DEC 8 1998
Sta. 4 58

ENGINEERING DATA TRANSMITTAL

1. EDT 625186

2. To: (Receiving Organization) Distribution	3. From: (Originating Organization) Cold Vacuum Drying Facility	4. Related EDT No.: n/a
5. Proj./Prog./Dept./Div.: W-441/Spent Nuclear Fuel	6. Design Authority/ Design Agent/Cog. Engr.: J. J. Irwin	7. Purchase Order No.: n/a
8. Originator Remarks: Initial release issued for configuration control.		9. Equip./Component No.: n/a
		10. System/Bldg./Facility: CVD Facility
11. Receiver Remarks: 11A. Design Baseline Document? [] Yes [X] No		12. Major Assm. Dwg. No.: n/a
		13. Permit/Permit Application No.: n/a
		14. Required Response Date: n/a

15. DATA TRANSMITTED

(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	(F) Approval Designator	(G) Reason for Transmittal	(H) Originator Disposition	(I) Receiver Disposition
1	SNF-3082		0	Cold Vacuum Drying Facility Process Water Conditioning System Design Description	SQ	1	/	/
2	Memo: J. Brehm to J.J. Irwin & C. Pitkoff dated 11/12/98	1-4	0	Comments to CVDF SDD's	NA	3	6	6

16. KEY

Approval Designator (F)	Reason for Transmittal (G)		Disposition (H) & (I)	
E, S, Q, D or N/A (see WHC-CM-3-5, Sec.12.7)	1. Approval 2. Release 3. Information	4. Review 5. Post-Review 6. Dist. (Receipt Acknow. Required)	1. Approved 2. Approved w/comment 3. Disapproved w/comment	4. Reviewed no/comment 5. Reviewed w/comment 6. Receipt acknowledged

17. SIGNATURE/DISTRIBUTION
(See Approval Designator for required signatures)

(G) Reason	(H) Disp.	(J) Name (K) Signature (L) Date (M) MSIN	(G) Reason	(H) Disp.	(J) Name (K) Signature (L) Date (M) MSIN
1	/	Design Authority J. J. Irwin [signature] 7/30/98 R3-86	3		R. Whitehurst R3-86
		Design Agent	3		C. A. Thompson R3-86
		Cog.Eng.			CVD File (BM Brown) R3-86
1	/	Cog. Mgr. T. Choho [signature] 11-19-98 R3-86			Project Files R3-11
1	2	QA ~~T. D. Hays~~ S.L. Mischke [signature] 8/10/98 R3-86			
1	2	Safety ~~C. Pili-Vincens~~ JoAnn R Brehm [signature] R3-26 10-29-98			
		Env.			

18. [signature] 7/30/98 Signature of EDT Originator Date	19. [signature] 11/4/98 Authorized Representative Date for Receiving Organization	20. [signature] 11/4/98 Design Authority/ Cognizant Manager Date	21. DOE APPROVAL (if required) Ctrl. No. [] Approved [] Approved w/comments [] Disapproved w/comments

SPENT NUCLEAR FUEL PROJECT COLD VACUUM DRYING FACILITY PROCESS WATER CONDITIONING SYSTEM DESIGN DESCRIPTION

J. J. Irwin
Numatec Hanford Corporation, Richland, WA 99352
U.S. Department of Energy Contract DE-AC06-96RL13200

EDT/ECN: 625186 UC: 721
Org Code: 8C453 Charge Code: LH302
B&R Code: 39EW70400 Total Pages: 45

Key Words: Cold Vacuum Drying, System Design Descriptions

Abstract: This document provides the System Design Description (SDD) for the Cold Vacuum Drying Facility (CVDF) Process Water Conditioning (PWC) System. The SDD was developed in conjunction with HNF-SD-SNF-SAR-002, *Safety Analysis Report for the Cold Vacuum Drying Facility, Phase 2, Supporting Installation of Processing Systems* (Garvin 1998), The HNF-SD-SNF-DRD-002, 1998, *Cold Vacuum Drying Facility Design Requirements*, and the CVDF Design Summary Report. The SDD contains general descriptions of the PWC equipment, the system functions, requirements and interfaces. The SDD provides references for design and fabrication details, operation sequences and maintenance. This SDD has been developed for the SNFP Operations Organization and shall be updated, expanded, and revised in accordance with future design, construction and startup phases of the CVDF until the CVDF final ORR is approved.

11/30/98
Release Approval Date

Release Stamp

Approved for Public Release

INTERОFFICE CORRESPONDENCE

To:	John Irwin	R3-86	Date:	November 12, 1998
	Carol Pitkoff	R3-86		
From:	JoAnn Brehm	R3-26	Telephone:	376-8602
cc:	Ron Besser	R3-26		
	Sara Harrington	R3-26		
	Andy McNeil	R3-86		
	Robert Morgan	R3-26		
	Ron Omberg	R3-26		

Subject: COMMENTS ON COLD VACUUM DRYING FACILITY SYSTEM DESIGN DESCRIPTION

SNF-3062	(EDT 625179)	CVDF Vacuum and Purge System Design Description
SNF-3063	(EDT 625180)	CVDF Residual Gas Monitoring System Design description
SNF-3067	(EDT 625181)	CVDF General Service Helium System Design Description
SNF-3068	(EDT 625182)	CVDF Safety Class Helium System Design Description
SNF-3075	(EDT 625183)	CVDF Safety Electrical System Design Description
SNF-3077	(EDT 625184)	CVDF Fire Protection System Design Description
SNF-3081	(EDT 625185)	CVDF Heating, Venting, and Air Conditioning System Design Description
SNF-3082	(EDT 625186)	CVDF Process Water Conditioning System Design Description
SNF-3083	(EDT 625187)	CVDF Conditioned Water Shipping System Design Description
SNF-3084	(EDT 625188)	CVDF Contaminated Water Sampling and Analysis System Design Description
SNF-3085	(EDT 625189)	CVDF Tempered Water and Tempered Water Cooling System Design Description
SNF-3086	(EDT 625190)	CVDF Chilled Water System Design Description
SNF-3087	(EDT 625191)	CVDF Vacuum and Purge System Chilled Water System Design Description
SNF-XXXX	(EDT XXXXXX)	CVDF Structural Systems Description
SNF-XXXX	(EDT XXXXXX)	CVDF Crane Description
SNF-XXXX	(EDT XXXXXX)	CVDF De-Ionized Water System
SNF-XXXX	(EDT XXXXXX)	CVDF Potable Water System
SNF-XXXX	(EDT XXXXXX)	CVDF Condensate Collection Description
SNF-XXXX	(EDT XXXXXX)	CVDF Effluent System
SNF-XXXX	(EDT XXXXXX)	CVDF Compressed and Instrument Air System

Twenty SDDs were transmitted to the SAR Safety organization for review and approval. Specific sections of two SDDs (SNF-3062, Vacuum and Purge System and SNF-3068, Safety Class Helium System) were reviewed for their ability to provide the system information required for preparing the CVDF FSAR. Section 3.0, "System Function," of the SDDs was of most interest to the SAR Safety organization for preparing the final SAR. It is noted that many comments previously submitted have been incorporated. It is also noted that some information is neither identified in the SDDs nor in any other design baseline document.

COMMENTS

SNF-3061 and SNF-3068

Section 3.0 (SNF-3061 and SNF-3068) was reviewed and it was noted that even though the SAR and SEL were referenced in this section, the information as noted in the revision number of these documents (as referenced in Section 9.3) was not documented accurately in the SDD. This section of the SDDs appears not to have been changed since the February 11, 1998 revision we reviewed. Between then and the latest SAR and the SEL as referenced in the SDDs, the systems have changed and this change is not reflected in the SDDs. All required safety class and/or safety significant equipment is not identified in the SDDs.

SNF-3062 AND SNF-3068

The Section 3.2 "SAFETY FUNCTIONS," is a combination of several things. It appears to try to identify information from the SAR accident analysis but falls short of providing complete and accurate information. It also appears to identify some other safety functions (from the DRD?). Since the term "safety function" is used as a very specific term in SARs, suggest that this section is kept pure and talks to just the "safety functions" identified in the SAR, Chapter 4.0. If the system is not a safety class or safety significant SSC then this section can state that in accordance with HNF-SD-SNF-SAR-002, there are no safety functions for this system. Perhaps all these other safety functions that are identified in the SDD but not in the SAR can be placed in a sub section listed, for example, "Non-SAR Safety Functions." (found a close example in the way Sections 3.2 and 3.3 in SNF-3075 were prepared).

Specific safety functions for each system (if required) is identified in Section 4.0 of the SAR. (The following descriptions also include the requirements of DOE-STD-3009-94.)

Section 4.3.5.1, "Safety Function," (of the SAR) states the safety function of the VPS (also applies to SNF-3068 but SAR Section 4.3.2):

1. Provides the safety-class function of isolation of the MCO from the VPS upon SCIC system actuation of the VPS isolation valves during the thermal runaway reaction.
2. Initiates the safety-class process instrument signals to the SCIC system to initiate SCIC activation that is credited for the thermal runaway reaction.
3. Performs the above functions to prevent or mitigate the safety-significant consequences of the gaseous release, internal hydrogen explosion and the external hydrogen explosion.
4. Provides additional "water isolation" of the MCO from potential water ingress sources during and after the proof-of-dryness demonstration (use of redundant safety-class valves).
5. Safety-class pressure instruments are also utilized during the pressure hold tests.

Section 4.3.5.2, "System Description," provides a description of each safety-class component. For the VPS this includes valves, connectors, flexible piping, hard piping, instruments, pressure transmitters, pressure indicators, and a differential pressure indicator/transmitter.

Section 4.3.5.3, "Functional Requirements," identifies the requirements that are specifically needed to fulfill the safety functions of the VPS safety-class components.

Section 4.3.5.4, "System Evaluation," this section provides performance criteria imposed on the components so they can meet the functional requirements and thereby satisfy their safety function. Performance criteria characterize the specific operational responses and capabilities necessary to meet functional requirements. An evaluation is performed to see if the capabilities of the components meet the performance criteria.

<u>The same comment above can be made for the other SDDs.</u>

The SDDs need to be consistent with the SAR, i.e., the systems in Section 3.2 of the SDDs need to be identical to that Chapter 4.0 (corresponding subsection) of the SAR. The SDDs also need to provide some detailed description of the SSCs to be used in Section 4.3.5.2 of the SAR. In addition, the SDDs need to identify how the systems (or components) can meet the requirements identified in Section 4.3.5.3 of the SAR so that they can perform their "safety function" as identified in Section 4.3.5.1 of the SAR. If we don't have this information, we will not be able to conclude in the SAR that we have the appropriate SSCs that will make the CVDF a safe facility to operate. We cannot risk having DOE think otherwise. This is what the SAR is all about, do we have adequate controls, and have we provided proof (a robust argument)?

<u>SNF-3062, Section 2.1.3</u>

Change sentence to read: "... The water vapor removed **from** the MCO is ..." (change "form" to "from.")

<u>SNF-3062, Section 3.2.4</u>

Identify all performance category items for the VPS and provide a reference. The second sentence in the paragraph, "All process water conditioning ..." has nothing to do with the VPS system. Change this to the VPS. Provide a reference to the study or section of the SDD that evaluates the VPS SSCs and their ability to perform their safety function. (The SDD will not be able to provide a reference because no evaluation has been performed and/or documented yet. The evaluation is the responsibility of the SDD in Section 3.0 for not just NPH, but for the SAR design basis accidents. See previous comments on Section 3.0 of the SDD above.)

<u>SNF-3062, Section 8.1</u>

The title of the section is "Potential System and Component Failure," however the contents do not comply with what appears to be the identified content matter of this section. First, the vacuum and purge system that this SDD was prepared for is not identified in the radioactive liquid release accident. Also, the SAR does not do a systematic review of the VPS failure. The SAR assumes systems are non-existent (or do not provide mitigation) so that an unmitigated dose can be calculated and then appropriate SSCs are identified to bring the dose to below guidelines for onsite and offsite doses. The SAR identifies that these SSCs must meet certain criteria and how the SSCs are built to meet the criteria to ensure that they can perform their intended safety function. But, the SAR does not identify system or component failure analysis. None of the other SSDs have a section on "System Design Analysis." Either delete this section from SNF-3062 or revise Section 8.1 to reference a correct failure analysis study.

<u>SNF-3075</u>
Section in this SDD does not always follow the same format as most of the other SDDs (SNF-3062, SNF-3063, etc.) Should the format be consistent, if not, why?

Description in Section 1.0, "Introduction," is more detailed than in Section 2.1 "General Description." Should this be the reverse, if not, why?

It is an interesting way of dividing Safety Function (Section 3.2) and Nonsafety Function (Section 3.3). Section 3.2 should reference the SAR (as long as the information is correctly summarized from the SAR). Section 3.3 could address all the other non-SAR items that the SDD may have to address.

SNF-3081
There is more system description (Section 1.1.2) and sometimes the exact description (Sections 1.1.3 and 1.1.5) in Section 1.0 as in Section 2.1 of the SDD. A summary system description should be in Section 1.0 with the more detailed description in Section 2.0.

Section 3.1.2 (and following sections) should specifically list by consistent nomenclature the system components that are safety class or safety significant as identified in the SAR. Identify these here since they need to be evaluated in this section (see comment on Section 3.0 for SNF-3062).

Crane SDD
There is very little description here, as a matter of fact you can find more description on the crane in the SAR than in the SDD. Add enough description so that this SDD is a stand-alone document.

GLOBAL COMMENTS FOR ALL SDDS

1. In general, Section 2.1 of all the SDDs has less descriptive information than the SAR (i.e., SCHe – SAR Section 2.5.4.2, VPS – SAR Section 2.5.3, etc.). SNF-3081 is better.

2. In general, Section 3.2.4 of all the SDDs has the same problem as noted in the comment above on SNF-3062. Provide a reference to the study or section of the SDD that evaluates the system SSCs and their ability to perform their safety function. (The SDD will not be able to provide a reference because no evaluation has been performed and/or documented yet. The evaluation is the responsibility of the SDD in Section 3.0 for not just NPH, but for the SAR design basis accidents. See previous comments on Section 3.0 of SNF-3062 above.)

3. Section 4.12.2 - As it currently reads it is not a true statement. Change the paragraph to read:

   4.12.2 Decontamination and Decommissioning

   A conceptual decontamination and decommissioning plan for the CVDF, as identified in the guidelines of DOE-STD-3009-94, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Safety Analysis Reports*, is scheduled for the final SAR.

   HNF-SD-SNF-SAR-002 (Rev 4/4a) states that this is scheduled for the FSAR. It is not in the Phase 2 SAR that is referenced in the SDDs.

COLD VACUUM DRYING FACILITY PROCESS WATER CONDITIONING SYSTEM DESIGN DESCRIPTION

SYSTEM 46-1

Numatec Hanford Corporation
Richland, Washington

COGEMA Engineering Corporation
Richland, Washington

This page intentionally left blank.

CONTENTS

CONTENTS (Continued)

CONTENTS (Continued)

LIST OF TERMS

CVDF	Cold Vacuum Drying Facility
HEPA	high-efficiency particulate air (filter)
IXM	ion exchange module
MCO	multi-canister overpack
MCS	monitoring and control system
PWC	process water conditioning (system)
SSC	structure, system, and component
TBD	to be determined

1.0 INTRODUCTION

This system design description addresses the process water conditioning (PWC) system to support the conditioning of process water removed from the (1) multi-canister overpacks (MCOs), (2) the vacuum and purge system condenser tanks, (3) tempered water system, and (4) MCO-Cask annulus. The discussion that follows is limited to the PWC system and its interfaces with other systems. Drawings H-1-82168, *Cold Vacuum Drying Facility Process Water Conditioning Piping Plan and Section*, and H-1-83766, *Cold Vacuum Drying Facility Process System P&ID*, depict the relationships of the different PWC subsystems and indicates the interfaces with other systems.

This system design description, in conjunction with other elements of the definitive design package, provides a complete picture of the cold vacuum drying system. Elements of this system design description include functions, requirements, and descriptions. Other documents comprising the definitive design of the PWC system include:

- Project design requirements (HNF-SD-SNF-DRD-002)
- Safety Analysis Report (HNF-SD-SNF-SAR-002)
- Safety equipment list (HNF-SD-SNF-SEL-002)
- Contract drawings (see Appendix A)
- Procurement specification (see Appendix A)
- Supporting Data and Calculation Database (SNF-3001)
- Sequence of operations (see HNF-2356).

1.1 SUMMARY DESCRIPTION OF EQUIPMENT

This system contains tanks, pumps, filters, and ion exchangers with associated piping, valves, instruments, and controllers that clean radioactive particulate matter and dissolved ions from liquid removed from the MCOs at the CVDF. A schematic of the PWC system is shown in Drawing H-1-83766, sheet 2.

1.2 ROLE OF SYSTEM IN PROCESS

The PWC system extracts contaminated water from the MCOs and other water streams from the CVDF and extracts spent nuclear fuel particles and dissolved radioactive ions that leach from the spent nuclear fuel. This conditioned liquid is then transported to the K West Basin integrated water treatment system process for final cleanup prior to disposition.

1.3 TECHNICAL RESPONSIBILITY OF SYSTEM DESIGN DESCRIPTION

The PWC system design authority is responsible for the accuracy and technical content of this system design description. Any questions regarding the system are to be resolved through the design authority.

This page intentionally left blank.

2.0 SYSTEM DEFINITION

2.1 GENERAL DESCRIPTION

One PWC system services all four CVDF processing bays. Contaminated process water removed from an MCO is directed through a drain line to a collection tank and filtration/ion exchange system of the PWC system. Once the process water has been purified to the point where it may be transported over road, the cleaned water is held in a storage tank for transfer by a tractor truck to the K West Basin integrated water treatment system. The process sequence is controlled by a programmable logic controller that is part of the overall cold vacuum drying facility monitoring and control system.

2.2 SYSTEM BOUNDARIES

The PWC system, with the exception of the ion exchange module (IXM) units and the 5000 gallon storage tank, PWC-TK-4001, is skid-mounted on a carbon steel framework 3.04 m (10 ft) wide, 1.22 m (4 ft) deep, and 3.81 m (12.5 ft) high located in the process water tank room. The IXMs are attached to the PWC system skid via flexible piping. There are two IXMs located in the process water tank room that are changed out periodically based on processing efficiency criteria.

2.3 SYSTEM INTERFACES

The PWC system has nine major interfaces within the CVDF.

2.3.1 Cold Vacuum Drying Facility Monitoring and Control System

The PWC system interfaces with the monitoring and control system (MCS). All instrumentation and controls wiring is per IEEE-577, *Standard Requirements for Reliability Analysis in the Design and Operation of Safety Systems for Nuclear Power Generating Stations*.

2.3.2 Cold Vacuum Drying Facility Electrical Supply System

The PWC system interfaces with the CVDF electrical system and power requirements are supplied through hard-wired connections with facility electrical as needed.

2.3.3 Process Water Tank Room

The PWC system interfaces with the CVDF building floor, the PWC system skid bolts to the floor of the process water tank room.

2.3.4 Cold Vacuum Drying Facility Process Ventilation

The PWC system interfaces with the CVDF general exhaust ventilation system. PWC-014-SS-1" is used to equalize pressure between receiving tanks PWC-TK-4033 and

PWC-TK-4032, and storage tank PWC-TK-4001. PWC-TK-4001 is vented to the tank room through a tank-mounted high-efficiency particulate air (HEPA) filter PWC-F-4043. The vent is in turn routed to the CVDF general exhaust system (H-1-83769).

2.3.5 Cold Vacuum Drying Facility Instrument Air System

The PWC system interfaces with the CVDF instrument air system. Instrument air is supplied through line IA-001-SS-½" to the gas-operated valves on the PWC system. These valves include PWC-GOV-4039, PWC-GOV-4045, PWC-GOV-4046, PWC-GOV-4047, and DI-GOV-4057 and the three samplers. Instrument air is also provided from line IA-001-SS-½" via line DI-014-SS-1 ½" to valve PWC-V-007 to enable instrument air purging of line PWC-006-SS-1½" (IXM Supply line) as needed.

2.3.6 Cold Vacuum Drying Facility Deionized Water Supply

The PWC system interfaces with the CVDF deionized water supply header DI-001-SS-1" in the process water tank room. Deionized water is supplied through line DI-004-SS-½" to flush tanks PWC-TK-4032 and PWC-TK-4033, to flush the PWC vent line PWC-014-SS-1½" via line DI-013-SS-½" to tank PWC-TK-4001, and finally to flush the PWC process lines on the PWC skid via line DI-014-SS-½" to tank PWC-TK-4033 or to tank PWC-TK-4001. DI water is also supplied to spray nozzles inside PWC tank PWC-TK-4001 via line DI-005-SS-½" and to the tanker truck transfer lines PWC-016-SS-2" and PWC-017-SS-1½" via line DI-006-SS-½".

2.3.7 Cold Vacuum Drying Process Water Drains

The PWC system interfaces with the MCO process water drain, the vacuum and purge system condensate drain, the tempered water system drain and the MCO-Cask annulus drain. Line PWC-001-SS-1" provides the drain path for the MCO bulk water removal step of the cold vacuum drying process. Line PWC-*02-SS-1" provides the drain path of condensate collected in tank VPS-TK-2*16 to line PWC-*03-SS-1" which leads to the PWC system. Line PWC-*03-SS-1" and PWC-*04-SS-1", provides the drain path for the tempered water system. Line PWC-*03-SS-1" provides the drain path for the MCO-Cask annulus drain.

2.3.8 Conditioned Water Transfer to the Tractor Trailer

The conditioned process water is pumped from the PWC system holding tank, PWC-TK-4001 through line PWC-016-SS-2" and PWC-017-SS-1 1/2" using PWC-P-4001 to the tractor trailer staged in process bay 1 for subsequent transfer to K West Basin.

2.3.9 Contaminated Water Sampling System

The PWC system interfaces with the contaminated water sampling system at lines PWC-006-SS-1½", PWC-008-SS-1½", and PWC-011-SS-1½". One sampler is installed in each line to obtain process water samples prior to and following the ion exchange column PWC-IXM-4037 or PWC-IXM-4038 and following the PWC filter PWC-F-4042. The samplers are PWC-SMP-4039, PWC-SMP-4040, and PWC-SMP-4041, listed respectively to line designation numbers in order of increasing number.

3.0 SYSTEM FUNCTION

3.1 SYSTEM CLASSIFICATION

The PWC system components are categorically designated as safety class, safety significant, and general service. The piping and valves that are safety class include PWC-*01-SS-1" from the MCO connection up to and including PWC-GOV-1*30 and PWC-GOV-1*03. This line has a safety-class isolation function. The PWC components designated as safety class are tanks PWC-TK-4032 and PWC-TK-4033, ion exchange modules PWC-IXM-4037 and PWC-IXM-4038, and process filter PWC-F-4042. The safety class classification for the above tanks, IXMs and filter is for criticality control which is achieved by geometry controls. The safety class components at the MCO are designed and qualified for performance category 3. The safety class components at the PWC skid are designed and qualified for performance category 2. Performance categories are as defined in DOE-STD-1020-94, *Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities*.

The PWC system components designated safety significant are the section of the MCO drain line from valve GOV-1*03 to and including the PWC system header PWC-001-SS-1", a portion of the cask drain line PWC-*03-SS-1", pipe supports for the process bay piping, support structure for safety class and safety significant components, process check valves PWC-CKV-002, PWC-CKV-003, PWC-CKV-004, PWC-CKV-005, PWC-CKV-*030, PWC-CKV-*058, and ball valve PWC-V-001. These safety significant components are designed and qualified for performance category 2.

All other PWC system components are designated to be in the general service category.

3.2 CVDF SAR SAFETY FUNCTIONS

The CVDF SAR, HNF-SD-SNF-SAR-002, defines the safety functions for the PWC system. These functions are defined in Section 4.3.5.1 of the CVDF SAR and are summarized as follows.

1. Provide the safety-class function of isolation of the MCO from the PWC upon SCIC system actuation of the VPS isolation valves.

2. Perform the above functions to prevent or mitigate the safety-significant consequences of the MCO gaseous release, MCO internal hydrogen explosion or external to MCO hydrogen explosion.

3. Provide additional water isolation of the MCO from potential water ingress sources during and after the proof of dryness operation.

The PWC system provides primary confinement of contaminated process water and criticality control. Geometry and double contingency are used for safety class components to provide criticality control. Designations are as required by HNF-SD-SNF-SAR-002, *Safety Analysis Report for the Cold Vacuum Drying Facility, Phase 2, Supporting Installation of Processing Systems*.

3.2.1 Tanks PWC-TK-4032 and PWC-TK-4033

Tanks PWC-TK-4032 and PWC-TK-4033 are designated safety class for criticality control. Geometry is used for these safety class components to provide criticality control.

3.2.2 Ion Exchange Modules PWC-IXM-4037 and PWC-IXM-4038

The ion exchange columns PWC-IXM-4037 and PWC-IXM-4038 are designated safety class to prevent accumulation of fuel fissile material to critical levels. Geometry is used for these safety class components to provide criticality control.

3.2.3 Filter PWC-F-4042

Filter PWC-F-4042 is designated safety class for criticality control. Geometry is used for this safety class component to provide criticality control.

3.2.4 Isolation Valves GOV-1*30 and GOV*03 on Line PWC-*01-SS-1"

The isolation valves GOV-1*30 and GOV-1*03 on line PWC-*01-SS-1" are designated safety class for the safety class MCO isolation function and to prevent a hydrogen explosion in the system.

3.2.5 Flex Hose and Line Section

The flex hose connecting line PWC-*01-SS-1" to the MCO and the section of line PWC-*01-SS-1" from the MCO to Valve PWC-GOV-1*03 are designated safety class for the safety class MCO isolation function and to prevent a hydrogen explosion in the system.

3.2.6 Process Water Conditioning System Piping and Valves

The section of MCO drain line from valve PWC-GOV-1*03 to and including the PWC system header PWC-001-SS-1" and the cask drain line PWC-*03-SS-1" are designated safety significant because they provide confinement of radioactive liquid and seismic 3/1 protection for adjacent safety class and safety significant structures, systems, and components (SSCs). The process check valves PWC-CKV-002, PWC-CKV-003, PWC-CKV-004, PWC-CKV-005, PWC-CKV-*030, PWC-CKV-*058, and ball valve PWC-V-001 are designated safety significant because they provide confinement of radioactivity and seismic 3/1 protection for adjacent safety class and safety significant SSCs.

3.2.7 Support Structure

The support structure for the PWC system is designated safety significant and all structural components and equipment anchorage are performance category 2 (DOE-STD-1021-92) qualified.

3.2.8 Instrumentation and Controls

The instrumentation and controls for the PWC system are designated general service. All instrumentation and controls are performance category 1.

3.3 Non-SAR SAFETY FUNCTIONS

3.3.1 Radiation Protection

The following list of radiation protection features has been considered and incorporated into the design of the PWC as appropriate to meet as low as reasonably achievable (ALARA) exposure requirements and design guidelines.

Engineering Controls. Engineering controls considered to achieve ALARA goals include the following.

1. Confinement systems, such as process piping, vessels, and structural enclosures.
2. Ventilation systems that ensure negative pressure and flow toward the areas with highest contamination risk.
3. Compartmentalization to isolate higher risk areas.
4. Equipment location and arrangement so that servicing and replacement can be accomplished away from high-risk areas.
5. Waste treatment and handling systems to minimize releases.
6. Inclusion of decontamination features.
7. Automation of the process so that operators need not be present in the radiation field in order to operate the process.
8. Arrangement designed so as to maximize the distance between operators and sources.
9. Traps where radioactive material can accumulate in the systems minimized and provisions included for periodic decontamination of the process system.
10. Local shielding, including piping and vessel materials, to minimize source terms.
11. Communication and observation systems to monitor operators when in the radiation field.

Maintenance Features. The following maintenance features were considered to reduce exposure of personnel.

1. Use of modular construction to expedite replacement.

2. Decontamination of equipment or piping prior to replacement or maintenance; equipment and piping selection basis included ease of decontamination.

3. High or enhanced system performance to reduce maintenance requirements.

4. Selection of components that do not require lubrication or regular service.

3.3.2 Natural Phenomena Hazard Mitigation (Seismic)

The PWC piping support structure (Process Hood Support Stand) and attachments are performance category 3. The PWC skid and attachments are performance category 2. All general services PWC structures, systems, and components (SSCs) have been evaluated for their potential to prevent safety class SSCs from performing their functions.

3.3.3 Worker Safety Hazards Protection

The PWC design has been evaluated against and complies with the required codes, standards, and regulations for industrial safety and hygiene.

3.4 ENVIRONMENTAL FUNCTION

The PWC system provides essential support to environmental SSCs by providing safety class/safety significant confinement of the radioactive effluents. All safety class/safety significant components are designed to function under worst case internal and external environmental conditions. The majority PWC system is seismically-qualified for performance category 2 and is not required to function after a design basis seismic event. The portion of the PWC system from the MCO to PWC-GOV-1*03 is seismically-qualified for performance category 3 and is required to function (isolate) after a design basis seismic event. The PWC system is protected from high winds and tornadoes by the structure of the CVDF. Flooding, lightning, and snow load protections are provided by the placement and design of the CVDF.

4.0 SYSTEM REQUIREMENTS

4.1 OPERATIONAL AND FUNCTIONAL REQUIREMENTS AND BASIS FOR REQUIREMENTS

4.1.1 Pumping and Filtration

The PWC shall be required to provide pumping and filtration capability for all process liquids generated during vacuum drying of the MCO. These liquids will primarily include bulk water drained from the MCO, water collected in the vacuum drying equipment, any contaminated water from the process bay floor drains and any contaminated tempered water used by the TWS to heat and cool the MCO.

Basis: The PWC system provides the only processing capability in the CVDF. Therefore, it is sized for, and capable of, handling all of the potential contaminated water streams associated with the CVDF.

4.1.2 Process Water Conditioning Capacity

The PWC shall provide capacity for liquid generated by the vacuum drying of one MCO. The inlet line to the PWC receiving tank shall be equipped with a flow meter and totalizer to track the volume of liquid that is pumped to the PWC.

Basis: With a single PWC system servicing all four process bays and the PWC system being essentially a batch process the logical batch size for practical and economic reasons is one MCO worth of effluent. The PWC inlet totalization is needed to track effluent into the PWC system receiver tanks to mitigate overflow situations.

4.1.3 Process Water Conditioning Liquid Flow Control

Air-operated, computer-controlled valves shall control flow of liquid within the PWC system.

Basis: Gas-operated/computer-controlled valves represent the most effective, error-free, reliable method of flow control.

4.1.4 Tank Overflow Control

An interlock shall be provided to prevent overfilling of the storage or transfer tanks.

Basis: Spillage of effluent from the storage or transfer tanks is a high-contamination consequence event with an easily preventable scenario. An interlock provides a reliable mitigating feature for such an event.

4.1.5 Tank Venting

The PWC tank shall be vented through a HEPA filter to the facility HVAC exhaust.

Basis: The tank vent path represents one of the several relatively open pathways out of zone 1 confinement. A HEPA filter on the storage tank vent mitigates releases along that pathway.

4.1.6 Liquid Control

The PWC shall be required to interface with the CVDF MCS to allow for computer control of liquid handling to and from the PWC.

Basis: For process control and reliability, computer-operated sequences offer the highest degree of certainty of safe operation.

4.1.7 Criticality Control

There are no safety class criticality instrumentation and control requirements. All criticality control is accomplished by design geometry control of the receiver tanks, IXMs, and filter in accordance with HNF-SD-SNF-CSER-006. The inside diameter of all subject tanks shall be verified to be less than 0.6 m (23.5 inches) to achieve passive criticality control. There are no active design features for criticality control.

Basis: A passive criticality control system based on geometry is more reliable and thus safer than an active system based on instrumentation and controls.

4.1.8 Process Water Impurity Removal Requirements

The PWC system shall clean the process water to the following levels prior to shipment to the KW IWTS; 1) Particulate shall be less than 20 microns, 2) Cs-137 shall be less than 15 microcurie/liter, 3) Sr-90 shall be less than 15 microcurie/liter, and 4) total soluble alpha shall not be greater than 1 microcurie/liter.

Basis: The impurity removal requirements are based upon processing requirements for the KW-IWTS as defined in Interface Control agreement IC number 012.

4.2 CIVIL/STRUCTURAL REQUIREMENTS

The PWC piping, valves, and support structures required to perform the safety class primary isolation functions are designed and qualified for performance category 3 as defined in DOE-STD-1020-94.

All PWC tanks, valves, components, instrumentation and controls, and support structures required to perform the safety significant primary confinement functions are designed and qualified for performance category 2 as defined in DOE-STD-1020-94.

4.3 MECHANICAL REQUIREMENTS

4.3.1 Tanks PWC-TK-4032 and PWC-TK-4033

Tanks PWC-TK-4032 and PWC-TK-4033 are designated safety class for criticality. To meet the safety class requirements the tanks are designed and tested to the following standards:

- *Boiler and Pressure Vessel Code* (ASME 1996), Section VIII

4.3.2 Tank PWC-TK-4001

Tank PWC-TK-4001 is designated general service and is designed and tested to the following standards:

- ANSI/AWWA D100, *Welded Steel Tanks for Water Storage.*

4.3.3 Filter PWC-F-4042

Filter PWC-F-4042 is designated safety class for criticality. To meet the safety class requirements, this filter is designed and tested to the following standards:

- *Boiler and Pressure Vessel Code* (ASME 1996), Section VIII

4.3.4 Piping and Valves

All safety-class PWC process equipment piping and valves are designed and fabricated per ANSI/ASME B31.1, *Power Piping Code*.

All safety significant and general service PWC process equipment piping and valves are designed and fabricated per ANSI/ASME B31.3, *Process Piping Code*, and ANSI/ASME B16 Standards series, *Fittings, Flanges, and Valves.*

4.3.5 Ion Exchange Columns

Ion exchange columns PWC-IXM-4037 and PWC-IXM-4038 are designated safety class for criticality. To meet the safety class requirements, these ion exchangers are designed and tested to *Boiler and Pressure Vessel Code* (ASME 1996), Section VIII, standards.

4.3.6 Pumps PWC-P-4035, PWC-P-4036, and PWC-P-4001

Pumps PWC-P-4035, PWC-P-4036, and PWC-P-001 are designated general service. To meet the general service requirements, the pumps are designed and tested to the following standards:

A. ANSI/ASME B73.1M, *Specification for Horizontal End Section Centrifugal Pumps for Chemical Process*, and ANSI/ASME B73.2M, *Specification for Horizontal In-Line Centrifugal Pumps for Chemical Process*

B. Hydraulic Institute 1.6.

4.4 MATERIALS REQUIREMENTS

The materials of construction for the various SSCs meet the following requirements as defined by the procurement specification.

4.4.1 American Society for Testing and Materials

- A36, *Standard Specification for Structural Steel*
- A240, *Standard Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels*
- A269, *Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service*
- A276, *Standard Specification for Stainless and Heat-Resisting Steel Bars and Shapes*
- A312, *Standard Specification for Seamless and Welded Austenitic Stainless Steel Pipes*
- A354, *Standard Specification for Quenched and Tempered Alloy Steel Bolts, Studs and other Externally Threaded Fasteners*
- A479, *Standard Specification for Stainless and Heat-Resisting Steel Bars and Shapes for Use in Boilers and other Pressure Vessels*
- A480, *Standard Specification for General Requirements for Flat-Rolled Stainless Heat-Resisting Steel Plate, Sheet, and Strip*
- A500, *Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes*
- A563, *Standard Specification for Carbon and Alloy Steel Nuts*
- F593, *Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs*
- F594, *Standard Specification for Stainless Steel Nuts*

4.5 INSTRUMENTATION AND CONTROLS

The PWC system interfaces with the MCS and provides computer control of the liquid flows to, within, and from the PWC system.

All instrumentation and controls power is nonsafety supplied by the facility uninterruptible power supply. Isolation from power transients and failures is provided such that safety functions are accomplished under power loss or transient conditions.

4.5.1 Transmitters

Local electronic transmitters for remote (and local) indication are provided whenever feasible.

4.5.2 Local Control Stations

Local control stations (hand-off-auto) for major electrical components are provided. The MCS is notified when equipment is taken out of "auto."

4.5.3 Engineering Units

Engineering units are used. Instrumentation ranges cover both the expected normal range as well as upset and emergency conditions.

4.5.4 Instrumentation and Controls Equipment

Instrumentation and controls equipment is standardized.

4.5.5 Emergency "Off" Buttons

Emergency "off" buttons are installed where required based on the impact to personnel and equipment.

4.6 RELIABILITY REQUIREMENTS

The actual life of the project is scheduled to be two years and the design life is scheduled for five years. Adequate spare parts per the maintenance manuals are on hand to handle any downtime situation in a timely manner.

4.7 ENVIRONMENTAL REQUIREMENTS

All safety class components are designed to function under worst case internal and external environmental conditions. The PWC system is seismically-qualified for performance category 3 and functions before and after a seismic event. It is protected from high winds and tornadoes by the structure of the CVDF. Flooding, lightning, and snow load protections are provided by the placement and design of the CVDF.

4.8 INTERFACING SYSTEMS REQUIREMENTS

4.8.1 Instrumentation and Controls Wiring

All PWC system instrumentation and controls wiring to the MCS is installed per IEEE-577 to meet safety significant requirements for safety significant SSC.

4.8.2 Cold Vacuum Drying Facility Electrical System

All PWC system interfaces with the CVDF electrical system are provided through hard-wired connections with facility single-phase, 120 V (ac) electrical, as needed. All wiring is per ANSI/NFPA 70, *National Electrical Code.*

4.8.3 Cold Vacuum Drying Facility Instrument Air

The cold vacuum drying instrument air system via line IA-001-SS-½" is able to supply 620 kPa gauge (90 lb/in^2 gauge) instrument air for the gas-operated valves on the PWC system.

4.9 OPERABILITY

Technical safety requirements will be included when they are fully developed.

4.10 TESTABILITY AND PERIODIC TESTING

The PWC system has sufficient testability designed into it to permit the periodic measurement and calibration of all setpoints and adjustments that affect the manner in which the PWC performs. Periodic testing of PWC SSCs is dictated by the requirements of the individual components according to the respective manufacturer's recommended schedule and practice and as administered by controlled procedures for all safety class and safety significant SSCs.

4.11 OPERATOR ACTIONS AND HUMAN FACTORS

The majority of PWC system operation is controlled automatically by the MCS. Certain manual operations are performed periodically such as sucking-up spills and extra sample bottle volume. Coordination between the control room and the field operator for these manual operations is practiced.

Changing out of IXMs and the filter requires manual operation. These operations are specified by controlled operating procedures.

4.12 SPECIAL CONSIDERATIONS

All aspects of the PWC system are in compliance with the *Hanford Federal Facility Agreement and Consent Order* (Ecology 1994), commonly referred to as the Tri-Party Agreement, and applicable federal, state, and local laws and American Indian treaty rights.

4.13 QUALITY ASSURANCE

The PWC system fabrication quality assurance/control program is based on the safety classification of the SSCs as detailed in the Safety Equipment List (HNF-SD-SNF-SEL-002) and application of a graded approach as described in the Project Hanford Quality Assurance Program Description (HNF-MP-599).

4.14 REQUIRED CODES AND STANDARDS

The PWC system is constructed in strict accordance with the following material and fabrication standards.

4.14.1 Code of Federal Regulations (CFR)

- 10 CFR 830.120, "Quality Assurance"
- 29 CFR 1910.120, "Occupational Safety and Health Standards."

4.14.2 American Society of Mechanical Engineers (ASME)

- B16.5, *Pipe Flanges and Flanged Fittings* (ANSI-approved)
- B31.1, *Power Piping Code* (ANSI-approved)
- B31.3, *Process Piping Code* (ANSI-approved)
- *Boiler and Pressure Vessel Code*

Section II, Part C	"Material Specifications, Welding Rods, Electrodes, and Filler Metals"
Section VIII, Division I	"Rules for Construction of Pressure Vessels"
Section IX	"Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators"

- NQA-1, *Quality Assurance Requirements for Nuclear Facilities Applications*

4.14.3 American Society of Nondestructive Testing (ASNT)

- SNT-TC-1A, *Recommended Practice*

This page intentionally left blank.

5.0 SYSTEM DESCRIPTION

5.1 GENERAL SUMMARY

The PWC system serves two purposes: to serve as a vacuum pump and receiver for MCO and cask waters, and to condition the MCO waters by removing radioactive particulates and soluble species using filtration and ion exchange. The PWC is designed to service one MCO at a time so priority determination and scheduling is important.

5.1.1 Process Water Conditioning Vacuum Pumping and Receiving

The PWC system, is powered by two (one running and one spare) canned motor pumps (PWC-P-4035,6) capable of pumping 0.00284 m^3/s (45 gal/min) against a back pressure of 463 kPa (155 ft of water). The pumps are either manually started or remotely started using a hand-off-auto switch. The pump discharge can be directed into two streams. Approximately 0.00284 m^3/s (45 gal/min) is recycled into receiver tanks PWC-TK-4032 and PWC-TK-4033 through water jet pump PWC-EJR-4031. The recycle flow serves as the motive force to pull at least 0.000315 m^3/s (5 gal/min) of liquid from the MCO during the MCO bulk water removal and at least 0.00236 m^3_{STP}/s (5 ft^3_{STP}/minute) helium during the MCO drain line flush. The same flow, 0.00284 m^3/s (45 gal/min), can also be routed through the IXM system for treatment and either recycled to receiver tanks PWC-TK-4032 and PWC-TK-4033 or sent to the PWC holding tank PWC-TK-4001.

Operation of the PWC system vacuum pumping and receiving include control and monitoring of the pump operation, flow loop performance, receiver tank conditions, and the suction line performance. Monitoring the pump operation is done by tracking the pump status on the MCS. If a trip is detected, the PWC system is considered not ready for continued operation, *PWC Not Ready*. Operator intervention is probably required to change pumps.

Flow loop performance is a less direct way of monitoring the pump operation. FI-4037 and PI-4038 are used to determine if adequate flow and pressure are being maintained. If less than 0.00158 m^3/s (25 gal/min) or 276 kPa gauge (40 lb/in^2 gauge) are being achieved, the PWC system is considered incapable of continued operation, *PWC Not Ready*.

Receiver tank condition measurements are used to determine if the PWC system is ready to receive additional MCO water. If a new MCO is ready to discharge water, the PWC system receiver tanks must be emptied to the lower level as measured by LAL-4034 and 10% LI-4033. Both of these meters must be active in order for the system to be considered. If LAL-4034 alarms on low level outside the 10% $\pm$ 0.7% range of LI-4033, the PWC system requires operator attention, *PWC Not Ready*. The receiver tanks are emptied by routing water through the filter/ion-exchange section (described below) and to holding tank PWC-TK-4001. Emptying is required to avoid the possibility of over-flowing the tanks and to check calibration of LI-4033. The receiver tanks have a total capacity of 0.893 m^3 (236 gal) between level probes LAL-4034 and LAH-4032 and the range of LI-4033. If during operations either LAH-4032 or 95% LI-4033 occur, the PWC is considered not ready, *PWC Not Ready*.

Suction line performance is used to determine initial startup conditions and to monitor line operation. For initial startup before any MCO emptying, process module tempered water tank level adjustment, process module condenser tank emptying, MCO/cask draining, or various line flushing, the process water suction line should be demonstrating adequate vacuum (PI-4031 < 5 lbf/in^2 gauge). If the MCS is not performing a PWC system operation and these conditions are not met, *PWC Not Ready*. Once the PWC system ready permissive is received and flow has started, the MCS monitors for breakthrough (defined as the transition from liquid flow to gas flow) by looking for a sudden pressure rise in PI-4031. The MCS is programmed to sense this change and proceed with the next processing step as defined in the operational sequences.

5.1.2 Process Water Conditioning Impurity Removal

The PWC impurity removal section consists of a flow branch for feeding 0.00284 m^3/s (45 gal/min) of process water through two IXMs. Automatic sampling is done before, between, and after the IXMs. Process water can be either directed to the shipping tank or returned to the receiver tanks.

Control of process water to the IXMs is through FE-4037 controlled by PWC-GOV-4039 at a nominal rate of 0.00284 m^3/s (45 gal/min). Normally, flow is continuously fed through the IXMs. If flow is not required, the operators can specify that PWC-GOV-4039 be placed in receiver tank recycle mode. Whenever flow is registered through FI-4037, the three samplers can be directed to take samples. The MCS controls the sample taking to one 1.0×10^{-5} m^3 (10 cm^3) sample for every 0.378 m^3 (100 gal) fed. The MCS sends a momentary sample initiation signal to the samplers (PWC-SMP-4039, PWC-SMP-4040, and PWC-SMP-4041). High differential pressure alarms PDAH-4040 alarm when the IXMs are beginning to plug (operating experience determines what differential pressure to set).

After the process water has passed through the IXMs, the treated water can be returned to the receiver tanks for recirculation through the PWC system process again. Recycling through the receiver tanks provides more effective impurity removal. PWC-GOV-4047 must be positioned to the PWC-008-SS-1½" branch for recycle by the MCS (either operator command or automatically when the level in the receiver tanks reaches LAL-4034). When there is a demand for a receiver tank level decrease, PWC-GOV-4047 is positioned to the PW-009-SS-1½" branch to force the treated process water stream into the holding tank, PWC-TK-4001. This operation can be accomplished by operator command or automatically when a new MCO requires draining. The valve can also be placed in a closed position for maintenance, if required.

Certain manual operations, such as sucking-up spills and extra sample bottle volume can be performed periodically as needed. The coordination between the control room and the field operator for these manual operations is practiced.

5.2 PIPING AND INSTRUMENTATION DIAGRAM AND FLOW DIAGRAM

The PWC system piping and instrumentation diagram is shown in Drawing H-1-83766, sheet 2.

5.3 SYSTEM ARRANGEMENT/CONFIGURATION

There is one PWC system that services the four process bays and it contains the following subsystems:

- Deionized water (DI)
- Instrument air (IA)
- Process vent (PV).
- Monitoring and Control (MCS).

Components, piping, instruments, and electrical wiring are mounted on a platform and frame designated as a skid. The PWC system is configured in Drawing H-1-83766, sheet 2.

5.3.1 Process Water Pumping

Process water from a cask-MCO is transferred into the receiving tank.

A. Process water from a MCO is transferred with the PWC-EJR-4031 ejector through the process bay line PWC-*01-SS-1" to the receiving tank PWC-TK-4032 via header line PWC-001-SS-1". Isolation valves GOV-1*30 and GOV-1*03 are in this line to allow isolation of the MCO in the event of a SCIC isolation command.

B. Prior to the intersection of PWC-001-SS-1" and ejector PWC-EJR-4031, pressure indicator PI-4031 and associated control elements measure line pressure.

C. Line PWC-015-SS-1 1/2" joins PWC-001-SS-1" at water jet pump PWC-EJR-4031. PWC-015-SS-1 1/2" provides the driving force for PWC-EJR-4031 creating suction in PWC-001-SS-1".

D. The outlet of PWC-EJR-4031 connects to the top of receiver tank PWC-TK-4032.

   (1) DI-004-SS-½" provides a source of deionized water for washdown to PWC-TK-4032 and receiver tank PWC-TK-4033 (below). Pressure control valve DI-PCV-4042 provides line pressure control prior to any of the branching described below. Valve DI-GOV-4057 provides remote control of DI-004-SS-½" into the tanks. Within each tank, DI-004-SS-½" terminates in a spray nozzle.

      (a) DI-014-SS-½" branches off of DI-004-SS-½" prior to DI-GOV-4057 and connects to line PWC-006-SS-1½" (described below) as a washdown source. Valve DI-V-007 controls flow in DI-014-SS-½".

      (b) DI-013-SS-½" branches off of DI-004-SS-½" prior to DI-014-SS-½" and connects to vent PWC-014-SS-1" (described below) as a washdown source. Valve DI-V-031 controls flow in DI-013-SS-½".

      (c) Rotometer FI-4049 controls flow and check valve DI-CKV-035 controls flow direction in DI-004-SS-½" prior to the branches.

E. The outlet of PWC-TK-4032 connects to PWC-TK-4033 near the outlet of PWC-TK-4033. Equalization line PWC-013-SS-2" connects the two tanks at the top providing pressure relief between the tanks and vent PWC-014-SS-1" vents the headspace of PWC-TK-4033 to the headspace of facility holding tank PWC-TK-4001. The level of PWC-TK-4033 is monitored in three locations.

   (1) Level switch high LSH-4032 and associated control elements give an overfill warning 13.5" from the top of the tanks.

   (2) Level switch low LSL-4034 and associated control elements give an empty warning 5.5 in. above the weld between the cylindrical and conical sections at the bottom of PWC-TK-4033.

   (3) Level element LE-4033 and associated control elements measure the tank levels.

F. Line PWC-002-SS-2" connects the outlet of PWC-TK-4033 to the inlet of valve PWC-GOV-4045.

   (1) A test port branches off of this section of piping controlled by valve PWC-V-044.

G. PWC-GOV-4045 and associated control elements control flow into parallel circulation pumps PWC-P-4035 and PWC-P-4036. PWC-003-SS-1½" connects PWC-GOV-4045 to PWC-P-4035, while PWC-004-SS-1½" connects PWC-GOV-4045 to PWC-P-4036. Each line necks down to 1.0 in. prior to the inlet of the pumps.

H. The outlet of the pumps meet at and are controlled by valve PWC-GOV-4046 and associated control elements. Each line expands from 0.75 in. to 1.5 in. after exiting the pumps.

I. Line PWC-005-SS-1" connects the outlet of PWC-GOV-4046 to the ejector PWC-EJR-4031 or IXM branch point.

   (1) Flow meter FE-4037 and associated control elements measure flow in PWC-005-SS-1"

   (2) Pressure gauge PWC-PI-4038 and temperature gauge PWC-TI-4044 with their associated control elements measure the line temperature and pressure. PWC-PI-4038 is off of a short branch line and is controlled by valve PWC-V-006.

   (3) PWC-006-SS-1½" branches off of PWC-005-SS-1" after the outlet of PWC-GOV-4046 the sampling station PWC-SMP-4039 and the three way branch valve PWC-V-4039. Automatic sampler PWC-SMP-4039 takes effluent samples from PWC-006-SS-1½" prior to connection to PWC-GOV-4039. The MCS initiates sampling sequences. Automatic sampler PWC-SMP-4039 provides for the determination of the composition of the water in the receiver tanks, which is the source input for the IXMs.

(4) PWC-015-SS-1½" branches from PWC-GOV-4039 and connects to the inlet of PWC-EJR-4031. PWC-007-SS-1½" is the other branches from PWC-GOV-4039 and connects to the inlet of PWC-IXM-4037 or -4038.

(5) At the connection between PWC-005-SS-1½" and PWC-006-SS-1½", DI-014-SS-½" and instrument air line IA-001-SS-½" connect to PWC-006-SS-1½". Deionized water and IA flow into PWC-006-SS-1½" is controlled by valve DI-V-007. Air flow into DI-014-SS-½" is controlled by valve DI-V-008.

(a) Flow in IA-001-SS-½" is measured by rotometer IA-FI-4048 and flow direction is controlled by check valve IA-CKV-034.

J. PWC-007-SS-1½" runs from its branch with PWC-GOV-4039 through sampler PWC-SMP-4039 and ion exchange module, PWC-IXM-4037/-4038 to connect into line PWC-008-SS-1½" up to control valve PWC-GOV-4047.

(1) Flow in PWC-007-SS-1½" and PWC-008-SS-1½"is monitored and controlled after the branch from PWC-006-SS-1½" by flow meter PWC-FE-4037 in series with flow control valve PWC-GOV-4039.

(2) PWC-007-SS-1½" connects to PWC-IXM-4037/-4038 with a flexible pipe.

(3) The outlet of PWC-IXM-40327/-4038 makes a flexible pipe connection to PWC-008-SS-1½". Pressure differential between PWC-007-SS-1½" and PWC-008-SS-1½" is monitored by pressure differential indicator PWC-PDISH-4040 and associated control elements.

(4) Automatic sampler PWC-SMP-4040 installed in line PWC-008-SS-1½" takes effluent samples from PWC-IXM-4037/-4038. The MCS initiates sampling sequences. Automatic sampler PWC-SMP-4040 provides for the determination of the composition of the retained material in PWC-IXM-40327/-4038, which is the source input for the PWC-F-4042.

(5) Pressure is monitored in PWC-008-SS-1½" by pressure indicator PI-4054 after the sampler and IXMs. Valve PWC-V-004 is the instrument root valve for PI-4054.

(6) Sequence controlled valve GOV-4047 (fail-open to PWC-008-SS-1½" and fail-closed to Line PWC-009-SS-1½") and mediates flow between PWC-008-SS-1½" and PWC-009-SS-1½". The outlet of GOV-4047 connects to PWC-008-SS-1½"which then connects to PWC-TK-4033. PWC-009-SS-1½" runs to PWC-F-4042 and TK-4001 (described below).

K. PWC-009-SS-1½" runs from PWC-GOV-4047 to safety class filter PWC-F-4042.

(1) PWC-FCV-4058 is contained in PWC-009-SS-1½" and throttles flow to the inlet of PWC-F-4042. Flow is set to 10 gpm for filter performance considerations.

(2) PWC-010-SS-1" branches from PWC-009-SS-1½" and connects to PWC-008-SS-1½". Valve PWC-V-015 (normally open) and check valve PWC-V-014 control flow and flow direction in PWC-010-SS-1".

(3) Line PWC-020-SS-1" connects to PWC-008-SS-1½" in this section providing pressure relief for PWC-009-SS-1½" through PWC-SRV-4059. The SRV is set at 50 psig to prevent exceeding filter media pressure limitations.

L. PWC-F-4042 provides final filtration of the process water prior to PWC-TK-4001. PWC-PDI-4043 provides filter delta pressure indication.

M. PWC-011-SS-1½" connects between PWC-F-4042 and PWC-TK-4001.

(1) Pressure differential between PWC-009-SS-1½" and PWC-011-SS-1½" is monitored by pressure differential indicator PWC-PDISH-4043 and associated control elements.

(2) Line DI-012-SS-½" joins PWC-011-SS-1½" and provides a source of deionized water for washdown.

(a) Valve DI-V-016 and check valve DI-CKV-017 provide flow and flow direction control in DI-012-SS-½".

(b) DI-012-SS-½" branches from DI-004-SS-½" prior to flow control described above.

(3) Valve PWC-V-019 controls flow in PWC-011-SS-1½" after the intersection with DI-012-SS-½".

(4) Automatic sampler PWC-SMP-4041 installed in line PWC-011-SS-1½" takes effluent samples from PWC-F-4042. The MCS initiates sampling sequences. Automatic sampler PWC-SMP-4041 provides for the determination of the composition of the retained material in PWC-F-4042, which is the source input for the PWC storage tank PWC-TK-4001.

(4) A test port on PWC-011-SS-1½" branches off after PWC-SMP-4042. Valve PWC-V-013 controls the test port.

(5) PWC-011-SS-1½" exits the PWC skid at this point on the way to PWC-TK-4001, PWC-011-SS-1½" expands to PWC-011-SS-2"and connects to PWC-TK-4001, flow is controlled by PWC-V-002.

N. Line PWC-016-SS-2" exits the storage tank PWC-TK-4001 and connects to loadout pump PWC-P-4001. Line PWC-016-SS-2" is isolated by PWC-V-003 and PWC-V-016, this line also has a drip leg and a DI water washout connection, DI-006-SS-½". Line PWC-017-SS-1½" exits the loadout pump PWC-P-4001. Line PWC-017-SS-1½" is isolated by PWC-V-008, PWC-V-017 and PWC-QD-045. Flow control is maintained by PWC-CKV-010.

M. Line PWC-018-SS-1" connects line PWC-017-SS-1½" and line PWC-011-SS-2" to allow mixing of the contents within PWC-TK-4001 for sampling or washout. PWC-018-SS-1" contains check valve PWC-CKV-009 and isolation valve PWC-V-011. A sample/drain connection is also provided with isolation valve PWC-V-012. The sample connection can also be utilized for transferring process water back through the IXMs if required. A special jumper assembly connecting valve PWC-V-012 with PWC-V-009 or DI-V-032 is provided for this purpose.

O. Line PWC-012-SS-½" joins PWC-001-SS-1". Valve PWC-V-036 and check valve PWC-CKV-018 control flow and flow direction in PWC-012-SS-½". PWC-012-SS-½" is a suction wand for spill clean-up.

5.4 EXPLANATION OF HOW THE SYSTEM MEETS DESIGN REQUIREMENTS

From HNF-SD-SNF-DRD-002, *Cold Vacuum Drying Facility Design Requirements*, the following design requirements for the PWC system have been defined. The following is a listing of each requirement and how that requirement is met.

5.4.1 Pumping and Filtration

The PWC has pumping and filtration capability for all process liquids generated during vacuum drying of the MCO. These liquids primarily include bulk water drained from the MCO and tempered water used by the tempered water system to heat and cool the MCO.

Pumps PWC-P-4035 and PWC-P-4036 in conjunction with water jet pump PWC-EJR-4031 provide the pumping capability to handle both MCO water and cask annulus water. Filter PWC-F-4042 provides filtration for all process water prior to transfer to the holding tank.

5.4.2 Liquid Holding Capacity

The PWC system provides holding capacity for liquid generated by the vacuum drying of one MCO. The inlet line to the PWC receiving tank is equipped with a flow meter and totalizer to track the volume of liquid that is pumped to the PWC system.

Receiver tanks PWC-TK-4032/4033 have a combined working volume of 0.893 m^3 (236 gal). The volume of water in one MCO is anticipated to be approximately 0.568 m^3 (150 gal). There is sufficient receiver tank capacity for one MCO with a substantial contingency.

5.4.3 Liquid Control Valves

Air-operated, computer-controlled valves control the flow of liquid within the PWC system. Gas-operated valves GOV-4039/4045/4046/4047 are pneumatically-operated computer-controlled valves. The valves are placed so as to control the process flow with the PWC system.

5.4.4 Interlock

An interlock prevents overfilling of the storage or transfer tanks. Level switch high PWC-LSH-4032 on PWC-TK-4033 and level switch high PWC-LSH-4016 on PWC-TK-4001 provide programmable logic controller input to interlock PWC-P-4035/4036 preventing overflows.

5.4.5 Process Water Conditioning Tank Venting

The PWC tank is vented through a HEPA filter to the facility HVAC exhaust.

PWC-TK-4033 vents into PWC-TK-4001. The exhaust of PWC-TK-4001 is locally HEPA-filtered prior to reaching the facility exhaust.

5.4.6 Liquid Handling

The PWC interfaces with the cold vacuum drying MCS to allow for computer control of liquid handling to and from the PWC. There are two junction boxes on the PWC skid where the MCS interfaces with the PWC instrumentation and controls.

5.4.7 Criticality Instrumentation and Control

There is no safety class criticality instrumentation and control requirements. All criticality control is accomplished by design geometry control of the receiver tanks, IXMs, and filter. There are no active design features for criticality control. The IXM design is a standard Hanford Site design that has been qualified to the appropriate standards and has been successfully used in other facilities.

5.5 SYSTEM PARAMETERS/SET POINTS

Nominal settings and system parameters for the PWC system are defined in HNF-SD-SNF-SEL-002, *Spent Nuclear Fuel Project Cold Vacuum Drying Facility Safety Equipment List*.

5.5.1 Liquid Flow Through the Ion Exchange Loop

Flow through PWC-006/007/008-SS-1½", the ion exchanger loop, is 0.00284 m^3/s (45 gal/min) as measured and controlled by PWC-FE-4037 and PWC-GOV-4039.

5.5.2 Liquid Flow Through the Jet Pump Loop

The nominal flow rate through PWC-005-SS-1½", PWC-006-SS-1½" and PWC-015-SS-1½", the water jet ejector pump loop, is 0.00284 m^3/s (45 gal/min) as measured at PWC-FE-4037.

5.5.3 Liquid Flow Through the Drain Line

Flow through PWC-001-SS-1", the MCO drain line, is 0.000315 m^3/s (5 gal/min) or greater as measured by changing levels in the receiver tank when draining an MCO.

5.5.4 Flow Control/Indicator

Flow control/indicator FI-4049 for DI-001-SS-½" is set at 0.000315 m^3/s (5 gal/min).

5.5.5 Deionized Water Pressure

Pressure in deionized water line DI-001-SS-½" is set at (12psig) as controlled by PCV-4042.

5.5.6 Instrument Air Flow Rate and Pressure

Flow control/indicator FI-4048 for IA-001-SS-½" is set at 0.00236 m^3_{STP}/s (5 ft^3_{STP}/s), pressure in the IA line IA-011-SS-½" is set at (20 psig) as controlled by PCV-4056.

5.5.7 Operating Limits

Equipment, components, and systems that comprise the PWC system have been selected to perform specific functions. To maintain functionality and confidence in the operability of the system, the following absolute operating limits are respected. Violation of any of these limitations requires the replacement of the effected part prior to active service.

A. Each IXM cannot exceed:

(1) 0.200 kg (0.441 lb) of plutonium.

(2) 3.70 x 10^6 Bq/kg (100 nano Ci/g) based upon the total weight of the IXM + shielding material. (This is an administrative limit based upon economic and regulatory constraints.)

B. Each sampler cannot exceed:

(1) 2,068 kPa (300 lb/in^2) of process line pressure.

(2) 135 °C (275 °F) temperature of sampled material.

C. Water content transferred to the tanker truck cannot exceed:

(1) Particulate shall be less than 20 microns.

(2) Cs-137 shall be less than 15 microcurie/liter.

(3) Sr-90 shall be less than 15 microcurie/liter.

(4) Total soluble alpha shall not be greater than 1 microcurie/liter.

5.5.8 Precautions

System controls and presets preclude violation of system and component limitations under normal conditions. Operations beyond normal conditions require inspection of the effected components to determine if operation limits have been exceeded. Items of special concern are noted in the operations manuals provided by the fabricator for the respective equipment and should be integrated into the normal operating procedures.

5.5.9 Recovery Procedures

Recovery from breakdown entails replacement and acceptance of the replacement part or component per operating procedures. Once replacements and acceptances are complete, a normal start-up procedure is implemented to return to operational readiness.

This page intentionally left blank.

6.0 SYSTEM OPERATION

The PWC system operation is described in HNF-2356, *Spent Nuclear Fuel Project Cold Vacuum Drying Facility Operations Manual*.

This page intentionally left blank.

7.0 SYSTEM SURVEILLANCE

The PWC system is designed to operate through the design life of the equipment (five years) without regularly scheduled facility shutdowns for maintenance. System maintenance activities are limited to maintenance due to failures. Additional maintenance activities and procedures are scheduled if system surveillance, testing, or maintenance identifies additional requirements. All maintenance is performed according to controlled procedures using approved (quality assurance-qualified) equipment and materials. Only spare parts meeting design criteria are procured and used. The equipment has been designed for efficient maintainability. The surveillance, testing, and maintenance of the system is achieved at a minimum level of cost and support services per DOE Order 6430.1A, *General Design Criteria*, Section 1300-12.4.10.

Change-out of a spent IXM requires 24 hours of draining to minimize the amount of free liquids in the module.

7.1 CORRECTIVE AND PREVENTIVE MAINTENANCE

A. Modular design is incorporated to permit easy change-out of systems requiring timely repair and/or special skills, and to reduce problems associated with equipment removal and repair.

B. Commercial equipment, components, and parts are used whenever feasible to reduce procurement, maintenance, training, and inventory costs.

7.2 SURVEILLANCE AND IN-SERVICE INSPECTION

Surveillance and in-service inspections are conducted per the manufacturer's recommendations for the respective components. Surveillances as dictated by the respective manuals are incorporated into standard operating procedures. Operators are expected to report and supervisors are expected to investigate any and all occurrences not regularly experienced. Accommodations are made for both manual and electronic inspection of PWC system equipment.

The safety class and safety significant systems are under administrative control for all testing, surveillance, and maintenance, all of which are performed under controlled procedures. System operability is verified by surveillance of the system's component states (i.e., tank level, system alarms) before enabling the system for each MCO process cycle.

7.3 EQUIPMENT CALIBRATION

A. All equipment must be calibrated and recalibrated according to the respective manufacturer's recommended schedule and practice. Calibration and test connections are provided to enable in-service testing and calibration when practical. All safety class and safety significant components were supplied calibrated and traceable back to the National Institute of Standards and Technology. All safety class and safety significant components are recalibrated per controlled cold vacuum drying procedures and standards.

B. Equipment and instrumentation have local and remote readouts when available.

C. Automatic "on-line" calibration has been specified when available.

D. Modular replacement has been employed.

8.0 REFERENCES

8.1 INDUSTRY STANDARDS AND CODES

ANSI/ASME B16 Standards series, 1996, *Fittings, Flanges and Valves*, American Society of Mechanical Engineers, New York, New York.

ANSI/ASME B16.5, 1996, *Pipe Flanges and Flanged Fittings*, American Society of Mechanical Engineers, New York, New York.

ANSI/ASME B31.1, 1996, *Power Piping Code*, American Society of Mechanical Engineers, New York, New York.

ANSI/ASME B31.3, 1996, *Process Piping Code*, American Society of Mechanical Engineers, New York, New York.

ANSI/ASME NQA-1, 1997, *Quality Assurance Requirements for Nuclear Facility Applications*, American Society of Mechanical Engineers, New York, New York.

ANSI/AWWA, D100, 1996, *Welded Steel Tanks for Water Storage*, American Water Works Association, Columbus, Ohio.

ANSI/NFPA 70, 1996, *National Electric Code*, National Fire Protection Association, Quincy Massachusetts.

ASME, 1995, *Boiler and Pressure Vessel Code*, American Society of Mechanical Engineers, New York, New York.

Section II, "Material Specifications, Welding Rods, Part C Electrodes, and Filler Metals"

Section VIII "Division I Rules for Construction of Pressure Vessels"

Section IX "Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators"

ASME B73.1M, 1991, *Specification for Horizontal End Section Centrifugal Pumps for Chemical Process*, American Society of Mechanical Engineers, New York, New York.

ASME B73.2M, 1991, *Specification for Horizontal In-Line Centrifugal Pumps for Chemical Process*, American Society of Mechanical Engineers, New York, New York.

IEEE-577, 1976 (R 92), *Standard Requirements for Reliability Analysis in the Design and Operation of Safety Systems for Nuclear Power Generating Stations*, Institute of Electrical and Electronics Engineering, Piscataway, New, Jersey.

SNT-TC-1A, 1996, *Recommended Practice*, American Society of Nondestructive Testing, Columbus, Ohio.

8.2 GOVERNMENT DOCUMENTS

10 CFR 50, "Domestic Licensing of Production and Utilization Facilities," *Code of Federal Regulations*, as amended.

10 CFR 72, "Licensing Requirements for the Independent Storage of Spent Nuclear Fuel and High-Level Radioactive Waste," *Code of Federal Regulations*, as amended.

10 CFR 830.120, "Quality Assurance Requirements," *Code of Federal Regulations*, as amended.

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

29 CFR 1910.120, "Occupational Safety and Health Standards," *Code of Federal Regulations*, as amended.

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

DOE Order 5480.20A, 1994, *Personnel Selection, Qualification, and Training Requirements for DOE Nuclear Facilities*, U.S. Department of Energy, Washington, D.C.

DOE Order 5480.23, 1992, *Nuclear Safety Analysis Reports*, U.S. Department of Energy, Washington, D.C.

DOE Order 5480.24, 1992, *Nuclear Criticality Safety*, U.S. Department of Energy, Washington, D.C.

DOE/EH-0256T, 1992, *U.S. Department of Energy Radiological Control Manual*, U.S. Department of Energy, Washington D.C.

DOE-STD-1020-94, 1994, *Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities*, U.S. Department of Energy, Washington, D.C.

DOE-STD-1021-92, 1992, *Natural Phenomena Hazards Performance Categorization Guidelines for Structures, Systems, and Components*, U.S. Department of Energy, Washington, D.C.

DOE-STD-3009-94, 1994, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Safety Analysis Reports*, U.S. Department of Energy, Washington, D.C.

Ecology, 1994, *Hanford Federal Facility Agreement and Consent Order*, as amended, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington.

G-10 CFR 835/B2-Rev.0, *Implementation Guide for Use with Title 10, Code of Federal Regulations, Part 835 Occupational Radiation Protection.*

8.3 SPENT NUCLEAR FUEL PROJECT DOCUMENTS

HNF-2356, 1998, *Spent Nuclear Fuel Project Cold Vacuum Drying Facility Operations Manual*, Rev. 1, DE&S Hanford, Incorporated, Richland, Washington.

HNF-MP-599, 1997, *Project Hanford Quality Assurance Program Description,* Rev. 1, Fluor Daniel Hanford, Incorporated, Richland, Washington.

HNF-SD-SNF-CSER-006, 1997, *Criticality Safety Evaluation Report for the Cold Vacuum Drying Facility's Process Water Handling System*, Rev. 0, Fluor Daniel Hanford, Incorporated, Richland, Washington.

HNF-SD-SNF-DR-003, 1997, *Multi-Canister Overpack Design Report*, Rev. 0, Fluor Daniel Hanford, Incorporated, Richland, Washington.

HNF-SD-SNF-DRD-002, 1998, *Cold Vacuum Drying Facility Design Requirements*, Rev. 4, Fluor Daniel Hanford, Incorporated, Richland, Washington.

HNF-SD-SNF-SAR-002, 1998, *Safety Analysis Report for the Cold Vacuum Drying Facility, Phase 2, Supporting Installation of Processing Systems*, Rev. 4, Fluor Daniel Hanford, Incorporated, Richland, Washington

HNF-SD-SNF-SEL-002, 1998, *Spent Nuclear Fuel Project Cold Vacuum Drying Facility Safety Equipment List*, Rev. 4, Fluor Daniel Hanford, Incorporated, Richland Washington.

HSRCM-1, 1995, *Hanford Site Radiological Control Manual*, Rev. 2, Westinghouse Hanford Company, Richland Washington.

SNF-AP-5-006, *ALARA Goals, Training, and Control Level Administration*, DE&S Hanford, Incorporated, Richland, Washington.

SNF-AP-5-012, *Radiological ALARA Work Planning Process*, DE&S Hanford, Incorporated, Richland, Washington.

SNF-AP-5-013, *Radiological ALARA Process*, DE&S Hanford, Incorporated, Richland, Washington.

SNF-3001, 1998, *CVDF Supporting Data and Calculation Database*, Rev. 0, DE&S Hanford, Incorporated, Richland, Washington.

SNF-3062, 1998, *Cold Vacuum Drying Facility Vacuum and Purge System Design Description*, Rev. 0, DE&S Hanford, Incorporated, Richland, Washington.

W-441-P2, *The Fabrication and Procurement Specification for the Process Water Conditioning System*, Fluor Daniel Hanford, Incorporated, Richland, Washington.

W-441-P3, *The Fabrication and Procurement Specification for the Monitoring and Control System*, Fluor Daniel Hanford, Incorporated, Richland, Washington.

8.4 DRAWINGS

H-1-82168, *Cold Vacuum Drying Facility Process Water Conditioning Piping Plan and Section*, Rev. 0, Numatec Hanford Corporation, Richland, Washington.

H-1-83766, *Cold Vacuum Drying Facility Process System P&ID*, Rev. 4, Numatec Hanford Corporation, Richland, Washington.

APPENDIX A

DRAWING AND SPECIFICATION LISTS AND SUPPORTING INFORMATION

DRAWING LIST

Process water conditioning system drawings are grouped under eight drawing numbers. The primary drawing title of all drawings is *Cold Vacuum Drying Facility*. The secondary title, drawing numbers, and number of sheets with each subpackage are as listed in Table A-1. Complete sets of drawings are located with the Spent Nuclear Fuel Project files for the Cold Vacuum Drying Facility project.

Table A-1. Drawings.

Drawing number	Revision number	Title	Sheet number
General			
H-1-82090	0	Drawing List and Vicinity Map	1
Piping and instrument diagram			
H-1-82160	1	P&ID Legend	1
H-1-82164	0	Process Water Conditioning P&ID	1
H-1-83766	4	Process System P&ID	1
H-1-83766	4	Process System P&ID	2
Mechanical			
H-1-82171	0	Process Water Conditioning Equipment Layout	1
H-1-82171	0	Process Water Conditioning Receiver Tank PWC-TK-4033	2
H-1-82171	0	Process Water Conditioning Receiver Tank PWC-TK-4032	3
Piping			
H-1-82168	0	Process Water Conditioning Piping Plan and Section	1
H-1-82168	0	Process Water Conditioning Piping Plan and Section	2
H-1-82168	0	Process Water Conditioning Piping Section	3
Structural			
H-1-82172	0	Process Water Conditioning Structural	1
H-1-82172	0	Process Water Conditioning Structural Details	2
Instrumentation			
H-1-82292	0	Instrumentation PLC Remote I/O Enclosure	1
H-1-82294	0	Instrumentation Bay I/O Connection Diag.	1
H-1-82294	0	Instrumentation Bay I/O Connection Diag.	9

SPECIFICATION LIST

The process water conditioning system is procured as part of one specification package. See Table A-2. A complete set of specifications is located with the Spent Nuclear Fuel Project files for the Cold Vacuum Drying Facility project.

Table A-2. Specifications.

Specification number	Title
W-441-P2	Procurement specification for the fabrication, acceptance testing, and shipment of the Cold Vacuum Drying Facility process water conditioning skid.

CALCULATIONS

Calculations in support of the process water conditioning system design are located in SNF-3001, 1998, *CVDF Supporting Data and Calculation Database*, Rev. 0, DE&S Hanford, Incorporated, Richland, Washington.