leak Detection Mock-Up* and in the Construction Work Package W-314-RPP-03 for the AY spare leak detector stations that are similar to the stations in the AN to WTS design.

Verification: (Test)

Met	Not Met	N/A
☐	☒	☐

The requirements of HNF-SD-W314-PDS-003, Rev. 3 were verified during performance of the ATPs RPP-9350 and RPP-9352.

3.2.1.1.4 Monitor for Pit Intrusion. (FFBD Function 3.2.3.4) After the waste transfer system is up and operating and after the administration lock has been removed, the pit leak detection system shall monitor for intrusions, sources can be spills, rain, washdown, etc. from the liquid sources outside the pit.

3.2.1.1.4.1 Intrusion Detection Signal. The pit leak detection system shall monitor for liquid sources outside the pit and shall provide a signal when an intrusion is detected.

Verification: (Analysis)

Met	Not Met	N/A
☒	☐	☐

The Pit Leak Detection System monitors for liquid intrusion continuously, both when a transfer is in progress and when there is no transfer in progress, as long as power is applied to the system. Any liquid that enters the pit will flow to the lowest point (the drain) and be held up by the drain plug. When the liquid reaches the height of the probes the electrical circuit is completed. The alarm light is activated by the leak detection relay and the automatic MPS shutdown signal is initiated. The MPS shutdown signal will first be connected into the existing MPS shutdown system and later connected into the new MPS system when installed at a later date. The leak detection circuitry is

shown on Drawings H-14-103357, H-14-103362, and H-14-103370. This requirement is also verified by TWR-4663, *Acceptance Test Report for Leak Detection Mock-Up.*

3.2.1.1.4.2 System Sensors. Pit leak detection system sensors shall be positioned below the level where the floor drain allows drainage from the pit into the waste tank.

Verification: (Analysis) [X] Met [ ] Not Met [ ] N/A

The pit leak detection probes are not located directly over the low point of the pit (interference from the pit drain) but are located adjacent to the low point. The probes are to be located at a height of approximately 1/16 inch from the pit floor. See Drawings H-14-103355, H-14-103361, and H-14-103366 for more details on probe placement.

Verification: (Test) [X] Met [ ] Not Met [ ] N/A

This requirement was verified during performance of the ATPs RPP-9350 and RPP-9352.

3.2.1.1.4.3 Monitoring Frequency. The monitoring frequency of the pit leak detection system shall be continuous. (See Section 5.1 for definition of continuous)

Verification: (Analysis) [X] Met [ ] Not Met [ ] N/A

The pit leak detection system monitors for leaks within the valve pit. This is accomplished with the use of a continuously energized leak detection relay and conductivity probes. Upon failure of power to the leak detection relay or probe circuit, an alarm is activated so operators can respond. The leak detection circuitry is shown on Drawings H-14-103357, H-14-103362, and H-14-103370.

3.2.1.1.4.4 Response Time. The required response time of the pit leak detection system shall be instantaneous. (See Section 5.1 for definition of instantaneous).

Verification: (Analysis) [X] Met [ ] Not Met [ ] N/A

The leak detection system is continuously monitoring for intrusion. When an intrusion is detected, the contacts of the leak detection relay will close and instantaneously initiate the local alarm light. The active components that would primarily contribute to the response time are the components that change state, i.e., the leak detection relay and the latching coil relay. Calculation W314-I-054 verified leak detection system response time to be 0.525 seconds. A signal is also sent to the master pump shutdown system by opening contacts and de-energizing the first of a series of trip relays within the master

pump shutdown logics. The leak detection circuitry is shown on Drawings H-14-103357, H-14-103362 and H-14-103370.

3.2.1.1.4.5 Sensor Wiring. The wiring between the leak detection system sensor and control panel shall be electrically supervised.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

Supervision for the wiring between the probes and the leak detection control panel is performed by the trip amplifier. This device monitors the voltage (at the probes) and is located in the leak detection control panel. Upon loss of probe voltage or wire failure, the trip amplifier will activate the local alarm and initiate the master pump shutdown system. The leak detection circuitry is shown on Drawings H-14-103357, H-14-103362, and H-14-103370.

Verification: (Test)

[X]	[ ]	[ ]
Met	Not Met	N/A

This requirement was verified during performance of the ATPs RPP-9350 and RPP-9352.

3.2.1.1.5 Activate Remote Pit Leak Detection Alarm. (FFBD Function 3.2.3.5)

3.2.1.1.5.1 Alarm Activation. An MCS alarm shall be activated whenever a Pit Leak Detector detects a leak.

Verification: (Analysis)

[ ]	[ ]	[X]
Met	Not Met	N/A

Not applicable to this package. The MCS is installed in the MPS Package.

Verification: (Test)

[ ]	[ ]	[X]
Met	Not Met	N/A

Not applicable to this package. The MCS is installed in the MPS Package.

3.2.1.1.5.2 Fail Safe Circuit. The circuit carrying the alarm signal shall be fail safe.

Verification: (Analysis)

[ ]	[ ]	[X]
Met	Not Met	N/A

Not applicable to this package. The MCS is installed in the MPS Package.

Verification: (Test)

Met	Not Met	N/A
☐	☐	X

Not applicable to this package. The MCS is installed in the MPS Package.

3.2.1.1.5.3 Circuit Load. The circuit carrying the alarm signal shall be less than 50 volts.

Verification: (Analysis)

Met	Not Met	N/A
☐	☐	X

Not applicable to this package. The MCS is installed in the MPS Package.

Verification: (Test)

Met	Not Met	N/A
☐	☐	X

Not applicable to this package. The MCS is installed in the MPS Package.

3.2.1.1.5.4 Safety Classification. This function shall be identified as Safety Significant.

Verification: (Analysis)

Met	Not Met	N/A
☐	☐	X

Not applicable to this package. The MCS is installed in the MPS Package.

Verification: (Test)

Met	Not Met	N/A
☐	☐	X

Not applicable to this package. The MCS is installed in the MPS Package.

3.2.1.1.6 Activate Remote Pit Leak Detection Malfunction Alarm. (FFBD Function 3.2.3.6)

3.2.1.1.6.1 Alarm Activation. An MCS alarm shall be activated when a Pit Leak Detector malfunctions.

Verification: (Analysis)

Met	Not Met	N/A
☐	☐	X

Not applicable to this package. The MCS is installed in the MPS Package.

Verification: (Test)

☐	☐	X

Met	Not Met	N/A

Not applicable to this package. The MCS is installed in the MPS Package.

3.2.1.1.6.2 Fail Safe Circuit. The circuit carrying the alarm signal shall be fail safe.

Verification: (Analysis)

Met	Not Met	N/A
☐	☐	☒

Not applicable to this package. The MCS is installed in the MPS Package.

Verification: (Test)

Met	Not Met	N/A
☐	☐	☒

Not applicable to this package. The MCS is installed in the MPS Package.

3.2.1.1.6.3 Circuit Load. The circuit carrying the alarm signal shall be less than 50 volts.

Verification: (Analysis)

Met	Not Met	N/A
☐	☐	☒

Not applicable to this package. The MCS is installed in the MPS Package.

Verification: (Test)

Met	Not Met	N/A
☐	☐	☒

Not applicable to this package. The MCS is installed in the MPS Package.

3.2.1.1.6.4 Safety Classification. This function shall be identified as Safety Significant.

Verification: (Analysis)

Met	Not Met	N/A
☐	☐	☒

Not applicable to this package. The MCS is installed in the MPS Package.

Verification: (Test)

Met	Not Met	N/A
☐	☐	☒

Not applicable to this package. The MCS is installed in the MPS Package.

3.2.2 Physical Characteristics

3.2.2.1 Weight Limit. Not applicable to this specification.

3.2.2.2 Access for Maintenance. The portion of the pit leak detection system located in the pit shall be replaceable without removing the pit cover block.

Verification: (Analysis) [X] Met [ ] Not Met [ ] N/A

The probes located under the cover block can be extracted through the 3 in. riser designated for pit leak detection assembly. By removing the pit leak detection riser radiation shielding plug (Refer to Drawing H-14-100981, Sheets 1 and 2) the probes can easily be extracted from the valve pit. In addition, the probe height can be adjusted from above the cover block in the electrode holder to determine the height of liquid within the pit.

Verification: (Demonstration) [X] Met [ ] Not Met [ ] N/A

This requirement is also verified by TWR-4663, *Acceptance Test Report for Leak Detection Mock-Up* and in the Construction Work Package W-314-RPP-03 for the AY spare leak detector stations that are similar to the stations in the AN to WTS design.

3.2.2.3 Requirements for Transport and Storage. Not applicable to this specification.

3.2.2.4 Durability Factors. Not applicable to this specification.

3.2.2.5 Health and Safety Criteria. The alarm and control panel portions of the pit leak detection system shall be located outside of the pit and shielded by the pit's cover block.

Verification: (Analysis) [X] Met [ ] Not Met [ ] N/A

The pit leak detector stations are located above the cover block and away from the pit. Refer to Drawings H-14-103354, H-14-103360, and H-14-103366 for placement of the leak detector stations. For reference of radiation limits above the cover block, see section 3.2.5.2.2.2 for analysis.

3.2.2.6 Security Criteria. Not applicable to this specification.

3.2.2.7 Vulnerability Factors. Not applicable to this specification.

3.2.3 Reliability

3.2.3.1 Design Life. Each pit leak detection system's buried conduit shall have a design life of 35 years. Replaceable components in each system requiring pit entry shall have a design life of 12 years. The design life for replaceable components that do not require pit entry or excavation shall be 5 years. The mission time required for no false or spurious alarms shall be one year.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

Construction Specification W-314-C5, Section 16400 specifies PVC coated rigid steel conduit or PVC non-metallic conduit, as shown in drawings, for underground applications. The drawings indicate use of PVC Coated rigid steel conduit inside the tank farms and PVC non-metallic conduit outside the tank farms. The PVC coated rigid steel conduit is the best available industrial category conduit for use inside the tank farms, which will provide both mechanical and chemical protection for the wiring inside the conduit. PVC non-metallic conduit is the most cost effective direct burial raceway system for use outside the tank farms, based upon application and burial depths. This type of raceway system will also provide both mechanical and chemical protection for the wiring inside the conduit. These conduit systems will be installed per manufacturer's instruction as specified in Construction Specification W-314-C5, Section 16400, Paragraph 3.2.3.9 which will provide maximum service life. There is no technical data available for conduit design life under the anticipated installation and environmental conditions both inside or outside the tank farms.

3.2.3.2 Leak Detection Probability. Pit leak detection systems shall be capable of detecting the leak with a probability of detection of 0.95 and a probability of false alarm of 0.05.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

The leak detection system probability that it will be operating of the time a leak occurs in a transfer line was determined to be 0.9736 over a 5 year time frame. This is based on a mean time to repair of 4 hours for all leak detection system components. Refer to Calculation W314-I-055. The probability of a false alarm for the leak detection systems in a period of one year is 0.0135 per Calculation W314-I-058.

3.2.3.3 Fault Detection/Isolation. Designs shall provide for the detection and isolation of faults to systems, structures, and components as necessary in order to minimize the risks associated with faulty operation to plant, personnel and environment. Protection systems and associated instrumentation and controls shall be designed in accordance with DOE 6430.1A, Section 1660-99.0.2.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

Isolation: Each leak detection relay cabinet enclosure is equipped with a disconnect switch. This mechanical device will terminate power when activated manually. Each cabinet is also equipped with an internal dc power supply. This supply is energized from the enclosure power that terminates when the disconnect is operated. Detection: The encasement leak detection relay cabinets are supplied 120 volts from a circuit breaker panel. In the event a fault occurs anywhere in this circuit, the breaker would isolate all

encasement leak detectors fed from this circuit. This design complies with the requirements of DOE Order 6430.1A, Section 1660-99.0.2 (Ref. FFS DOE 6430.1A Checklist).

3.2.4 Maintainability

3.2.4.1 Maximum Time to Repair. The time to repair the pit leak detection system, excluding craft time to mobilize and enter tank farms, shall be equal to or less than 4 hours.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

All components of the leak detection system, with the exception of the leak detection probes and probe wire, are commercially available, off-the-shelf items. It is assumed that spare components will be maintained on-site to support maintenance requirements. The design of the system allows for easy access to all components outside the pit. The probes inside the pits are also designed to allow for removal without the cover blocks being removed. With the current design and after setup time, the components can be replaced within a 3.90 hour time period as documented in Calculation W314-I-056.

3.2.4.2 Preventive Maintenance. The frequency of preventive maintenance shall be no less than annually.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

Based on a review of vendor information, it is anticipated that the specified components will require no more than annual preventative maintenance which is cleaning the probes otherwise all other maintenance is corrective.

3.2.4.3 Interference with Cover Block Removal. The leak detection system sensor assembly and electrical connections shall not interfere with removal of the pit cover blocks.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

The probes are capable of being removed from the top of the cover block prior to or without the removal of the cover block. See Drawing H-14-100981 for details of this design.

3.2.4.4 System Testability. The leak detection system sensors that are located in the pits shall be testable in place by the addition to the pit of water or any solution with a conductivity nominally equivalent to the waste solution.

Verification: (Analysis) [X] [ ] [ ]

Met	Not Met	N/A

By introducing approximately 10 gallons of water (or another solution) into the valve pit (beyond the minimum required for detecting a leak), the leak detection warning light will activate. The solution may be introduced into the pits from one of the observation ports. For details on how the leak detection system is activated, refer to Section 3.2.1.1.1.2.

Verification: (Demonstration)

Met	Not Met	N/A
[X]	[ ]	[ ]

This requirement is also verified by TWR-4663, *Acceptance Test Report for Leak Detection Mock-Up* and in the Construction Work Package W-314-RPP-03 for the AY spare leak detector stations that are similar to the stations in the AN to WTS design.

Verification: (Test)

Met	Not Met	N/A
[X]	[ ]	[ ]

This requirement was verified during performance of the ATPs RPP-9350 and RPP-9352.

3.2.5 Environmental Conditions

The systems and components covered by this specification shall be compatible with the environmental conditions listed below, as applicable. Performance Category (PC) 3 is assigned to Safety Class (SC) and Safety Significant (SS) systems and PC1 is assigned to General Service (GS) systems. The design and analysis of loads associated with existing systems shall, as a minimum, be performed to the design requirements of the existing system.

3.2.5.1 Natural Environments

3.2.5.1.1 Ambient Air Temperature. The ambient air temperature range is 48.9°C (120°F) to -35.5°C (-32°F), and with a maximum 24 hour differential of 28.9°C (52°F).

Verification: (Analysis)

Met	Not Met	N/A
[X]	[ ]	[ ]

Representative vendor information was reviewed to determine the leak detection relay panel components complied with the given ambient temperature ranges. The ambient temperature verification data is summarized in Calculations W314-I-065 and W314-I-004. Based on the results of the temperature verification it was determined to add a heater to the leak detection relay panel. Refer to Calculation W314-I-063 for heater sizing. By adding the heater, the temperature will not drop below the operating range for any device in the leak detection relay cabinet.

3.2.5.1.2 Soil Temperature. The minimum soil temperatures below ground surface are:

1.3 cm (0.5 in):	-19.5 °C (-3.0 °F)
38 cm (15 in):	-8.8 °C (16.1 °F)
92 cm (36 in):	0.8 °C (33.5 °F)

Verification: (Analysis) [X] Met [ ] Not Met [ ] N/A

Due to the design of instrumentation for this project being above ground, the soil temperature does not apply. The conduit will be buried at varying depths between 12" and 48". The limiting temperature is -7.1 °C (19.2 °F). The conduit is coated with PVC which is rated -20 °C to 80 °C according to manufacturer's data. The wire routed through the conduit has TFN (Teflon) insulation rated at -70 °C to 260 °C according to manufacturer's data. The insulation quality of the materials specified in this design meet the design requirements.

3.2.5.1.3 Seismic Loads. PC1 structures, systems, and components

Earthquake load design of PC1 SSCs shall comply with the UBC, Seismic Zone 2B, for standard occupancy facilities.

PC3 structures, systems, and components

Earthquake load design of PC3 SSCs shall comply with DOE-STD-1020 by using dynamic analysis and site-specific design response spectra listed in Table 3-1.

Calculate elastic seismic response, DS, by dynamic analysis using Response Level 2 damping values from Table 3-2.

Table 3-1 Response Spectra

Horizontal Response Spectra "g"						
Frequency (Hertz)	Damping					
	0.50%	2%	5%	7%	10%	12%
100	0.26	0.26	0.26	0.26	0.26	0.26
33.3	0.26	0.26	0.26	0.26	0.26	0.26
13.3	0.57	0.48	0.41	0.38	0.36	0.35
10	0.77	0.59	0.47	0.43	0.38	0.36
5	1.04	0.76	0.58	0.52	0.45	0.42
3.3	0.98	0.72	0.54	0.48	0.42	0.39
2	0.74	0.55	0.41	0.37	0.33	0.30
1	0.45	0.34	0.26	0.23	0.21	0.19
0.5	0.22	0.17	0.13	0.12	0.11	0.10
0.25	0.08	0.06	0.05	0.05	0.04	0.04

Vertical Response Spectra "g"						
Frequency (Hertz)	Damping					
	0.50%	2%	5%	7%	10%	12%
100	0.18	0.18	0.18	0.18	0.18	0.18
33.3	0.18	0.18	0.18	0.18	0.18	0.18
13.3	0.60	0.46	0.37	0.33	0.30	0.28
10	0.66	0.49	0.37	0.33	0.29	0.27
5	0.60	0.44	0.33	0.30	0.26	0.24
3.3	0.48	0.36	0.27	0.24	0.21	0.19
2	0.32	0.24	0.18	0.16	0.14	0.13
1	0.19	0.14	0.11	0.10	0.09	0.08
0.5	0.14	0.11	0.08	0.07	0.07	0.06
0.25	0.06	0.05	0.04	0.03	0.03	0.03

Table 3-2 Response Level

	Damping (% of critical)
	Response Level 2
Demand/capacity ratio	~0.5 to 1.0
Welded and friction bolted metal structures	4
Bearing-bolted metal structures	7
Prestressed concrete structures without complete loss of prestress	5
Reinforced concrete structures	7
Masonry shear walls	7
Wood structures with nailed joints	10
Distribution systems	5
Massive low stressed components (pumps, motors, etc.)	3
Light welded instrument racks	3
Electrical cabinets and other equipment	4
Liquid containing metal tanks Impulsive mode	3
Liquid containing metal tanks Sloshing mode	0.5

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

Civil Calculation W314-C-008 analyzes the structures associated with the instrumentation installed by this design package using UBC earthquake loads and meets the requirements. Even though the pit leak detection system is designated as Safety Class or Safety Significant, the system does not have to operate after a DBA (as per design direction, given in Letter No. 9750215, W.W. Rutherford, Numatec Hanford Corporation, to K.J. Dempsey, Fluor Daniel Northwest, Inc., dated January 17, 1997) and thus, does not have to be designed and analyzed to the higher earthquake loads.

3.2.5.1.4 Wind Loads.

For PC3 systems:

"Fastest Mile" wind velocity:	36 m/s (80 mi/h)
"Three Second Gust" wind velocity:	44 m/s (100 mi/h)
*Missile (horizontal):	50 x 100 mm (2 x 4 in.) Timber plank weighing 7 kg (15 lb) @ 22 m/s (50 mi/h). Maximum trajectory height = 9 m (30 ft).

*Note: for Safety Significant SSCs, the missile criteria does not apply.

For PC1 systems:

"Fastest Mile" wind velocity:	31 m/s (70 mi/h)
"Three Second Gust" wind velocity:	38 m/s (85 mi/h)

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

The pit leak detection relay cabinets meet the requirements for the wind velocity specified as shown in Calculations W314-C-008 and W314-C-033. Per customer direction, CHG Letter CHG-0100106, Dated January 10, 2001, the missile shields and their associated foundations have been deleted.

3.2.5.1.5 Snow Loads. The ground snow loads are: 720 Pa (15 lb/square foot)

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

Calculations W314-C-008 and W314-C-033 detail the snow loading as being minimal on the horizontal surfaces of the leak detection relay cabinets compared to the structural strength of the relay cabinet material and supporting frame assembly.

3.2.5.1.6 Relative Humidity. The relative humidity range is 0 to 100% (Rate of change is negligible).

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

All devices affected by relative humidity are located in a NEMA 4X rated enclosure as shown on Drawing H-14-100983, Sheet 1. The enclosure will be sealed and rated for windblown dust and rain, splashing water, and hose-directed water. In addition, the operating limits of the trip amplifier and the switch operated relay are 5 - 95% RH. The humidity inside the enclosure is governed by the pressure and temperature inside and outside the enclosure. With the addition of a combination breather and drain (refer to Drawing H-14-100983), the temperature and pressure inside the enclosure will equalize. Any additional build-up of condensation will drain out of the enclosure. Although the addition of the breather/drain can not quantify what the humidity would be inside the enclosure if the humidity outside the enclosure was 100%, it should be less than 100% due to the heat produced inside the cabinet from components that are normally energized.

In the case where the humidity inside the enclosure falls below 5% RH, the breather will allow moisture absorption from the outside environment which will raise the relative humidity inside the enclosure.

Engineering judgement with regards to relative humidity induced failure, is that electronic components would fail in a safe condition.

3.2.5.1.7 Surface Precipitation. The surface precipitation is 4 cm (1.56 in) in a 24 hour period.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

The instrumentation components located outside the valve pits that would be affected by surface precipitation are protected by the leak detection relay enclosure and the electrode holder. The leak detection relay cabinet enclosure is designed as a NEMA type 4X with gaskets to protect the components inside from dust, dirt, oil and water. The electrode holder has service rating of watertight, heavy duty outdoor. The electrical junction boxes have been specified NEMA 4 to provide the necessary protection against dust and water. Watertight fittings have been specified for conduits terminating in the junction boxes. The hand holes that are used for the conduit runs have been provided with drain holes to avoid water accumulation. Refer to Construction Specification W-314-C5, Section 16400 for details.

3.2.5.1.8 Hail Events. The hail diameter is less than or equal to 1.9 cm (0.75 in).

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

The enclosures discussed in Section 3.2.5.1.7 also protect against the damages due to hail. The NEMA rated enclosure and electrode holder are made of stainless steel and

will not be damaged by hail to the extent that the components within the enclosure would be damaged.

3.2.5.1.9 Sand and Dust. The sand/dust concentration is 0.177 gm/cubic meter with a typical size of 350 µm.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

The enclosures covered in Section 3.2.5.1.7 also protect the components internal operations from sand and dust.

3.2.5.1.10 Solar Radiation. The solar radiation range is between 4 Watts/square meter and 406 Watts/square meter.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

The leak detection relay cabinet and electrode holder are the only two components directly exposed to solar radiation. The leak detection relay cabinet is regulated by the maximum operating temperature of the trip amplifier set at 60 °C. At a maximum solar radiation of 406 Watts/square meter, the temperature of this enclosure will increase significantly. Calculation W314-I-004 shows that with a maximum solar radiation of 406 Watts/square meter and a maximum ambient air temperature of 120 °F, the inside of the enclosure will not rise above the maximum operating temperature of the trip amplifier. This calculation has considered the heat generated inside the relay cabinet from normally energized components and concludes that the enclosure is below the operating maximum of 60 °C without the use of forced air moving through the cabinet. The probe wiring and cord grips located inside the electrode holder have breakdown temperatures much higher than the solar radiation and maximum ambient temperature.

3.2.5.1.11 Glaze. (See definition is Section 5.1) The glaze is 2.54 cm (1 in.).

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

Glaze is not considered to affect the leak detection system. All active components that glaze would effect are inside the relay cabinet enclosure which is rated to protect against ice formation. Civil Calculation W314-C-008 identifies the ice as not being a considerable weight factor in the structural analysis for loading.

3.2.5.1.12 Ashfall. A total combination load of snow fall and ash fall of 960 Pa (20 lb/square foot) shall be used.

Verification: (Analysis)

[X]	[ ]	[ ]

Met	Not Met	N/A

Civil Calculations W314-C-008 and W314-C-033 identify that weight loading due to an ashfall event has negligible affect on the structure.

3.2.5.1.13 Dead Loads. Dead loads include the weights of all permanent materials and equipment, including the structure's own weight. Design dead loads shall include the weight of all permanent service equipment. Load calculations shall include an allowance for any loadings anticipated to be added at a later date. Initially assumed loads shall be revised so that the final design reflects the configuration shown on the drawings.

The unit weights of materials and construction assemblies for buildings and other structures shall be those given in ASCE 7-95. Where unit weights are neither established in that standard nor determined by test or analysis, the weights shall be determined from data in manufacturer drawings or catalogs.

Verification: (Analysis)

Met	Not Met	N/A
[X]	[ ]	[ ]

This requirement is verified by Calculations W314-C-008 and W314-C-033 as meeting the requirements.

3.2.5.1.14 Thermal Forces. The design of structures shall include the effects of stresses and movements resulting from variations in temperature. Structures shall be designed for movements resulting from the maximum seasonal temperature change. The design shall provide for the lags between air temperatures and the interior temperatures of massive concrete members or structures. Consideration shall be given to passive soil loading resulting from thermal growth of subgrade structures.

Verification: (Analysis)

Met	Not Met	N/A
[ ]	[ ]	[X]

This requirement is not applicable to this design package as there are no concrete structures that are a part of Pit Leak Detection.

3.2.5.1.15 Creep and Shrinkage Forces. Concrete and masonry structures shall be investigated for stresses and deformations induced by creep and shrinkage. For concrete and masonry structures, the minimum linear coefficient of shrinkage shall be assumed to be 0.0002 mm/mm, unless a detailed analysis is undertaken. The theoretical shrinkage displacement shall be computed as the product of the linear coefficient and the length of the member.

Verification: (Analysis)

Met	Not Met	N/A
[ ]	[ ]	[X]

This requirement is not applicable to this design package as there are no concrete structures that are a part of Pit Leak Detection.

3.2.5.1.16 Load Combinations and Allowable Stresses. Load combinations, allowable stresses, and strength requirements for load conditions that include live load, dead load, snow load, and normal operating loads for all SSCs shall comply with the UBC or applicable system national codes and standards.

Load combinations, allowable stresses, and strength requirements for load conditions that include live load; dead load; snow load; normal operating loads; and Natural Phenomena Hazard (NPH) loads of extreme wind, earthquake, flood, and ashfall for all SSCs shall comply with DOE-STD-1020.

Load factors and load combinations for PC1 structures, systems, and components

Combine response from various loadings to determine the structural demand by using the UBC-specified load combination rules (e.g., load factors for ultimate strength design and unit load factors for allowable stress design).

Where:

DL = DEAD LOAD
LL = LIVE LOAD
RL = ROOF LIVE LOAD
S = SNOW LOAD
W = WIND LOAD
E = EARTHQUAKE
T = THERMAL
C = CREEP/SHRINKAGE

Allowable Stress (AS) Design: All Construction
AS = DL + LL + RL(or S)
AS = 0.75[DL + LL + W (or E)]
AS = 0.75[DL + LL + W + S/2]
AS = 0.75[DL + LL + S + W/2]

Ultimate Strength (U) Design: Reinforced Concrete
U = 1.4DL + 1.7LL + 1.7RL(or 1.7S)
U = 0.75[1.4DL + 1.7LL + 1.7W]
U = 1.05[DL + LL + E]
U = 0.9DL + 1.3W(or 1.4E)
U = 1.4[DL + T(or C)]
U = 0.75[1.4DL + 1.7LL + 1.4T(or 1.4C)]

Strength (S) Design: Steel (Load & Resistance Factor Design) S=1.4DL
S = 1.2DL + 1.6LL + 0.5(RL or S)
S = 1.2DL + 0.5LL(or 0.8W) + 1.6(RL or S)
S = 1.2DL + 1.3W + 0.5LL + 0.5(RL or S)
S = 1.2DL + 1.5E + 0.5LL(or .2S)
S = 0.9DL - 1.3W(or 1.5E)

Load factors and load combination for PC3 structures, systems, and components

Combine response from various loadings to determine structural demand as follows:

Where:

DL = DEAD LOAD
LL = LIVE LOAD
RL = ROOF LIVE LOAD
S = SNOW LOAD
W = WIND LOAD
E = EARTHQUAKE
A = ASHFALL
T = THERMAL
C = CREEP/SHRINKAGE

Allowable Stress (AS) Design:
AS = DL + LL + RL(or S)
AS = 0.62[DL + LL + RL(or S) + W + T(or C)]

for shear stress
AS = 0.71[DL + LL + RL(or S) + E(or A) + T(or C)]

for all stress other than sheer stress
AS = 0.59[DL + LL + RL(or S) + E(or A) + T(or C)]

Ultimate Strength (U) Design:
U = 1.4DL + 1.7LL + 1.7RL(or 1.7S)
U = 1.4[DL + T(or C)]
U = DL + LL + RL(or S) + W(or E or A) + T(or C)

Strength (S) Design: Steel (Load & Resistance Factor Design) S=1.4DL
S = 1.2DL + 1.6LL + 0.5(RL or S)
S = 1.2DL + 0.5LL + 1.6(RL or S)
S = DL + LL + RL(or S) + W(or E or A) + T

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

Civil Calculation W314-C-008 identifies that a combination of loads due to a natural environmental effect would not impact the structural strength of the frame assembly of the leak detection relay cabinet enclosure.

3.2.5.2 Induced Environments

3.2.5.2.1 Waste Properties. Materials used that come in contact with the waste shall be capable of safely handling waste with the following properties:

Specific Gravity	1 to 1.5
Viscosity	1 to 30 centipoise (Newtonian)

Miller Number	100 Maximum
pH	7 to 14
Temperature	10 to 93 °C (50 to 200 °F)
Solids Content	30 Vol. %
Particle Size	0.5 to 4000 microns

Note: 95% of total particles 0 to 50 microns
<5 percent of total particles 50 to 500 microns
<1 percent of total particles 500 to 4000 microns

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

The only pit leak detection components subject to the effects of waste are the probe, probe cover and wire coating. The probe cover is made of PEEK (poly ether ketone) filled with glass and graphite. PEEK is a high performance thermoplastic that resists continuous temperatures of up to 480 °F. It features excellent chemical resistance, plus high tensile strength and wear resistance. In addition, PEEK resists abrasion, radiation and exhibits low moisture absorption. Due to the application of the probe and probe cover, the only relevant requirements that need to be addressed are the waste pH levels and the waste temperature. PEEK withstands a wide pH range, from 60 percent sulfuric acid (pH less than 7) to 40 percent sodium hydroxide (pH great than 14), and at high temperatures. With this percentage range, PEEK meets the pH requirement. The waste temperature is far below that of PEEK breakdown temperatures (at 480 °F). For this design, PEEK is the most suitable material with radiation tolerances well above that required to be used in this application, while remaining to be machinable. The probe cover is considered to be an insulator and will protect the probes from unnecessary contact of metallic devices.

The probe wire coating is made of Tefzel 280 or HT-2183 (DuPont) which exhibits some of the same Properties as the probe cover. The wire insulation is located approximately 5 inches from the pit floor. If a leak does occur, it will be detected when 10 gallons has accumulated at the pit floor. In order for the leaking fluid to come in direct contact with the probe wire insulation, more than 10 gallons would have to be located on the pit floor. For this design, the pit drain releases fluid to a tank well before it would come in contact with the wire insulation. In the event the waste does come in contact with the coated probe cable, Tefzel 280 or HT-2183 will not break down with waste pH in this range as it is specified by the vendor to have a base and acidic resistance that meets this requirement. The temperature at which Tefzel breaks down is 270 °C, which is above the waste temperature requirement.

The probe is made of solid stainless steel that has stable metallic properties that will withstand all of the above requirements.

3.2.5.2.2 Radiation Tolerance

3.2.5.2.2.1 Inside Pit Radiation Level. Materials used that are located inside a pit shall be capable of operating in the following radiation environment:

3.2.5.2.2.1.1 Inside Pit Radiation Level (Non-HLW Contact).

Total accumulated dose: 1.0E+7 rads
Dose rate: 1.0E+7 mr/hr

Verification: (Analysis)

Met	Not Met	N/A
☐	☐	☒

Not applicable to this package. Components within the pit that are part of the Pit Leak Detection System are included in 3.2.5.2.2.1.2.

3.2.5.2.2.1.2 Inside Pit Radiation Level (For Hardware in Contact with HLW).
Total accumulated dose: 6.0E+7 rads
Dose rate: 1.0E+7 mr/hr

Verification: (Analysis)

Met	Not Met	N/A
☒	☐	☐

There are three items located under the cover block and considered inside the pit; the probe, the probe cover, and the probe wire and coating. The probe is made of stainless steel and is considered to withstand this radiation level and not be affected. The probe cover or insulator is made of PEEK, as stated in Section 3.2.5.2.1, and stated from the manufacturer to have a tolerance to radiation of 2E+09 rads. This is well above the range specified above. Tefzel 280 or HT-2183 is designed to operate in the nuclear facilities with a total accumulated dose rate resistance of 2E+08 rads. This is also well within the tolerance levels above.

3.2.5.2.2.2 Background Radiation Level. Materials used that are located outside a pit, above grade, shall be capable of operating in the following radiation environment:

total accumulated dose:	4.4 rad/year
dose rate:	0.5 mrem/hour

Verification: (Analysis)

Met	Not Met	N/A
☒	☐	☐

All equipment outside the pit is protected in a metal enclosure and based on representative manufacturer information, will not break down at this radiation level. In addition, the equipment is similar to equipment that has previously been used in the tank farms without any adverse affects.

3.2.6 Transportability

Not applicable to this specification.

3.2.7 Flexibility and Expansion

3.2.7.1 Flexibility and Expansion. Each system design shall, to the maximum extent practicable, provide sufficient flexibility to accommodate for programmatic changes or operation

modifications.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

The leak detection system design has the ability to adjust the height at which the probes are positioned above the pit floor. This feature will allow flexibility to meet changing operational requirements. See Drawing H-14-100981 for details of this feature.

3.3 Design and Construction

3.3.1 Materials, Processes, and Parts

3.3.1.1 System Compliance. All systems shall comply with DOE 6430.1A, Div. 16, NFPA 70, and UL 508A.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

Compliance with UL508A and NFPA 70 are verified in Construction Specification W-314-C5, Section 16400, Paragraph 3.2.1.1 and Procurement Specification W-314-P6, Section 3.5.4. The requirement of UL 508 comes from DOE 6430.1A and is applicable only to motor controllers. The design engineer applied UL 508A to this design package. For compliance with DOE Order 6430.1A, Div. 16, refer to FFS DOE Order 6430.1Aa, Div. 16 checklist.

Verification: (Examination)

[X]	[ ]	[ ]
Met	Not Met	N/A

This requirement is verified by documentation of UL508A lavels affixed to the pit leak detection panels in construction work package W314-4L-001. Final NEC Inspection is documented in construction work packages W314-4L-019, W314-4L-020, and W314-4L-029.

3.3.1.2 Electrical Materials. Electrical materials and equipment shall be UL or FM tested, with label attached, for the purpose intended, whenever such products are available.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

Construction Specification W-314-C5, Section 13440, Paragraphs 1.3.2 and 1.3.3 and Procurement Specification W-314-P6, Section 4.2 require components of the leak detection system to be UL or FM listed components. Additionally, if material or equipment is not UL or FM tested, other nationally recognized testing labs is allowed per DOE 6430.1A.

Verification: (Examination) [X] Met [ ] Not Met [ ] N/A

This requirement was verified by examination during receiving inspection for W-314-C5 and W-314-P6.

3.3.1.3 Electrical Equipment Enclosures. As a minimum electrical equipment enclosures shall be NEMA Type 4.

Verification: (Analysis) [X] Met [ ] Not Met [ ] N/A

The leak detection relay cabinets and pressure alarm relay cabinets on Drawings H-14-100983 and H-14-103368, respectively, are both rated NEMA 4X. The Field Terminal Box (FTBX) enclosure on Drawing H-14-101341 is rated NEMA 4.

Verification: (Examination) [X] Met [ ] Not Met [ ] N/A

This requirement was verified by examination during receiving inspection for W-314-C5 and W-314-P6.

3.3.1.4 Optimization. During the design of facilities, optimization principles, as discussed in ICRP Publication 37, shall be utilized in developing and justifying facility design and physical controls.

Verification: (Analysis) [X] Met [ ] Not Met [ ] N/A

ICRP Publication 37 addresses techniques for use in the optimization of radiation protection based on cost-benefit analysis to various radiation levels. Project W-314 is upgrading existing facilities where the architecture is constrained, the operational practices are already in place, and the acceptable risk and detriment to individuals is already provided and the applicable radiation levels are listed as separate requirements in this specification.

3.3.1.5 Dome Loading. The equipment used for installation and maintenance shall comply with the DST dome loading constraints.

Verification: (Analysis) [ ] Met [ ] Not Met [X] N/A

If equipment is located outside a 20' exclusion zone around the DST, dome loading

effects are mitigated. Compliance with this requirement will be verified by the calculation by the customer and by the issuing of dome loading permits for locating the equipment from Tank Farm Engineering and Operations.

3.3.2 Electromagnetic Radiation

3.3.2.1 Interference. Hand held radio and cell phone wattage frequency shall not interfere with electrical/electronic components at a distance of one meter.

Verification: (Analysis) [X] Met [ ] Not Met [ ] N/A

The electrical/electronic components are located in a stainless steel NEMA 4X rated enclosure. Based on prior operational experience and the voltages of the leak detection system, it is anticipated the shielding provided by the enclosure will be sufficient to protect the system from interference due to hand held radios or cell phones.

Verification: (Demonstration) [X] Met [ ] Not Met [ ] N/A

This requirement is also verified by TWR-4663, *Acceptance Test Report for Leak Detection Mock-Up.*

Verification: (Test) [X] Met [ ] Not Met [ ] N/A

This requirement was verified during performance of the ATPs RPP-9350 and RPP-9352.

3.3.2.2 Electromagnetic Force Interference. The pit leak detection system shall not be adversely affected by outside electromagnetic forces generated by a 60 horse power, 480 Vac, induction type motor operating at frequencies between 0 and 60 hertz and located 1 meter away from the leak detection system.

Verification: (Analysis) [X] Met [ ] Not Met [ ] N/A

Any EMI to the signals located outside the pit above the cover blocks next to the motor are shielded either by a grounded metal enclosures or conduit. In addition, the cabling is shielded with metal (aluminum) foil which is also grounded to the electrical system ground in the 241-AN-271 building.

The grounded shielding drains away any stray induced currents caused by the motor electromagnetic field.

3.3.3 Identification and Marking

3.3.3.1 Equipment Labeling. New equipment and/or modifications to existing equipment shall be labeled in a standardized format in accordance with the tank farm labeling program as specified in HNF-IP-0842, Volume II, Section 6.1, "Tank Farm Operations Equipment Labeling," Rev. 0e.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

Construction Specification W-314-C5, Section 13440, Paragraph 2.2.4 specifies labeling will be by CHG OCM per their existing procedures. New H-14 drawings identified on Drawing H-14-100929 were prepared using equipment numbering formats provided by CHG.

Verification: (Examination)

[X]	[ ]	[ ]
Met	Not Met	N/A

This requirement was verified by examination at the end of construction and is documented in the field verification packages.

3.3.3.2 Reserved for Future Use

3.3.3.3 Operations and Maintenance Drawings. Operations and maintenance drawings (as-built H-14 essential drawings) shall be prepared as the system master drawings showing as-built configuration changes in accordance with HNF-IP-0842, Volume II, Section 6.1, "Tank Farm Operations Equipment Labeling," Rev. 0e.

Verification: (Analysis)

[ ]	[ ]	[X]
Met	Not Met	N/A

This requirement is planned as an activity during Title III stage of the project. Completion of this analysis will take place at the end of construction.

Verification: (Examination)

[X]	[ ]	[ ]
Met	Not Met	N/A

This requirement was verified by examination at the end of construction and is documented in the field verification packages.

3.3.4 Workmanship

Not applicable to this specification.

3.3.5 Interchangeability

3.3.5.1 Interchangeable Parts. All like equipment (e.g., sensors, alarm lights, etc.) shall have interchangeable parts.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

This requirement is verified by the fact that all like equipment in this design package and other design packages for W-314 will be of identical make and model and, therefore, have interchangeable parts. The equipment that are identical and identified as Safety Class or Safety Significant can be used in a non-Safety Class or Safety Significant application but a non-Safety Class or Safety Significant item can not be used as a Safety Class or Safety Significant item until special qualifications are performed on the item.

3.3.6 Safety

3.3.6.1 Leak Detection System Safety Class. The Pit Leak Detection System is identified as Safety Significant for the safety structures, systems and components (SSCs) except 241-AN-04D, Slurry Receiver Pit. The safety functions of the Pit Leak Detection System are to detect leaks inside the pit to limit the volume of waste spilled to the pit and provide an interlock to the transfer pump or an alarm.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

Per the TWRS FSAR, the Safety Class or Safety Significant functions of the Pit Leak Detection system are to detect a leak 1 inch from the pit floor and provide a local alarm or pump interlock. The design will detect the leak within at least 1 inch from the floor (see Drawings H-14-103362 and H-14-103370) and provide a pump interlock.

3.3.6.1.1 Slurry Receiver Pit Safety Class. The 241-AN-04D, Slurry Receiver Pit leak detector shall be identified as General Services.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

This requirement is verified on Drawing H-14-103370.

3.3.6.1.2 Safety Class Power. Safety class power shall not be required.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

Power to the pit leak detectors is general service. See Drawing H-14-103370.

3.3.6.1.3 Leak During Transfer. The Pit Leak Detection System, in conjunction with the MCS, shall shut down the waste transfer upon detection of a leak.

Verification: (Analysis)

[X] Met	[ ] Not Met	[ ] N/A

Any liquid that enters the pit will flow to the lowest point (the drain) and be held up by the drain plug. When the liquid reaches the height of the probes, the electrical circuit is completed and the automatic MPS shutdown is initiated by the leak detection relay. The MPS shutdown signal will first be connected into the existing MPS shutdown system and later connected into the new MPS system when installed at a later date. The leak detection circuitry is shown on Drawings H-14-103370 and H-14-100983.

3.3.6.1.4 Pit Leak Detection System Interlocks. The Pit Leak Detection System, in conjunction with the MCS, shall have a failsafe interlock to shutdown any waste transfer operation.

Verification: (Analysis)

[X] Met	[ ] Not Met	[ ] N/A

The pit leak detection system portion of the fail safe interlock is the leak detection malfunction signal. Upon loss of power, the general purpose relay will de-energize and send a signal to the MPS System. See Drawings H-14-103370 and H-14-100983.

3.3.6.1.5 Seismic Qualification. The Pit Leak Detection System components are not required to operate during or after a seismic event. No seismic qualification of components is required. The design of structures should be limited to UBC for performance category (PC) 1.

Verification: (Analysis)

[X] Met	[ ] Not Met	[ ] N/A

Calculation W314-C-008, *Miscellaneous Equipment Supports for the Encasement Leak Detection Relay Cabinets* analyzes the structures associated with the instrumentation installed by this design package using UBC earthquake loads. Even though the pit leak detection system is designated as Safety Class or Safety Significant, the system does not have to operate after a DBE (per Design Authority letter #74740-97-GPJ-001 dated January 13, 1997) and thus, does not have to be designed and analyzed to the higher earthquake loads.

3.3.6.1.6 Loss of Power. The Pit Leak Detection System shall be fail safe on loss of power.

Verification: (Analysis)

[X] Met	[ ] Not Met	[ ] N/A

Upon loss of power, the leak detection malfunction alarm will be activated. The general

purpose relay is normally energized when in a nonalarm condition. Upon loss of power, the relay will de-energize and send an alarm signal to the MPS System.

3.3.6.1.7 Redundant Equipment. No single component of the Pit Leak Detection System shall prevent the system from performing its intended safety function.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

There is no single component of the Pit Leak Detection System that will prevent it from performing its safety function with the exception of the leak detection probes. See RPP-5831, Section 5.0. The probes are 5/8" diameter stainless steel rods. The probes may fail due to corrosion or non-conductive sludge covering them. This requires, as a minimum, annual inspection and cleaning of the probes. Note that the probes may be removed from the pit without removing the cover blocks.

3.3.6.1.8 Redundant Wiring. The Pit Leak Detection System redundant wiring shall be separated unless one of the following conditions is met. 1) The failure of the wiring results in a fail-safe condition (i.e. the failure is detectable), or 2) the failure can be shown by analysis to occur less that 1E-06 times per year.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

This requirement is verified by RPP-5831.

3.3.6.1.9 Isolation of Wiring. The Pit Leak Detection System safety significant wiring shall be isolated from the non-safety significant wiring unless one of the following conditions is met. 1) The failure of the wiring results in a fail-safe condition (i.e. the failure is detectable), or 2) the failure can be shown by analysis to occur less that 1E-06 times per year.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

This requirement is verified by RPP-5831.

3.3.6.1.10 Commercial Grade Components. Commercial grade components used for Safety Class or Safety Significant service shall be procured from a qualified vendor or be dedicated using the commercial grade dedication process.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

This requirement is verified by W-314-C5, Section 13440, Paragraph 2.3.1, W-314-P19, Section 3.4, W-314-P28, Section 4.3, and W-314-P30, Section 3.4.

3.3.6.2 Flammable Gas Hazardous Environment. The Pit Leak Detection System components installed in ex-tank intrusive or waste intrusive locations shall be designed to meet NFPA 70 Class I, Division 1, Group B criteria for hazardous locations.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

The only ex-tank intrusive components of the pit leak detection system are the probes and the connecting wiring. The leak detector probes meets the criteria for a Simple Apparatus as defined by the NEC and therefore needs no approval. A Simple Apparatus is a device that will neither generate nor store more than 1.2 volts, 0.1 ampere, 25 milliwatts, or 20 microjoules. The leak detection relay connects to the probes and is FM approved as being intrinsically safe. Thus, this is an intrinsically safe circuit and is accepted by the NEC for use in a Class I, Division 1 or 2, Group B location. Refer to Drawings H-14-103357, H-14-103362, and H-14-103370 for details on how these components are wired.

3.3.7 Human Performance/Human Engineering

3.3.7.1 Control Devices. Each control device shall be in accordance with NUREG 0700, Section 6.4 and MIL-STD-1472E, Section 5.4.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

This requirement is verified by Calculation W314-I-002, *Human Factor Analysis Pit Leak Detection Warning Lights.*

3.3.7.2 Warning Systems. Warning systems shall be in accordance with the general guidelines found in MIL-STD-1472E, Section 5.3. Auditory signal guidelines shall be in accordance with NUREG 0700, Section 6.2.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

This requirement is verified by Calculation W314-I-002, *Human Factor Analysis Pit Leak Detection Warning Lights.*

3.4 Documentation

3.4.1 Drawings Preparation

Drawings shall be prepared according to the formats set forth in HNF-PRO-242, Rev. 1, *Engineering Drawing Requirements* for drawings produced prior to June 15, 1999 and RPP-PRO-709, Rev. 0, *Preparation and Control Standards for Engineering Drawings* for

drawings produced after June 15, 1999. After January 24, 2001 use HNF-IP-0842, Volume IV, Section 4.31, Rev. 0a.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

H-Series Drawings were prepared and released per ECN W314-4L-002 dated April 23, 2001 in accordance with the guidelines set forth in HNF-PRO-709, Rev. 1.

3.4.2 Document Control

Records, documents, and document control pertinent to design functions shall be in accordance with HNF-PRO-224 and HNF-IP-0842, Volume XI, Section 3.5, Rev. 0a.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

The overall record management for identification and storage of drawings, calculations, and specifications pertinent to design functions were performed according to HNF-PRO-224 and HNF-IP-0842, Volume 11, Section 3.5.

Verification: (Examination)

[X]	[ ]	[ ]
Met	Not Met	N/A

TBD CHG.

3.5 Logistics

3.5.1 Maintenance

3.5.1.1 Fully Remote Maintenance and Operation. Each system or portion of a system having radiation levels greater than 50 mrem/hr contact exposure shall be designed to be remotely maintained and operated or designed to require no maintenance and be remotely operated.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

This requirement applies only to equipment inside the pit. Probes located inside the pit can be washed down as they are extracted from the top of the cover block and maintained outside radioactive environments. Decontamination of the probes will be in accordance with ALARA. Areas outside the pit do not require protection from radiation levels greater than 50 mrem/hr and therefore do not apply.

3.5.1.2 Limited Contact Maintenance and Operation. Each system or portion of a system

having radiation levels greater than 0.1 mrem/hr to less than or equal to 50 mrem/hr shall be designed for limited contact maintenance and operation.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

See analysis in Section 3.5.1.1.

3.5.1.3 Full Contact Maintenance and Operation. Each system or portion of a system having radiation levels less than or equal to 0.1 mrem/hr shall be designed for full contact maintenance and operation.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

See analysis in Section 3.5.1.1. The operation of the pump pit leak detection system does not require full contact. Full contact maintenance, if required, will be performed only after decontamination in accordance with ALARA.

3.5.2 Supply

3.5.2.1 Parts and Components. The system design shall, to the greatest extent practicable, use readily available parts and components.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

All components in the leak detection systems, except the leak detection probes, are off the shelf items and can be readily purchased from off site suppliers.

3.5.3 Facilities and Facility Equipment

Not applicable to this specification.

3.6 Personnel and Training

3.6.1 Personnel

Not applicable to this specification.

3.6.2 Training

Not applicable to this specification.

3.7 Major Component Characteristics

Not applicable to this specification.

4 SYSTEM QUALIFICATION PROVISIONS

4.1 General

The Project W-314 QAPP (HNF-SD-W314-QAPP-001) defines the quality assurance requirements for this project.

Table 4-1 listed verifications may be performed in conjunction with QAPP verifications. Inspections as defined in 4.2 shall be conducted during the design and development of each system to provide assurance of compliance with the requirements of this PDS.

4.1.1 Responsibility for Inspections

The design contractor shall be responsible for the performance of all inspections for each system developed in accordance with this PDS. Inspections shall be conducted at the contractor facilities or the facilities of his choice with the approval of the procuring authority. The procuring authority reserves the right to witness or perform the specified inspections.

4.1.2 Special Tests and Examinations

Verification of the pit leak detection system by the design contractor shall be accomplished with the use of a mock-up of the system. The mock-up shall include: sensors and sensor holder in simulated pit with cover block, system circuitry and alarms. The mock-up shall demonstrate that the design of the leak detection system is capable of meeting the requirements of the pit leak detection system.

4.2 Quality Conformance Inspections.

Qualification shall be performed on System hardware representative of the approved production design. Qualification of the System to assure compliance with the requirements of Section 3 shall be by examination, demonstration, test, and/or analysis, as defined herein. Test program data may be used to assure compliance with requirements.

a. Examination is an element of inspection consisting of investigation, without the use of special laboratory appliances or procedures, to determine compliance with requirements. This method is intended to be construction related and consists of examination of documents and construction activities.

b. Demonstration is an element of inspection that is limited to readily observable functional operation to determine compliance with requirements. This element of inspection does not require the use of special equipment or sophisticated instrumentation. This method is intended to be utilized for any mock-up testing.

c. Test is an element of inspection that employs technical means including (but not limited to) the evaluation of functional characteristics by use of special equipment or instrumentation, simulation techniques, and the application of established principles and procedures to determine compliance with requirements. The analysis of data derived from test is an integral part of this inspection. This method is intended to be utilized for any acceptance testing in the field.

d. Analysis is an element of inspection, taking the form of the processing of accumulated results and conclusions, intended to provide proof that verification of a requirement(s) has been accomplished. The analytical results may be comprised of a compilation of interpretation of existing information or derived from lower level examinations, tests, demonstrations, or analyses.

The environmental capability of equipment shall be demonstrated by appropriate testing, analysis, and operating experience, or other methods that can be supported by auditable documentation, or a combination of these methods.

5 NOTES

5.1 Definitions

5.1.1 Instantaneous Response Time

The time allowed for the leak detection system to produce an output signal after it has detected a leak. Based on the design authority judgement this time is less than or equal to one second.

5.1.2 Local Alarm

A local alarm is defined as an alarm located at or near the point of measurement. For example the leak detector local alarm would be at the pit leak detection system control panel, which would be at or near the pit where the leak detection sensor is located.

5.1.3 Leak

Leaks from waste transfer systems at the Hanford Site are established for each specific project. Each project demonstrates to the Washington Department of Ecology that the proposed system meets state regulations. The leak for the proposed system is established in this process. The leak for the pit leak detection system has been established at 10 gallons in a 24 hour period.

5.1.4 Glaze

Glaze is a coating of ice formed when rain or drizzle freezes on contact with any surface which has a temperature that is below freezing.

5.1.5 Continuous Monitoring Frequency

Continuous monitoring frequency is defined as monitoring for a leak without interruption as long as power is applied to the system which normally means that the sensing instrumentation is dedicated to a single measurement.

5.2 Acronym List

ALARA	As Low As Reasonably Achievable
ANSI	American National Standards Institute
ATP	Acceptance Test Procedure
BIO	Basis for Interim Operation

DOE	U.S. Department of Energy
DRD	Design Requirements Document
FFBD	Functional Flow Block Diagram
LDSTA	Leak Detection Station
MCS	Monitoring and Control System
PC	Performance Category
PDS	Project Development Specification
PICD	Project Interface Control Document
RPP	River Protection Project
SSCs	Safety Structures, Systems and Components
TFC	Tank Farm Contractor
USQ	Unreviewed Safety Questions

5.3 Applicable Documents

National codes and standards will be identified within Section 2, Applicable Documents, of the PDS without dates or revision numbers. Government documents and Hanford site standards will be identified by the effective date or revision number.

APPENDIX D

Requirements Verification

for

Master Pump Shutdown System

This PDS not applicable to this RVR.

APPENDIX E

Requirements Verification

for

Special Protective Coating

1 SCOPE

This appendix documents how the requirements that are listed in the Project Development Specification (PDS) for the Special Protective Coating (SPC) (HNF-SD-W314-PDS-005) are satisfied for the SPC that will be installed in existing Pump Pits 241-AN-01A and 241-AN-04A.

2 APPLICABLE DOCUMENTS

For a list of the applicable documents, refer to the appropriate PDS.

3 REQUIREMENTS

3.1 Item Definition

No requirements are listed in this section.

3.2 Characteristics

3.2.1 Performance Characteristics

The performance requirements of the SPC system are as follows:

3.2.1.1 Provide Chemical Resistance

3.2.1.1.1 Chemical Resistance. The SPC system shall be capable of withstanding the liquid waste chemical composition ranges listed in Table 3-1.

Table 3-1 Chemical Composition Range

Species	Retrieved waste			
	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
As	0	0.0066	-	-
B	0	0.013	-	-
Ba	0	0.0004	0	0.0014
Bi	-	-	0	0.076
Ca	0.0014	0.1	0	0.17
Cd	0	0.0074	0	0.0007
Cr	0.0067	0.28	0.0001	0.091
Cu	0	0.02	-	-

Table 3-1 Chemical Composition Range (Continued)

Retrieved waste				
Species	DST		SST	
	Anion/cation		Anion/cation	
	min mol/L	max mol/L	min mol/L	max mol/L
Fe	0.0004	0.26	0.0057	0.89
Hg	0	2.8E-05	0	0.0001
K	0.044	0.55	0.0002	0.0095
La, Nd	0	0.0066	0	0.001
Mg	0.0004	0.046	-	-
Mn	0.0003	0.16	0.0009	0.41
Mo	0	0.0029	-	-
Na	1.6	10.7	1.6	7.1
Ni	0.0002	0.008	0	0.042
Pb	0	0.004	0	0.12
Pd, Rh	0	0.0063	-	-
Si(SiO2)	0.0024	0.028	0.0004	0.46
Ti	0	0.002	-	-
U	0	0.0092	-	-
Zr(ZrO2)	0	0.3	0	0.065
Acetate	-	-	0	0.0055
Citrate	0	0.03	0.0042	0.06
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
CO3	0.03	0.69	0.014	0.38
F	0.014	1	0.001	0.71
Fission product	0	0.0001	-	-
NO2	0.1	1.8	0.0086	0.83
NOX(NO3)	0.15	3.6	0.64	5.1
OH	0.24	4.4	0.25	6.9
PO4	0	0.4	0.0007	3.8
SO4	0.003	0.16	0.01	0.22

Table 3-1 Chemical Composition Range (Continued)

Retrieved waste				
Species	DST		SST	
	Anion/cation		Anion/cation	
	min mol/L	max mol/L	min mol/L	max mol/L
TOC	0	2	-	-

DST = Double-shell tank
EDTA = Ethylenediametraacetic acid
HEDTA = n-(hydroxyethyl)-Ethylenediametraacetic acid
SST = Single-shell tank
TOC = Total organic carbon

Verification: (Analysis) [X] Met [ ] Not Met [ ] N/A

This requirement is included in Construction Specification W-314-C5, Sections 09855 and 09856. This analysis was completed when Vendor Submittals W-314-C5-007, W-314-C5-008, W-314-C5-009, and W-314-C5-010 were received.

3.2.1.2 Provide Decontaminability

3.2.1.2.1 Radionuclide Compatibility. The SPC system shall be compatible with the waste radionuclide concentrations listed under the W-314 column in Table 3-2.

Table 3-2 Radionuclide Concentrations

Nuclide	Nuclide Concentrations (Bq/L)		
	(a)All liquids	(a)All solids	(b)W-314
14C	2.3E+05	1.6E+05	2.3E+05
60Co	9.5E+06	4.9E+08	1.7E+08
79Se	(c)	1.7E+04	1.7E+04
90Sr	1.1E+10	2.9E+12	9.6E+11
90Y	1.1E+10	2.9E+12	9.6E+11
99Tc	1.7E+07	1.2E+10	4.0E+09
106Ru	9.9E+02	7.2E+04	2.4E+04
125Sb	3.4E+04	1.8E+08	5.9E+07
129I	2.0E+04	6.4E+06	2.1E+06
134Cs	6.1E+06	9.4E+06	7.2E+06
137Cs	8.8E+10	1.0E+11	9.2E+10
144Ce	9.1E+00	3.4E+02	1.2E+02

Table 3-2 Radionuclide Concentrations (Continued)

Nuclide	Nuclide Concentrations (Bq/L)		
	(a)All liquids	(a)All solids	(b)W-314
147Pm	3.6E+07	(c)	3.6E+07
154Eu	2.4E+09	1.1E+10	5.2E+09
155Eu	5.9E+07	5.0E+06	5.9E+07
237Np	2.3E+05	9.9E+08	3.3E+08
238Pu	1.8E+06	1.9E+08	6.4E+07
239Pu(d)	3.6E+07	1.6E+09	5.5E+08
241Pu	2.6E+08	3.8E+09	1.4E+09
241Am	4.2E+07	1.1E+10	3.7E+09
242Cm	1.1E+01	2.0E+02	7.3E+01
244Cm	4.2E+05	6.1E+07	2.0E+07

(a) From Table 1a., Van Keuren, J. C., 1996, Tank Waste Compositions and Atmospheric Dispersion Coefficients for Use in Safety Analysis Consequence Assessments, WHC-SD-WM-SARR-016, Rev. 2, Westinghouse Hanford Company, Richland, Washington.
(b) W-314 values represent a bounding mixture for design of 67% liquid and 33% solid, except for 14C and 155Eu where the maximum liquid value was used as it is higher than the mix and for 79Se and 147Pm where data is not available.
(c) No available data.
(d) The 239Pu activity concentration also includes 240Pu.

Verification: (Analysis)

[X] Met	[ ] Not Met	[ ] N/A

This requirement is included in Construction Specification W-314-C5, Sections 09855 and 09856. This analysis was completed when Vendor Submittals W-314-C5-007, W-314-C5-008, W-314-C5-009, and W-314-C5-010 were received.

3.2.1.2.2 Decontamination Factor. The top coating of the SPC system shall demonstrate relative ease of decontamination with a minimum Decontamination Factor (DF) of 100. The DF after initial water wash shall be a minimum of 20.

Verification: (Analysis)

[X] Met	[ ] Not Met	[ ] N/A

This requirement is included in Construction Specification W-314-C5, Sections 09855 and 09856. This analysis was completed when Vendor Submittals W-314-C5-007, W-314-C5-008, W-314-C5-009, and W-314-C5-010 were received.

3.2.2 Physical Characteristics

3.2.2.1 Surface Application. The SPC system shall develop the ability to resist the development of holidays with time.

Verification: (Analysis) [X] Met [ ] Not Met [ ] N/A

Construction Specification W-314-C5, Section 09855, specifies a rigid coating system consisting of four coats totaling 15 mils in thickness and Section 09856 requires a single coat of 125 mils thickness for walls and 250 mils thickness for floors. Proper application of these coatings at these thicknesses will resist the development of holidays. Once the coating cures holidays will not form.

Verification: (Examination) [X] Met [ ] Not Met [ ] N/A

This requirement was verified during construction and documented in CWPs W314-4L-017 and W314-4L-018.

3.2.2.2 Thermal Stress Endurance. The SPC system shall successfully fill or bridge cracks of 1.0 - 1.5 mm (0.040 - 0.060 inches) caused by thermal movement and stresses within concrete.

Verification: (Analysis) [X] Met [ ] Not Met [ ] N/A

Construction Specification W-314-C5, Section 09855, requires elongation at break be at least 5% for rigid coatings. This requirement will assure cracks up to 1.5 mm (0.060 inches) can be bridged. Section 09856 requires elongation at break to be a minimum of 400%. Cracks under 1/16 inch width can be bridges. Cracks of 1/16 inch to 1/8 inch will be bridged with masking or duct tape to preclude 3 point adhesion and cracks and spalls greater than 1/8 inch will be repaired as directed by the Design Engineer. These requirements assure that the coating can resist the thermal stresses.

3.2.2.3 Volatile Organic Content Compliance. The SPC system shall be volatile organic content (VOC) compliant with a maximum VOC of 2.9 lbs/gallon (350 grams/liter).

Verification: (Analysis) [X] Met [ ] Not Met [ ] N/A

This requirement is included in Construction Specification W-314-C5, Sections 09855 and 09856. This analysis was completed when Vendor Submittals W-314-C5-007, W-314-C5-008, W-314-C5-009, and W-314-C5-010 were received.

3.2.2.4 Tensile Properties. The SPC system shall have minimum acceptable tensile properties

tabulated in Table 3-3, and -4, and -5.

Table 3-3 Tensile Properties of Coatings

Properties	Rigid Coating (Epoxy)	Flexible Coating (Elastomeric)
Tensile Strength	N/A	Minimum 20,700 KPa (3,000 psi) at 30 days
Elongation at break at 24 °C (75 °F)	Minimum 5 percent	Minimum 400 percent at 30 days

Table 3-4 Tensile Properties of Joint Sealants

Properties	Flexible Epoxy	Fluoroelastomer, Polysulfide, Polyurethane
Tensile Strength	Minimum 3,500 KPa (500 psi)	Minimum 10,400 KPa (1,500 psi)
Elongation at break at 24 °C (75 °F)	Minimum 100 percent	Minimum 100 percent

Table 3-5 Tensile Properties of Fillers

Properties	Solid Epoxy Mastic
Tensile Strength	Minimum 3,500 KPa (500 psi)
Elongation at break at 24 °C (75 °F)	Minimum 20 percent

Verification: (Analysis)

[X] Met	[ ] Not Met	[ ] N/A

This requirement is included in Construction Specification W-314-C5, Sections 09855 and 09856. This analysis was completed when Vendor Submittals W-314-C5-007, W-314-C5-008, W-314-C5-009, and W-314-C5-010 were received.

3.2.2.5 Abrasion Resistance. The top coating shall demonstrate the abrasion resistance property. The acceptable abrasion resistance values of the installed coating are tabulated in Table 3-6. The weight loss values are for 1000 cycles when a CS-17 wheel is used with a 1000 g load in accordance with ASTM D 4060.

Table 3-6 Abrasion Resistance Properties of Coatings

Properties	Rigid Coating (Epoxy)	Flexible Coating (Elastomeric)
Abrasion Resistance	Weight loss less than 100 mg	Weight loss less than 10 mg

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

This requirement is included in Construction Specification W-314-C5, Sections 09855 and 09856. This analysis was completed when Vendor Submittals W-314-C5-007, W-314-C5-008, W-314-C5-009, and W-314-C5-010 were received.

3.2.2.6 Permeability. The SPC system shall be capable of resisting the migration of liquid waste/water into the pit wall. The permeability shall be measured as follows:

- The maximum water vapor transmission (WVT) rate for a top coating shall be 8 gm/square meter/24 hr.
- The maximum water absorption rate for a top coating and joint sealant shall be 0.5 percent per 24 hours.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

This requirement is included in Construction Specification W-314-C5, Sections 09855 and 09856. This analysis was completed when Vendor Submittals W-314-C5-007, W-314-C5-008, W-314-C5-009, and W-314-C5-010 were received.

3.2.2.7 Adhesion to Substrate. The SPC system shall display an adhesion property to the underlying concrete and previously coated surfaces. Minimum pull-off strength shall be 1378 KPa (200 psi). For new concrete the minimum pull-off strength shall be 2412 KPa (350 psi). Adhesion strengths greater than 1378 KPa (200 psi) are acceptable for old concrete, and adhesion strengths greater than 2412 KPa (350 psi) are acceptable for new concrete. Existing pit interior SPC repairs are excluded from this requirement when ALARA considerations prevent surface preparation per manufacturer's recommendations.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

Per ECN 665749, dated April 6, 2001, the minimum pull-off strength has been changed to 1378 kPa (200 psi). For new concrete, a minimum pull-off strength of 2412 kPa (350 psi) has been given. Adhesion strengths greater than 1378 kPa (200 psi) are acceptable for old concrete, and adhesion strengths greater than 2412 kPa (350 psi) are acceptable for new concrete. This requirement is included in Construction Specification W-314-C5, Sections 09855 and 09856. This analysis was completed when Vendor Submittals W-314-C5-007, W-314-C5-008, W-314-C5-009, and W-314-C5-010 were received. Specification Section 09855 calls for adhesion to steel of 900 psi for rigid coating only. Steel is used as the standard because of repeatability, but the test is a meaningful measure of adhesion to concrete.

3.2.2.8 Color. The color of the top coat shall be white or near white such that nozzle labels and

markers can be painted over the top coat.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

This requirement is included in Construction Specification W-314-C5, Sections 09855 and 09856.

Verification: (Examination)

[X]	[ ]	[ ]
Met	Not Met	N/A

This requirement was verified during construction and documented in CWPs W314-4L-017 and W314-4L-018.

3.2.2.9 Labeling Paint. Paint (coating) use for identification marking on the SPC top coat shall be compatible with the SPC system.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

This requirement is included in Construction Specification W-314-C5, Section 09855 by requirements to use SPC coating materials and by Section 09856 to use materials in Section 09855. Thus no compatibility issues.

3.2.3 Reliability

The SPC system shall have a design life of 12 years when installed per the manufacturer's recommendations.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

This requirement is included in Construction Specification W-314-C5, Sections 09855 and 09856. This analysis was completed when Vendor Submittals W-314-C5-007, W-314-C5-008, W-314-C5-009, and W-314-C5-010 were received.

3.2.4 Maintainability

The SPC system shall be repairable for cracks appearing through the applied coated surface to the substrate or for chips and flaking on account of mechanical damage.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

This requirement is included in Construction Specification W-314-C5, Sections 09855

and 09856. This analysis was completed when Vendor Submittals W-314-C5-007, W-314-C5-008, W-314-C5-009, and W-314-C5-010 were received.

3.2.5 Environmental Conditions

The systems and components covered by this specification shall be compatible with the environmental conditions listed below, as applicable.

3.2.5.1 Natural Environments

3.2.5.1.1 Ambient Air Temperature. The ambient air temperature range is 48.9°C (120°F) to -35.5°C (-32°F), and with a maximum 24 hour differential of 28.9°C (52°F).

Verification: (Analysis)

[X] Met	[ ] Not Met	[ ] N/A

Construction Specification W-314-C5, Sections 09855 and 09856, requires coatings be applied only when temperatures are within the range recommended by the coating manufacturer. This analysis was completed when Vendor Submittals W-314-C5-007, W-314-C5-008, W-314-C5-009, and W-314-C5-010 were received.

3.2.5.1.2 Soil Temperature. Not applicable to this specification.

3.2.5.1.3 Seismic Loads. Not applicable to this specification.

3.2.5.1.4 Wind Loads. Not applicable to this specification.

3.2.5.1.5 Snow Loads. Not applicable to this specification.

3.2.5.1.6 Relative Humidity. The relative humidity range is 0 to 100% (Rate of change is negligible).

Verification: (Analysis)

[X] Met	[ ] Not Met	[ ] N/A

This requirement is included in Construction Specification W-314-C5, Sections 09855 and 09856. This analysis was completed when Vendor Submittals W-314-C5-007, W-314-C5-008, W-314-C5-009, and W-314-C5-010 were received.

3.2.5.1.7 Surface Precipitation. The surface precipitation is 4 cm (1.56 in) in a 24 hour period.

Verification: (Analysis)

[X] Met	[ ] Not Met	[ ] N/A

Coating meeting requirements of Construction Specification W-314-C5, Sections 09855 and 09856, will not be affected by surface precipitation.

3.2.5.1.8 Hail Events. The hail diameter is less than or equal to 1.9 cm (0.75 in).

Verification: (Analysis) [X] Met [ ] Not Met [ ] N/A

Wear resistance as specified in Construction Specification W-314-C5, Sections 09855 and 09856, will help provide resistance to hail damage.

3.2.5.1.9 Sand and Dust. The sand/dust concentration is 0.177 gm/cubic meter with a typical size of 350 µm.

Verification: (Analysis) [X] Met [ ] Not Met [ ] N/A

Wear resistance as specified in Construction Specification W-314-C5, Section 09855 and 09856, will help protect the SPC applied to the top of the cover blocks from sand/dust damage.

3.2.5.1.10 Solar Radiation. The solar radiation range is between 4 Watts/square meter and 406 Watts/square meter.

Verification: (Analysis) [X] Met [ ] Not Met [ ] N/A

All coatings specified in the Construction Specification W-314-C5, Sections 09855 and 09856, are for use on surfaces exposed to solar radiation. Exposure to solar radiation may weather the surface of the coating, but not effect the integrity of the coating.

3.2.5.1.11 Glaze. (See definition is Section 5.1) The glaze is 2.54 cm (1 in.).

Verification: (Analysis) [X] Met [ ] Not Met [ ] N/A

Coating meeting requirements of Construction Specification W-314-C5, Sections 09855 and 09856, will resist glaze.

3.2.5.1.12 Ashfall Events. Not applicable to this specification.

3.2.5.1.13 Load Combinations and Allowable Stresses. Not applicable to this specification.

3.2.5.2 Induced Environments

3.2.5.2.1 Waste Properties. Materials used that come in contact with the waste shall be

capable of safely handling waste with the following properties:

Specific Gravity	1 to 1.5
Viscosity	1 to 30 centipoise (Newtonian)
Miller Number	100 Maximum
pH	7 to 14
Temperature	10 to 93 °C (50 to 200 °F)
Solids Content	30 Vol. %
Particle Size	0.5 to 4000 microns

Note: 95% of total particles 0 to 50 microns
<5 percent of total particles 50 to 500 microns
<1 percent of total particles 500 to 4000 microns

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

Coating will be subject to only occasional splashes and spills and not to prolonged immersion. Conformance to requirements of the Construction Specifications W-314-C5, Sections 09855 and 09856, will assure resistance to the waste. This analysis was completed when Vendor Submittals W-314-C5-007, W-314-C5-008, W-314-C5-009, and W-314-C5-010 were received.

3.2.5.2.2 Radiation Tolerance

3.2.5.2.2.1 Inside Pit Radiation Level. Materials used that are located inside a pit shall be capable of operating in the following radiation environment:

3.2.5.2.2.1.1 Inside Pit Radiation Level (Non-HLW Contact).
Total accumulated dose: 1.0E+7 rads
Dose rate: 1.0E+7 mr/hr

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

Construction Specification W-314-C5, Section 09855, requires Ameron Amerlock 400 and PSX 700 or approved equal. Ameron complies with the requirement per AN Valve Pit Submittal W-314-CI-6. This analysis was completed by submittal W-314-C5-007.

3.2.5.2.2.1.2 Inside Pit Radiation Level (For Hardware in Contact with HLW).
Total accumulated dose: 6.0E+7 rads
Dose rate: 1.0E+7 mr/hr

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

Standard ASTM tests as specified in Construction Specification W-314-C5, Sections 09855 and 09856, will assure coating has resistance to radiation. This analysis was

completed when Vendor Submittals W-314-C5-007, W-314-C5-008, W-314-C5-009, and W-314-C5-010 were received.

3.2.5.2.2.2 Background Radiation Level. Materials used that are located outside a pit, above ground, shall be capable of operating in the following radiation environment:

total accumulated dose:	4.4 rad/year
dose rate:	0.5 mrem/hour

Verification: (Analysis)

Met	Not Met	N/A
[X]	[ ]	[ ]

The SPC is required to meet the inside pit radiation level and as such, it will fulfill this requirement.

3.2.6 Transportability

Not applicable to this specification.

3.2.7 Flexibility and Expansion

Each system design shall, to the maximum extent practicable, provide sufficient flexibility to accommodate for programmatic changes or operation modifications.

Verification: (Analysis)

Met	Not Met	N/A
[X]	[ ]	[ ]

The use of SPC will allow for easier decontamination of the pit prior to entry, which will allow for timely changes and modifications that may be required for support of future operations.

3.3 Design and Construction

3.3.1 Materials, Processes, and Parts

3.3.1.1 Materials

3.3.1.1.1 SPC System

3.3.1.1.1.1 Service Area. The SPC system shall be suitable for Service Level II Area.

Verification: (Analysis)

Met	Not Met	N/A
[X]	[ ]	[ ]

This requirement, which is defined in ASTM D-5144, is included in Construction Specification W-314-C5, Sections 09855 and 09856. This analysis was completed when Vendor Submittals W-314-C5-007, W-314-C5-008, W-314-C5-009, and W-314-C5-010

were received.

3.3.1.1.1.2 SPC System Schedule. A SPC system schedule shall be prepared during definitive design stage, based on manufacturer recommendations, published data for the SPC system and field ALARA conditions. The schedule shall provide descriptions of prime, base, intermediate, and finish coats as applicable; minimum dry film thickness in mils; and color.

Verification: (Analysis)

Met	Not Met	N/A
X		

Construction Specification W-314-C5, Sections 09855 and 09856, lists representative products with appropriate requirements that will meet this requirement. This analysis was completed when Vendor Submittals W-314-C5-007, W-314-C5-008, W-314-C5-009, and W-314-C5-010 were received.

3.3.1.1.2 SPC System Accessory Materials. Coating accessory materials such as joint sealants, fillers, primers, thinners, form release agents, and scrim cloth shall be as recommended by the manufacturer of the SPC system suitable for environmental conditions specified in this document.

Verification: (Analysis)

Met	Not Met	N/A
X		

This requirement is included in Construction Specification W-314-C5, Sections 09855 and 09856. This analysis was completed when Vendor Submittals W-314-C5-007, W-314-C5-008, W-314-C5-009, and W-314-C5-010 were received.

3.3.1.2 Processes

3.3.1.2.1 Surface Preparation

3.3.1.2.1.1 Surface Preparation (Excluding Existing Pit Interior SPC Repairs). The design document will incorporate a surface preparation procedure prepared in consultation with the manufacturer of the SPC system. Substrate preparation method(s) and acceptance criteria will be selected and documented in the design media during the design phase.

Verification: (Analysis)

Met	Not Met	N/A
X		

Construction Specification W-314-C5, Sections 09855 and 09856, includes a general preparation requirement. This analysis was completed when Vendor Submittals W-314-C5-007, W-314-C5-008, W-314-C5-009, and W-314-C5-010 were received.

3.3.1.2.1.2 Surface Preparation for Existing Pit Interior SPC Repairs. The design document will incorporate a surface preparation procedure prepared in consultation with the manufacturer of the SPC system when field radiological/toxicological conditions permit. When field radiological/toxicological conditions prohibit surface preparation per manufacturer's

consultation, the design document will provide minimum surface preparation details consistent with ALARA.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

Construction Specification W-314-C5, Sections 09855 and 09856, includes a general preparation requirement.

3.3.1.2.2 SPC System Application. The SPC system shall be installed only when ambient and surface temperatures are within the range recommended by the coating manufacturer for the respective coating. The application procedure for the SPC system shall be in accordance with the manufacturers' specification.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

Construction Specification W-314-C5, Sections 09855 and 09856, and inspection during construction will ensure coating application occurs only when ambient conditions are suitable for coating chosen.

Verification: (Examination)

[X]	[ ]	[ ]
Met	Not Met	N/A

This requirement was verified by examination during construction and documented in CWPs W314-4L-014, W314-4L-015, W314-4L-017, and W314-4L-018.

3.3.1.3 Optimization. During the design of facilities, optimization principles, as discussed in ICRP Publication 37, shall be utilized in developing and justifying facility design and physical controls.

Verification: (Analysis)

[ ]	[ ]	[X]
Met	Not Met	N/A

ICRP Publication 37 addresses techniques for use in the optimization of radiation protection based on cost-benefit analysis. The SPC is not intended to provide any radiation protection and thus this requirement is not applicable to this specification.

3.3.1.4 Dome Loading. The equipment used for installation and maintenance shall comply with the DST dome loading constraints.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

If equipment is located outside a 20 foot exclusion zone around the DST, dome loading

effects are mitigated. Compliance with this requirement will be verified by calculation and by the issuing of dome loading permits, by the customer, for locating the equipment from tank farm engineering and operations.

3.3.2 Electromagnetic Radiation

Not applicable to this specification.

3.3.3 Identification and Marking

Not applicable to this specification.

3.3.4 Workmanship

Not applicable to this specification.

3.3.5 Interchangeability

Not applicable to this specification.

3.3.6 Safety

3.3.6.1 Material Safety Data Sheets. Material Safety Data Sheets (MSDS) for the SPC system components shall be furnished during the data transmittal review stage for approval. Obtain inspection and acceptance by the construction engineer before opening containers or removing labels.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

Construction Specification W-314-C5, Sections 09855 and 09856, requires submittal of MSDS for coating chosen. This analysis was completed when Vendor Submittals W-314-C5-007, W-314-C5-008, W-314-C5-009, and W-314-C5-010 were received.

3.3.6.2 Fire Protection

3.3.6.2.1 Fire Characteristics. Any materials with unusual fire characteristics, such as urethane foams, and any materials that develop significant quantities of toxic or other harmful products of combustion, shall not be used as interior finishes or other interior applications without the approval of the cognizant DOE fire protection authority. The use of foamed plastics in construction shall be prohibited unless it fully complies with Factory Mutual 1-57.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

This requirement is included in Construction Specification W-314-C5, Sections 09855 and 09856. This analysis was completed when Vendor Submittals W-314-C5-007, W-314-C5-008, W-314-C5-009, and W-314-C5-010 were received.

3.3.6.2.2 Interior Finishes. Nuclear facilities and laboratories shall have interior finish materials (decorations, furnishings, and exposed wall or insulating material) that have an Underwriters Laboratories (ASTM E-84/NFPA 255) flame spread rating of 25 or less, and smoke developed rating of 50 or less.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

This requirement is included in Construction Specification W-314-C5, Sections 09855 and 09856. This analysis was completed when Vendor Submittals W-314-C5-007, W-314-C5-008, W-314-C5-009, and W-314-C5-010 were received.

3.3.7 Human Performance/Human Engineering

Not applicable to this specification.

3.4 Documentation

3.4.1 Document Control

Records, documents, and document control pertinent to design functions shall be in accordance with HNF-PRO-224 and HNF-IP-0842, Volume XI, Section 3.5, Rev. 0a.

Verification: (Analysis)

[X]	[ ]	[ ]
Met	Not Met	N/A

Submittals required by Construction Specification W-314-C5, Sections 09855 and 09856, will assure proper documentation.

Verification: (Examination)

[X]	[ ]	[ ]
Met	Not Met	N/A

TBD CHG.

3.5 Logistics

3.5.1 Maintenance

Not applicable to this specification.

3.5.2 Supply

3.5.2.1 Parts and Components. The system design shall, to the greatest extent practicable, use readily available parts and components.

Verification: (Analysis) [X] Met [ ] Not Met [ ] N/A

Construction Specification W-314-C5, Sections 09855 and 09856, lists various manufacturer's products or approved substitute that are suitable for use. These products are considered to be readily available.

3.5.3 Facilities and Facility Equipment

Not applicable to this specification.

3.6 Personnel and Training

3.6.1 Personnel

Not applicable to this specification.

3.6.2 Training

Not applicable to this specification.

3.7 Major Component Characteristics

Not applicable to this specification.

4 SYSTEM QUALIFICATION PROVISIONS

4.1 General

The Project W-314 QAPP (HNF-SD-W314-QAPP-001) defines the quality assurance requirements for this project.

Table 4-1 listed verifications may be performed in conjunction with QAPP verifications. Inspections as defined in 4.2 shall be conducted during the design and development of each system to provide assurance of compliance with the requirements of this PDS.

4.1.1 Responsibility for Inspections

The design contractor shall be responsible for the performance of all inspections for each system developed in accordance with this PDS. Inspections shall be conducted at the contractor facilities or the facilities of his choice with the approval of the procuring authority. The procuring authority reserves the right to witness or perform the specified inspections.

4.1.2 Special Tests and Examinations

Not applicable to this specification.

4.2 Quality Conformance Inspections.

Qualification shall be performed on System hardware representative of the approved production design. Qualification of the System to assure compliance with the requirements of Section 3 shall be by examination, demonstration, test, and/or analysis, as defined herein. Test program data may be used to assure compliance with requirements.

a. Examination is an element of inspection consisting of investigation, without the use of special laboratory appliances or procedures, to determine compliance with requirements. This method is intended to be construction related and consists of examination of documents and construction activities.

b. Demonstration is an element of inspection that is limited to readily observable functional operation to determine compliance with requirements. This element of inspection does not require the use of special equipment or sophisticated instrumentation. This method is intended to be utilized for any mock-up testing.

c. Test is an element of inspection that employs technical means including (but not limited to) the evaluation of functional characteristics by use of special equipment or instrumentation, simulation techniques, and the application of established principles and procedures to determine compliance with requirements. The analysis of data derived from test is an integral part of this inspection. This method is intended to be utilized for any acceptance testing in the field.

d. Analysis is an element of inspection, taking the form of the processing of accumulated results and conclusions, intended to provide proof that verification of a requirement(s) has been accomplished. The analytical results may be comprised of a compilation of interpretation of existing information or derived from lower level examinations, tests, demonstrations, or analyses.

The environmental capability of equipment shall be demonstrated by appropriate testing, analysis, and operating experience, or other methods that can be supported by auditable documentation, or a combination of these methods.

5 NOTES

5.1 Definitions

5.1.1 Abrasion Resistance

The property of a surface by which it resists being worn away as the result of friction.

5.1.2 Adhesion

The bond or attraction of a coat of paint to the underlying material, such as a substrate or another coat.

5.1.3 Chip

The detachment of small pieces of the substrate.

5.1.4 Decontamination

The act of removing radioactive nuclides from a surface.

5.1.5 Decontamination Factor

The ratio of the original number of radioactive nuclides on the surface of a specimen to the number remaining after a decontamination process.

5.1.6 Dry-film Thickness

Depth of applied coating when dry, expressed in mils (0.001 in).

5.1.7 Flaking

The detachment of small pieces of the coating film.

5.1.8 Glaze

Coating of ice formed when rain or drizzle freezes on contact with any surface having a temperature that is below freezing.

5.1.9 Holiday

Pinhole, skip, discontinuity, or a void in coating film.

5.1.10 Laitance

A fine, whitish accumulation on concrete surfaces. It consists mainly of cement particles that were carried by water rising to the surface of freshly placed concrete.

5.1.11 Permeability

The measure of water or water vapor transmission rate through films of coating.

5.1.12 Service Level II Area

That area outside primary containment subject to radiation exposure and radionuclide contamination in accordance with ASTM D 5144.

5.1.13 Substrate

The base surface to which a coating is to be applied.

5.1.14 Wet-Film Thickness

Depth of applied coating expressed in mils measured immediately after application.

5.1.15 Water Vapor Transmission Rate

The steady water vapor flow in unit time through unit area of a body.

5.2 Acronym List

AIM	Architectural and Industrial Maintenance
ANSI	American National Standard Institute
ASTM	American Society for Testing and Materials
DF	Decontamination Factor
DFT	Dry Film Thickness
DOE	U.S. Department of Energy
DRD	Design Requirements Document
EPA	Environmental Protection Agency
FDNW	Fluor Daniel Northwest
MSDS	Material Safety Data Sheet
N/A	Not Applicable
NACE	National Association of Corrosion Engineers
PC	Performance Category
RPP	River Protection Project
SPC	Special Protective Coating
TFC	Tank Farm Contractor
VOC	Volatile Organic Components
WVT	Water Vapor Transmission

5.3 Applicable Documents

National codes and standards will be identified within Section 2, Applicable Documents, of the PDS without dates or revision numbers. Government documents and Hanford site standards will be identified by the effective date or revision number.