ENGINEERING CHANGE NOTICE

1. ECN 658723

Proj. ECN

2. ECN Category (mark one) Supplemental [] Direct Revision [X] Change ECN [] Temporary [] Standby [] Supersedure [] Cancel/Void []	3. Originator's Name, Organization, MSIN, and Telephone No. B.J. Shapley, SNF-CVD, X3-78, 373-6653	4. USQ Required? [X] Yes [] No	5. Date 8/17/00
	6. Project Title/No./Work Order No. SNF/W-441 Spent Nuclear Fuel/Cold Vacuum Drying Facility	7. Bldg./Sys./Fac. No. CVDF	8. Approval Designator S^N,Q
	9. Document Numbers Changed by this ECN (includes sheet no. and rev.) SNF-2356, Rev. 3	10. Related ECN No(s). N/A	11. Related PO No. N/A

12a. Modification Work	12b. Work Package No.	12c. Modification Work Complete	12d. Restored to Original Condition (Temp. or Standby ECN only)
[] Yes (fill out Blk. 12b) [X] 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? [X] Yes [] No

The CVD Operations Manual was revised to incorporate the following changes:

- Editorial Changes
- Changed DI water min. flow from 5gpm to a flow range of 5-10gpm
- Added statement to record cask pressure and temperature data to MCO traveler
- Added and Deleted some special tools listed in table 3-2
- Changed seal ring alarm setpoint from 43 to 40 psig
- Changed pwc minimum level from 2±0.5% to 6-10%
- Added oil limit in IA system
- Added leak rate acceptance criteria
- Added additional sampling logic to PWC system
- Clarified He purge operation to PWC header
- Changed breakthrough pressure from 600 to 400 torr
- Changed pumpdown pressure from 0.1 to 0.5 torr
- Updated flowsheets

USQ NUMBER: CVD-00-1621 [signature] 9/5/00

14a. Justification (mark one)

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

14b. Justification Details

Revised to reflect current design and operation of the PWC system, as well as changes made as a result of initial testing data. This ECN closes out ECN request #421.

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

See distribution sheet.

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STA: #19
ID: 15

16. Design Verification Required	17. Cost Impact NA						18. Schedule Impact (days)	
	ENGINEERING			CONSTRUCTION			NA	
[] Yes	Additional	[N/A]	$	Additional	[N/A]	$	Improvement	[N/A]
[x] No	Savings	[N/A]	$	Savings	[N/A]	$	Delay	[N/A]

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	[x]	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	[]		[]

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

Document Number/Revision	Document Number/Revision	Document Number Revision
NA		

21. Approvals

	Signature	Date		Signature	Date
Design Authority J.J. Irwin	John J. Irwin JJI 11/16/2000	8/21/2000	Design Agent		
Cog. Eng.			PE		
Cog. Mgr. C.S. Haller	[signature] 11/16/00	11/16/00	QA		
QA H. M. Chafin	Hank M. Chafin HMC 11/16/00	8/21/00	Safety		
Safety N J. Brehm	for Taber [signature]	11.6.00	Design		
Independent Reviewer	[signature]	11/16/00	Environ.		
Other: W. C. Alaconis	[signature], [signature]	9/5/2000	Other		
C.R. Miska	for C.R. Miska [initials]	9/4/2000			
G. Singh	[signature]	9/4/00			
R. Whitehurst	[signature] RW 11/16/00	8/23/00	DEPARTMENT OF ENERGY		
			Signature or a Control Number that tracks the Approval Signature		
			ADDITIONAL		

Example Design Review Checklist for Simple Designs/ Simple Design Changes (Routine ECNs).

Documents/ECNs Reviewed ECN 658723 / SNF 2356 Rev 4

Affected Document(s) (Optional) Ops Manual

Yes	No	NA	
[✓]	[ ]	[ ]	Were the design inputs correctly selected?
[✓]	[ ]	[ ]	Are assumptions necessary to perform the design activity adequately described and reasonable?
[✓]	[ ]	[ ]	Where necessary, are the assumptions identified for subsequent reverifications when the detailed design activities are completed?
[✓]	[ ]	[ ]	Was an appropriate design method used?
[✓]	[ ]	[ ]	Were the design inputs correctly incorporated into the design?
[✓]	[ ]	[ ]	Is the design output reasonable compared to design inputs?
[ ]	[ ]	[✓]	Are the necessary design input and verification requirements for interfacing organizations specified in the design documents or in supporting procedures or instructions?

[signature] 11/16/00

Checklist Completed By Date

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		ECN No. 658723

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SNF-2356
Revision 4

Spent Nuclear Fuel Project Cold Vacuum Drying Facility Operations Manual

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

Project Hanford Management Contractor for the
U.S. Department of Energy under Contract DE-AC06-96RL13200
Fluor Hanford
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Revision 4

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Spent Nuclear Fuel Project Cold Vacuum Drying Facility Operations Manual

Project No: W-441 Document Type: RPT Division: SNF

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

Project Hanford Management Contractor for the
U.S. Department of Energy under Contract DE-AC06-96RL13200

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(1) Document Number: SNF-2356

Page 1

(2) Title

SPENT NUCLEAR FUEL PROJECT, COLD VACUUM DRYING FACILITY OPERATIONS MANUAL

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 623998, INITIAL RELEASE	J. J. IRWIN	T. CHOHO
0a	ECN 645101, GENERAL REVISION	J. J. IRWIN	T. CHOHO
0b	ECN 645110, GENERAL REVISION WITH INCLUSION OF SDDs	J. J. IRWIN	A. MCNEIL
1	ECN 651404, GENERAL REVISION	WHITEHURST	T. CHOHO
2	ECN 653488, GENERAL REVISION	J. J. IRWIN	T. CHOHO
3	ECN 657881, GENERAL REVISION	J. J. IRWIN	C. S. HALLER
4 RS	ECN 658723, GENERAL REVISION WITH INCLUSION OF INITIAL TESTING DATA. Incorporated ECN-663719 (JKB 11/18/00)	J. J. IRWIN per telecon for JJI 11/17/00	C. S. HALLER CSHaller 11/16/00

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SNF-2356
Rev 4

SPENT NUCLEAR FUEL PROJECT
COLD VACUUM DRYING FACILITY
OPERATIONS MANUAL

Prepared for the U.S. Department of Energy

Numatec Hanford Corporation
Richland, Washington

Fluor Hanford, Incorporated
Richland, Washington

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CSB	Canister Storage Building
CVD	Cold Vacuum Drying
HEPA	High Efficiency Particulate Air (Filter)
HVAC	Heating, Ventilating, And Air Conditioning
I/O	input/output
IXM	Ion Exchange Module
LCO	Limiting Condition of Operation
MCO	Multi-Canister Overpack
MCS	Monitoring and Control System
MSLD	Mass Spectrometer Leak Detection
P&ID	Piping and Instrumentation Diagram
PWC	Process Water Conditioning (system)
SCHe	Safety Class Helium (system)
SCIC	Safety Class Instrument and Control (system)
SNF	Spent Nuclear Fuel
STP	standard temperature and pressure
UPS	Uninterruptible Power Supply
VPS	Vacuum Purge system

SPENT NUCLEAR FUEL PROJECT COLD VACUUM DRYING FACILITY OPERATIONS MANUAL

1.0 COLD VACUUM DRYING FACILITY OVERVIEW

The mission of the Spent Nuclear Fuel (SNF) Project Cold Vacuum Drying Facility (CVDF) is to achieve the earliest possible removal of free water from Multi-Canister Overpacks (MCOs). The MCOs contain metallic uranium SNF that have been removed from the 100K Area fuel storage water basins (i.e., the K East and K West Basins) at the U.S. Department of Energy Hanford Site in southeastern Washington state. Removal of free water is necessary to halt water-induced corrosion of exposed uranium surfaces and to allow the MCOs and their SNF payloads to be safely transported to the Hanford Site 200 East Area and stored within the SNF Project Canister Storage Building (CSB).

The CVDF is located within a few hundred yards of the basins, southwest of the 165KW Power Control Building and the 105KW Reactor Building. The site area required for the facility and vehicle circulation is approximately 2 acres. Access and egress is provided by the main entrance to the 100K inner area using existing roadways.

The CVDF will remove free water from the MCOs to reduce the potential for continued fuel-water corrosion reactions. The cold vacuum drying process involves the draining of bulk water from the MCO and subsequent vacuum drying. The MCO will be evacuated to a pressure of 8 torr or less and backfilled with an inert gas (helium). The MCO will be sealed, leak tested, and then transported to the CSB within a sealed shipping cask. (The MCO remains within the same shipping Cask from the time it enters the basin to receive its SNF payload until it is removed from the Cask by the CSB MCO handling machine.)

The CVDF subproject acquired the required process systems, supporting equipment, and facilities. The cold vacuum drying operations result in an MCO containing dried fuel that is prepared for shipment to the CSB by the Cask transportation system. The CVDF subproject also provides equipment to dispose of solid wastes generated by the cold vacuum drying process and transfer process water removed from the MCO back to the K Basins.

WHC-SD-SNF-FRD-020, *K Basin Spent Nuclear Fuel Cold Vacuum Drying Facility Functions and Requirements*, summarizes the requirements of the CVDF subproject and identifies federal, state, and local regulations and laws that may be applicable to the CVDF subproject. HNF-SD-SNF-DRD-002, *Cold Vacuum Drying Facility Design Requirements*, provides the detailed design requirements for the CVDF that establish the basis for the design, development, and testing of equipment to safely and efficiently vacuum dry the K Basins SNF. Finally HNF-3553, *Spent Nuclear Fuel Project Final Safety Analysis Report Annex B, Cold Vacuum Drying Facility Final Safety Analysis Report,* provides the safety basis for the CVDF. The CVDF procurement and performance specifications are as follows:

- HNF-3228, *CVD Safety Class Instrument and Control System Performance Specification*
- SNF-5301, *Procurement Specification for the Fabrication, Acceptance Testing, and Shipment of the Cold Vacuum Drying System Equipment Process Skid*
- SNF-5302, *Procurement Specification for the Fabrication, Acceptance Testing, and Shipment of the Cold Vacuum Drying System Equipment Process Water Conditioning Skid*
- W-441-P3, *Procurement Specification for the Fabrication, Acceptance Testing, and Shipment of the Monitoring and Control System of the Cold Vacuum Drying Facility Equipment*
- SNF-5303, *Procurement Specification for the Fabrication, Acceptance Testing, and Shipment of the Cold Vacuum Drying System Process Hood/Seal Ring*
- SNF-5304, *Procurement Specification for the Fabrication, Acceptance Testing, and Shipment of the Cold Vacuum Drying Facility Safety Class Helium Equipment*
- SNF-6209, *Cold Vacuum Drying Facility Technical Specifications*

2.0 COLD VACUUM DRYING PROCESS SYSTEMS OVERVIEW

The CVDF operations are depicted schematically on the CVDF Process Flow Diagrams, H-1-81166. The CVDF process and HVAC systems Engineering Flow Diagrams are depicted on drawings H-1-83965 through H-1-83968. The essential and support drawing list for the CVDF is contained within SNF-5335, *Spent Nuclear Fuel Cold Vacuum Drying Facility Essential & Support Drawing List.*

The Cask-MCO handling operation starts with the receipt of the Cask-MCO trailer at the CVDF process bay. Operators raise the door to allow the trailer to back into the process bay. The trailer is backed into a predetermined position, the landing legs are lowered to lift the front of the trailer to allow disengagement of the kingpin, and the tractor is disconnected. The tractor is driven out of the bay and the bay door is closed. Bay confinement is then established. Radiation surveys are conducted on the cask/trailer, and the quality assurance package is delivered to the CVDF shift operations manager.

The process bay instrument air service is connected to the trailer air supply control station, and the trailer is leveled. A bridge is installed from the process bay mezzanine to the trailer work platform. Contamination control supplies are installed on the work platform. The top of the cask is prepared for venting, purging, and cask lid removal.

The MCO is vented to the cask headspace (the cask annulus was partially filled with water by operations at the K Basins, and the cask headspace was purged and filled with helium at approximately 3 psig before it left the basin), see Figure 2-1. During transport to the CVDF, hydrogen is generated and vented to the cask. Pressure also increases due to temperature increases associated with radioactive decay heat, solar heating, and water-uranium corrosion reactions. This gas is vented to the cold vacuum drying process vent system by means of special venting hardware and flex lines connected to the cask lid port and the CVDF process vent system. After venting, the cask headspace is purged with helium. Following purging, the cask lid is removed by the CVDF process bay overhead crane using a dedicated lifting fixture. The cold vacuum drying process hood/seal ring assembly is installed onto the cask and the MCO is prepped for the process operations described below. The overhead crane is moved to a designated position prior to commencing the CVD process. A depiction of the Cask-MCO with the processing system connected is shown in Figure 2-2.

The process is performed per approved operating procedures, which include bulk water removal, helium purging, evacuation with or without helium purge, an initial pressure rebound test, an extended operation under vacuum at the base pressure of the system, a final pressure rebound test, an integrated leak test of the MCO mechanical seals, and backfilling the dried MCO with helium. The majority of all process actions are automatically actuated by the Monitoring and Control System (MCS) with input (start/stop commands) from the operators. There are minimal manual operator actions in the process sequences. Field operator actions are required, such as connecting MCO valve operators, DI/He rinse/blowdown after draining and tempered water connections. The control room operator actions include acknowledging alarms or instructing the MCS to proceed with the next step. Valve state changes, water temperature control and other process parameter changes are performed by the MCS.

Protection from causing off-site consequences is provided by maintaining water in the Cask-MCO annulus space, pressure venting via a 30 psig rupture disc and automatic actuation of the Safety Class Helium (SCHe) system and the Safety Class Instrument and Control (SCIC) system. The 30 psig vent path is passive and maintaining annulus water is, for the most part, passive. The SCIC prevents the Tempered Water (TW) temperatures from exceeding the parameter limit of 50°C by opening the TW heater contactor on high temperature detection.

There are two normal operator interfaces, the MCS computers and the SCIC Mode switch, both are located in the CVDF control room. The SCIC mode switch defines the MCO process mode and directly feeds this information into the Monitoring and Control System (MCS). While most sequences are held for operator permissives, some occur based solely on SCIC mode switch position. These are related to keeping hydrogen concentration low in the MCO and PWC receiving tanks.

Following the cold vacuum drying process, the Cask-MCO is prepared for shipment to the CSB. This operation is the reverse of the receipt operation. The Cask-MCO is cooled by the Tempered Water system, the MCO pressurized with helium, and sealed. The Cask-MCO annulus is drained and dried with an instrument air purge, a He leak test of the MCO is performed, and the cask lid is then reinstalled. Only 1 atmosphere of air is left in the cask annulus. The trailer is connected to the tractor and released for shipment to the CSB.

MCO Port Configuration

Port	Status
1 -Plug/Internal Filter Assembly	Inactive, sealed by cover plate
2 - Process Valve/Filtered	Active, sealed by large hole cover plate
3 - Process Valve/Long Tube/Filtered	Inactive, sealed by blind cover plate
4 - Process Valve/Rupture Disk/Screened	Active, sealed by large hole cover plate

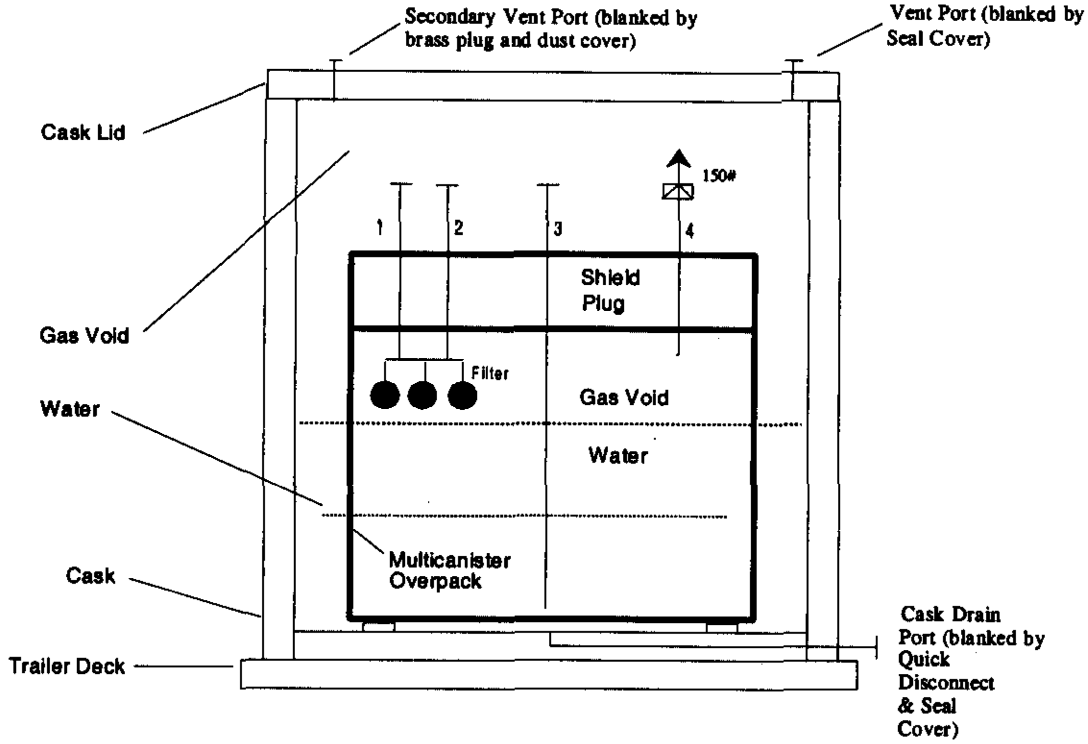

Figure 2-1. Cask-Multi-Canister Overpack Configuration upon Receipt at the CVD Facility

MCO Port Configuration

Port	Status
1 -Plug/Internal Filter Assembly	Inactive, sealed by cover plate
2 - Process Valve/Filtered	Active, as indicated
3 - Process Valve/Long Tube/Filtered	Active, as indicated
4 - Process Valve/Rupture Disk/Screened	Active, to vent hood

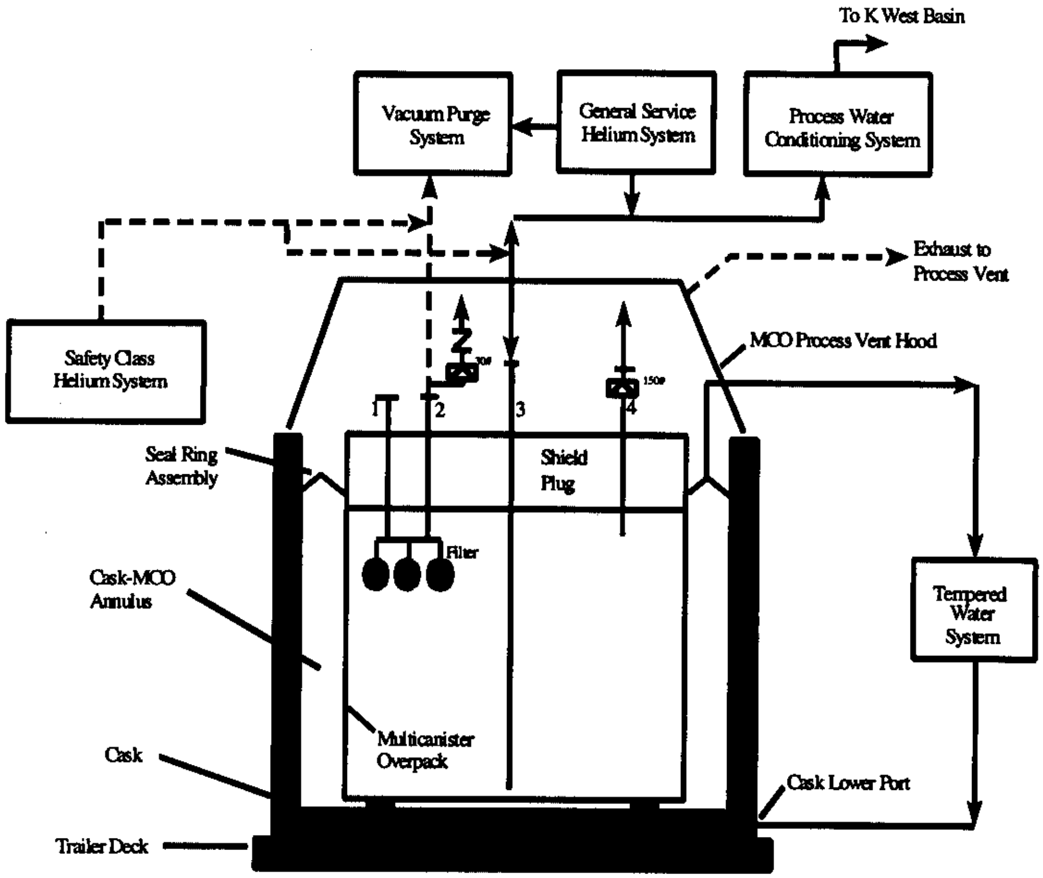

Figure 2-2. Cask-Multi-Canister Overpack Configuration with Process Systems at the CVD Facility

3.0 COLD VACUUM DRYING FACILITY SYSTEM DESCRIPTIONS

3.1 COLD VACUUM DRYING FACILITY PROCESS SYSTEMS

Table 3-1 lists the various systems within the CVDF. These systems are briefly described in the sections below and in more detail in the system design descriptions, (see Table 3-1 and section 4.0 References for a listing of the SDDs). The process equipment systems that will be operated in the CVDF were designed following the criteria in HNF-SD-SNF-DRD-002. Safety classification for the equipment is documented in HNF-SD-SNF-SEL-002, *Safety Equipment list for the CVDF*, and SNF-4148, CVDF Master Equipment List. The overall drawing list for the CVDF is contained within SNF-5335, *Preliminary Spent Nuclear Fuel Cold Vacuum Drying Facility Essential & Support Drawing List.*

3.1.1 System 07, Vacuum Purge System (VPS)

The CVDF Vacuum Purge System (VPS) (refer to piping and instrumentation diagrams [P&IDs] H-1-82160 through H-1-82162) is designed to drain and dry SNF elements contained within an MCO, which is in turn contained by a shielding Cask vessel. The VPS system consists of Process Equipment Skids (PES) each containing a gas purge and evacuation system, a gas stream analysis system and a tempered water system described below. There is one PES in each active process bay.

Components, piping, instruments, and electrical wiring are mounted on a platform and frame designated as a PES. The piping runs from the process equipment skid to a process hood/seal ring assembly (refer to H-1-82364 and H-1-83275). The process hood/seal ring assembly is swung over the top of the MCO by the CVDF crane and fixed to the top of the cask (after removing the cask lid). This allows the MCO valve operators (refer to H-1-82366 and H-1-82368) to be attached to the MCO, effectively providing process connection. The MCO tempered water system, described below, is also included on the process equipment skid.

The VPS consists of the following subsystems:

- System 07-1, Vacuum Purge System (VPS)
- System 07-2, Residual Gas Monitoring system (RGM)
- System 07-3, Helium Mass Spectrometer Leak Detection and Auxiliary Vacuum system (MSLD).

Table 3-1. Cold Vacuum Drying Facility Systems. (2 Sheets)

System Number	Cold Vacuum Drying System	Abbreviation	P&ID or PFD	SDD Doc. No.
05	Personnel monitoring system	(PMS)		
05-1	Radiation monitoring system	(RM)	H-1-82243	SNF-3060
05-2	Room air quality system	(AQ)	H-1-82243	SNF-3060
06	Civil/structural systems	(CIV)		
06-1	Administrative building (civil/structural/architectural)	(CIV- A)	H-1-82101 to H-1-82103	SNF-3061
06-2	Process bay (civil/structural/architectural)	(CIV- B)	H-1-82101 to H-1-82103	SNF-3061
06-3	Transfer corridor/mechanical equipment room (civil/structural/architectural)	(CIV-C)	H-1-82101 to H-1-82103	SNF-3061
06-4	Process water tank room (civil/structural/architectural)	(CIV- D)	H-1-82101 to H-1-82103	SNF-3061
07	Vacuum Purge system	(VPS)		
07-1	Vacuum Purge system	(VPS)	H-1-82161, -162	SNF-3062
07-2	Residual gas monitoring system	(RGM)	H-1-82161, -162	SNF-3063
07-3	Helium MSLD and auxiliary vacuum system	(MSLD)	H-1-84456	SNF-3064
11	Communications system	(COMM)	H-1-82243	SNF-3065
12	Compressed/Instrument air system	(CA/IA)	H-1-82222	SNF-3066
13	Helium systems	NA		
13-1	General service helium system	(He)	H-1-82161, -222	SNF-3067
13-2	Safety class helium system	(SCHe)	H-1-82161, -165	SNF-3068
14	Cranes and hoists	(HOI)	H-1-82104, H-1-82132	SNF-3072
18	Effluent drains system	(EFS)	H-1-82223	SNF-3073
19	Condensate collection system	(CCS)	H-1-82223	SNF-3074
20	Electrical systems	(ES)		
20-1	Electrical power distribution system	(EPD)	H-1-82241 to H-1-82248	SNF-3075
20-2	Lighting (external/internal/exit/emergency) system	NA	H-1-82241	SNF-3075
20-3	Grounding system (power/instrumentation and control)	NA	H-1-82246	SNF-3075
20-4	Facility uninterruptible power supply system	UPS	H-1-82241 to H-1-82248	SNF-3075
20-5	Lightning/surge protection system	NA	H-1-82095	SNF-3075
20-6	Standby power system	NA	H-1-83974	SNF-3075

23	Service Water System	SWS	NA	NA
24	Fire protection system	(FPS)	H-1-82237 to H-1-82240, H-1-82244	SNF-3077
25	Deionized water system	(DI)	H-1-82222	SNF-3078
26	Potable water system	(PW)	H-1-82222	SNF-3079
27	Sanitary collection system	(SANS)	H-1-82222	SNF-3080
30	HVAC systems	(HVAC)		
30-1	Administrative Building HVAC system	(HVAC)	H-1-82195	SNF-3081
30-2	Process bay re-circulation HVAC system	(HVAC)	H-1-82204	SNF-3081
30-3	Process bay local exhaust HVAC and process vent system	(HVAC/PV)	H-1-82206	SNF-3081
30-4	Process general supply/exhaust HVAC system	(HVAC)	H-1-82205	SNF-3081
30-5	Reference air system	(RA)	H-1-82207	SNF-3081
46	Process water systems	NA		
46-1	Process water conditioning system	(PWC)	H-1-82161, -164	SNF-3082
46-2	Conditioned water shipping system	(CWS)	H-1-82164, -224	SNF-3082
46-3	Contaminated water sampling and analysis system	(SMP)	H-1-82164	SNF-3082
47	Tempered and Cooling water systems	(CW)		
47-1	Tempered water (annulus) system	(TW)	H-1-82161, -163	SNF-3085
47-2	Tempered water cooling system	(TWC)	H-1-82163, -224	SNF-3085
47-3	Chilled water system	(CHW)	H-1-82208	SNF-3086
47-4	Vacuum purge system chilled water system	(VPSCHW)	H-1-82224	SNF-3087
50	Stack monitoring system	(SM)	H-1-82209	SNF-3088
54	Security system	(SEC)	H-1-82245	SNF-3089
93	Instrumentation and control system	(IC)		
93-1	Monitoring and control system	(MCS)	H-1-82291, H-1-82297	SNF-3090
93-2	Safety class instrumentation and control system	(SCIC)	H-1-82161 through -165	SNF-3091
100	Specialty equipment	(SE)		SNF-3076
100-1	Specialty equipment – Facility	(SE)	NA	SNF-3076
100-2	Specialty equipment – Cask/MCO Handling	(SE)	NA	SNF-3076
100-3	Specialty equipment – Process Systems	(SE)	NA	SNF-3076

HVAC = heating, ventilating, and air conditioning.
MSLD = mass spectrometer leak detector.
NA = not applicable.
P&ID = piping and instrumentation diagram.
PFD = process flow diagram

The VPS (System 07-1) consists of a single vacuum pump, piping and valves; pressure control valves and piping for helium purge gas supply and venting; a condensing assembly, piping, valves, and auxiliaries to dry process gases (Refer to P&IDs H-1-82161 and H-1-82162) from the MCO,. Instrumentation and gas monitoring equipment that achieves, maintains, and monitors the required operating pressures and gas concentrations in the MCO is contained in the RGM system (System 07- 2, Refer to Refer to P&IDs H-1-82161 and H-1-82162). A separate subsystem (System 07-3) consists of a helium MSLD, auxiliary vacuum pump, piping, valves, test domes and instrumentation (Refer to P&ID H-1-84456) to measure the pressure boundary leak rate of the MCO following the cold vacuum drying process. The tempered water system (System 47-2) is described elsewhere in this document.

The CVDF trace heat system consists of (1) self-regulating heat cable consisting of two bus wires, a semi-conductive polymer core whose resistance varies with temperature, and an insulating jacket; (2) connection accessories; and (3) local on-off thermostatic control. The trace cable is Chromalox[1] Type SRM, 120 V service, with a fluoropolymer jacket over braid. The trace heat cable is controlled from a Chromalox DL series local controller with resistance temperature detector input. The trace heat cable is installed on selected VPS piping in each of the process equipment skids. The CVDF trace heat system maintains selected portions of the VPS piping at greater than 50°C to prevent condensation of water within the piping until the water vapor reaches the VPS condenser. The exhaust line from the vacuum pump is trace heated to 100 °C to prevent water condensation collection at this point. There is heat trace on the PWC vent line to prevent condensation damage to the vent line HEPA filter. There is also heat trace on the TW system expansion tank vent line to prevent condensation damage to the vent line HEPA filter.

The process consists of first venting and purging the Cask and MCO, heating the MCO to 45°C using the tempered water system (refer to P&ID H-1-82160 and H-1-82163). The SNF immersion water is drawn from the MCO and transferred to a receiving and treatment system (the Process Water Conditioning [PWC] system, see H-1-82164). Once the immersion water is removed from the MCO, the system is backfilled and purged with helium (see description of the helium supply system below) at a rate of approximately 1.5 scfm [SCIC setpoint 1.1scfm (Parameter limit 0.7scfm)] as measured by FI-1*20 or FI-1*21. In the VPS, VPS-COND-2*13 (refer to P&ID, H-1-82162) continuously dries the purge gas prior to exhausting to the facility vent system. A small purge of helium (maintained at 1 psig) maintains a slight pressurization in all piping and equipment to prevent hydrogen buildup and intrusion of air (via a small leak or line break).

The majority of the remaining water will be removed during the evacuation step. The vacuum pump (VPS-P-2*11) withdraws water vapor, trace hydrogen and helium until the pressure drops to an equilibrium value, expected to be about 60 to 100 torr, as measured by PI-1*08 or PI-1*10. The condenser is maintained at about 3°C (38°F) as measured by TI-2*36. There will be a continuous purge of helium, at a rate of approximately 1.5 scfm through the MCO during the initial vacuum mode. In this mode the atmosphere in the MCO will be a low

[1] Chromalox/Wieg and Industrial Company, Pittsburgh, Pennsylvania.

pressure mixture of water vapor, helium, and hydrogen. The condensed water is collected in a collection tank, VPS-TK-2*16, that is located on the process equipment skid. The condensed water in the tank is transferred to the PWC system at the end of the drying operation. The non-condensed gases (helium and hydrogen) are transferred through the vacuum pump to the facility HEPA filtered vent system and out the exhaust stack.

A helium purge of ~1.5 scfm is maintained to assure that hydrogen does not accumulate. This mode of operation is continued until the MCO is dried to a point that allows a pressure reduction to below the 12 Torr Bypass of 7.4 torr set and 7.9 torr reset [SCIC setpoint 7.5 set, 8.0 reset, (Parameter limit ≤ 12 torr)] for a maximum time, under vacuum, of < 7 hours 55 minute [SCIC setpoint ≤ 8 hours, (Parameter limit < 8 hours)]. If pressure cannot be reduced to less than 7.4 torr within the 7 hour 55 minute period, the vacuum pump is isolated and a backfill of the MCO with helium is initiated. The pressure is increased to 1 psig and a helium purge of ~1.5 scfm is then maintained. The purge is maintained for 4 hours 5 minutes [SCIC setpoint ≥ 4 hours (Parameter limit ≥ 4 hours)] to reduce thermal gradients within the fuel which is a safety requirement (Thermal Reset). Following the helium backfill and purge for 4 hours and 5 minutes, a second evacuation of the MCO is performed. The maximum time for the second and any subsequent evacuation will be 3 hours and 55 minutes [SCIC setpoint of ≤ 4 hours, (Parameter setpoint of ≤ 4 hours). Each subsequent evacuation will be followed by a 4-hour and 5 minute minimum duration of helium backfill and purge. Once the condenser is no longer removing water the condenser is isolated by closing VPS-GOV-2*21 and VPS-GOV-2*22, the flow is routed through a condenser bypass line by opening VPS-GOV-2*03, and the vacuum pump operates until pressure equalizes based on the minimum helium flow injection.

Upon reaching a pressure of < 0.5 torr, the MCO is isolated by closing PWC-GOV-1*30, PWC-GOV-1*03, VPS-GOV-1*11, VPS-GOV 1*17, He-GOV-1*06, VPS-GOV-1*05, He-GOV-1*02, and VPS-GOV-1*09. A dryness verification test is performed by means of a pressure rebound test. If the pressure rate of rise is above 2.3 torr (Parameter limit 2.4 torr) within an hour (Pressure Rebound Test), insufficient drying has taken place and more drying is required. More vacuum pumping is performed if the test fails. Once the MCO passes the pressure rebound test, an evacuation to less than 8 torr for up to 28 hours is then conducted with the expected system base pressure of 0.5 torr, this is called the "**6 PROOF**" mode of operation. The "**6 PROOF**" mode requires the use of the vacuum pump only, while residual gas analyzer AI-2*13 samples the build-up of impurities within the MCO atmosphere during this operation. Multiple faulted conditions could result in water addition to the MCO, therefore a second and final rebound test is conducted at the end of the "**6 PROOF**" mode. This post drying operation (i.e., "**6 PROOF**" mode) at 45°C is utilized to verify that 200 g (0.44 lb.) of water or less is in the MCO prior to shipment to the CSB (see HNF-1851, *Cold Vacuum Drying Residual Free Water Test Description*) which is indicated by passing the final pressure rebound test.

At the completion of the 45°C "**6 PROOF**" mode operation, the MCO is refilled with helium and maintained at a nominal 4 psig. The tempered water system is instructed to achieve a maximum TW system temperature of 15 °C (actual) at TIC-3*05. After this temperature is achieved, the Cask-MCO shall be cooled for a minimum period of 6 hours at a minimum flow rate of 15 gpm (actual). The MCO is then filled with helium to a minimum of 9.5 psig (actual –

parameter limit) and a maximum of 12.5 psig (actual). The MCO ports are closed (close port #3 (Axial Process Tube port), wait 5 minutes and then close port #2 (Process Exhaust port)), and then the MCO valve operators are removed. The space between the MCO and cask is drained of water and the annulus dried with an instrument air purge (for a 1-hour period). The process hood/seal ring assembly is disconnected from the MCO. An integrated helium leak rate test of the MCO is then conducted. All helium leak tests are conducted with the helium MSLD equipment (System 07-3). Finally, the cask lid is reinstalled while the Cask-MCO annulus retains 1 atmosphere of air.

The VPS performs safety class isolation functions between the MCO and isolation valves located on the process hood support stand. VPS piping between these valves and the MCO are considered to form an extension of the primary confinement barrier for release of contamination. These are considered safety class primary confinement and are designed to performance category 3 standards. The system design description for the VPS is contained in SNF-3062.

3.1.2 System 46-1, Process Water Conditioning System (PWC)

The PWC system (refer to P&IDs H-1-82160, H-1-82164 and H-1-82224) serves two purposes. First, the PWC system is a vacuum source and receiver for MCO waters. Second, the PWC system conditions the MCO waters by removing radioactive particulate and soluble species using filtration and ion exchange. The PWC system is designed to service one MCO at a time so priority determination and scheduling are important. The PWC vacuum source is a water jet ejector that requires a water circulation. The PWC system will continuously circulate water through the ejector thus having a continuous source of vacuum for draining MCOs, VPS condenser tanks, tempered water systems, or the Cask–MCO annulus.

Normal operations of the PWC system include draining water from the MCO, VPS condenser tank, the Cask-MCO annulus, and tempered water system; processing collected water through the ion exchange module (IXM); and transferring processed water to facility storage tank PWC-TK-4001. The PWC system will also drain a spent IXM prior to its removal.

The PWC system is powered by 2 (1 running and 1 spare) canned motor pumps, PWC-P-4035 and PWC-P-4036, capable of pumping 45 gal/min at a head of 140 ft of water. The pump discharges into primary receiver tank PWC-TK-4032 through water jet-ejector PWC-EJR-4031. There is a second receiver tank, PWC-TK-4033, mounted in parallel to the primary receiver tank. The total working capacity of the two tanks is approximately 260 gallons of water (PWC-TK-4032 and PWC-TK-4033 each have a working volume of 130 gallons). The ejector is capable of pulling at least 5 gal/min of liquid at a head of 17 ft of water. Operation of the PWC vacuum pumping and receiving include control and monitoring of the pump operation; flow loop performance (FI-4037); receiver tank conditions (LI-4033); and the suction line performance (PI-4031).

The PWC impurity removal section consists of a flow branch for feeding approximately 40 gal/min of process water through the IXM, PWC-IXM-4037 or PWC-IXM-4038 (Both located in the PWC room). Flow at 10 gpm is eventually directed to a separate particulate filter

PWC-F-4042 prior to water transfer to the PWC storage tank, PWC-TK-4001. Automatic sampling is done before the IXM (PWC-SMP-4039), after the IXM (PWC-SMP-4040), and after the filter (PWC-SMP-4041). Process water can be directed to storage tank PWC-TK-4001 or returned to receiver tanks PWC-TK-4032 and PWC-TK-4033.

Control of process water to the IXM is through PWC-GOV-4039 as measured by FI-4037 at a nominal rate of 40 gal/min. A single IXM is connected to the PWC equipment skid by two stainless steel, Teflon[2] lined, flex lines with quick disconnects. Normally, flow is continuously fed through the IXM. High differential pressure alarm PDAH-4040 alarms when the IXM is beginning to plug. Operating experience will determine what differential pressure to set. IXM loading with transuranics will be administratively controlled as determined by sample analysis and will likely require IXM changeout (disconnecting from one IXM and connecting the other) prior to reaching the differential pressure limit. Removing a spent IXM from the CVD Facility will require additional analysis. After the process water has passed through the IXM, the treated water can be returned to the receiver tanks for re-circulation through the PWC impurity removal process. Re-circulation improves the impurity removal. Final transfer of processed water is to the facility storage tank, PWC-TK-4001. The system design description for the PWC system is contained in SNF-3082.

The PWC system has four main operating modes; 1) water receiving mode (see sections 3.5.2, 3.5.3, 3.5.4, and 3.5.5), 2) water purification mode (see section 3.5.6), 3) water transfer to Storage tank (see section 3.5.8) and 4) water transfer to tractor trailer (see section 3.5.9). The operating modes are controlled by the MCS as directed by the facility operators.

3.1.3 System 46-2, Conditioned Water Shipping System (CWS)

The conditioned water shipping system consists of a 5,000 gal tanker truck to transfer the CVDF process water back to the K Basins or Effluent Treatment Facility (200E area). The tanker is backed into process bay 1 (room 131), the truck removed from the bay, and a transfer line is connected to the tanker using a flex line and quick disconnects. The tanker has a vent connection for a CVDF supplied HEPA filter. Water is pumped from PWC system Storage tank PWC-TK-4001 to the tanker by opening valves PWC-V-008 and PWC-V-016, and starting pump PWC-P-4001 (refer to P&ID H-1-82224). The level in tank PWC-TK-4001 is monitored from LI-4014 and the tanker water level is monitored by a local monitoring system installed in bay no. 1. After the tanker is filled to 4000 gallons max., it is released to ship the processed water to the K West Basin Integrated Water Treatment System (IWTS) or to the ETF. The water transported to KW-basin or ETF shall meet the requirements specified in SNFP Interface Control agreement IC number 012; 1). Particulate shall be less than 5 microns in size, 2). Cs-137 shall be less than 15 microcuries/liter, 3). Sr-90 shall be less than 15 microcuries/liter and 4). total soluble alpha shall not be greater than 1 microcuries/liter). The system design description for the conditioned water shipping system is contained in SNF-3082. The tanker trailer is specified in HNF-2635.

[2] Teflon is a Registered Trademark of the DuPont Corporation

3.1.4 System 46-3, Contaminated Water Sampling and Analysis System (SMP)

The contaminated water sampling and analysis system (refer to P&ID H-1-82164) is used to take water samples before process water is fed into the PWC system IXM, after water exits the IXM and after water exits the PWC filter, PWC-F-4042. The sample bottles are periodically removed and sent to the 222S Laboratory or K Basins for analysis. The results of the analysis will determine the quantity of radionuclides removed from the MCOs, the radionuclides contained in the IXM and filter, and the water quality being transferred to the facility storage tank.

The PWC impurity removal operation consists of a flow branch for feeding approximately 45 gal/min of process water through IXM PWC-IXM-4037 or PWC-IXM-4038 and separate particulate filter PWC-F-4042 (flow is throttled to 10 gal/min at the filter). The MCS controls the sample, taking one 10cc sample for every 30 gal of feed. The MCS sends a momentary sample initiation signal to samplers PWC-SMP-4039, PWC-SMP-4040, and PWC-SMP-4041 to initiate sampling as dictated by the mode of operation. The system design description for the contaminated water sampling and analysis system is contained in SNF-3082.

3.1.5 System 47-1, Tempered Water (Annulus) System (TW)

The MCO outer shell temperature, while at the CVDF, will normally be maintained over a temperature range of 15 °C to 45 °C using the tempered water system (refer to P&IDs H-1-82160 and H-1-82163). Water lines are connected to ports in the Cask body and seal ring so that tempered water is circulated through the annulus between the shielding Cask and the MCO. Water is transferred at a nominal flow of 20 gal/min using pump TW-P-3*14, flow is measured with flowmeter FIT-3*16, and temperature is controlled through TIC-3*05. The water is heated or cooled by electric heater TW-HTR-3*11 or cooler TW-CLR-3*10. Chilled water to the cooler is supplied from the tempered water cooling system described below. The tempered water system supply pressure to the Cask-MCO annulus is controlled at 25 psig utilizing pressure control valve TW-SRV-3*11 and TW-FCV-3*18. Pump discharge pressure is monitored at PI-3*08. The tempered water system utilizes surge/holding tank TW-TK-3*12. The water level in this tank is monitored from LI-3*04 and has a high-level alarm (LAH-3*06).

The tempered water system has three safety functions, maintain water in the Cask-MCO annulus, maintain Cask-MCO inlet water temperature at 45°C and to provide local water level indication. All of these functions are required throughout the CVD drying process until the final pressure rebound test is completed. The design for maintaining water level is passive however level alarms are provided to the SCIC system for annunciation in the CVDF control room on low level. The two level switches are LSL-1*24 and 1*25 which are part of the level gauges, LG-1*24 and LG-1*25. Two independent temperature switches (TSH-1*28 and TSH-1*29) provide input to the SCIC panels which will trip the TW heater if the temperature setpoint is exceeded. Both the level and temperature alarms are provided to the MCS, which provides process parameter indication in the control room. There is also a seismic trip cutoff of electrical power to the TW system heater. The system design description for the tempered water (annulus) system is contained in SNF-3085.

3.2 COLD VACUUM DRYING SAFETY CLASS SYSTEMS OVERVIEW

3.2.1 System 13-2, Safety Class Helium System (SCHe)

3.2.1.1 General.

The SCHe system (refer to P&IDs H-1-82160, H-1-82161and H-1-82165) is designed to supply a helium purge to the MCO in the event the SCIC automatically actuates or is manually activated by the operator. Since the SCHe isolation valves are fail open, a loss of electrical power or Instrument Air will also result in an initiation of the SCHe system purge and vent.

The function of the SCHe system is to provide a minimum purge of helium through the MCO of ~1.5 scfm to bring hydrogen below 4% in inert He gas, or following a line break, remove oxygen that entered under MCO vacuum conditions. The SCHe system will maintain a positive pressure in the MCO under all events except a line break within the MCO process line isolation valves, in this case a steady flow of helium is provided to preclude air ingress until recovery action can be performed.

The elements of the SCHe system include four parallel purge systems, two on the MCO Axial Process Tube (port #3) connection and two on the MCO Process Exhaust port (port #2, HEPA filter) connection. Each of the four independent SCHe systems have two sources of helium: the 240 cu. ft at STP helium bottles, SCHe-TK-5*01, -5*02, -5*03 and -5*04, and the General Service helium tube trailers. The safety class bottles take over should the non-safety tube trailer become unavailable. Safety to non-safety isolation is provided by a series of pressure control and check valves between these two sources assuring a safety class supply of helium to the MCO.

3.2.1.2 Pressure Control.

Pressure controls (higher pressure control setpoints) are used to preferentially use normal (non-safety) helium gas supply from the tube trailers. Under non-faulted conditions (refer to HNF-SD-SNF-DRD-002, Section 2.2.10, for definition of faulted conditions) this would preserve the SCHe system purge bottle supply and reduce the need for SCHe bottle refill. Under any condition that does not allow normal helium supply, the SCHe system bottle supply would not be affected (safety class separation criteria) and would be utilized upon a SCIC purge initiation.

Regardless of the actual helium supply source, pressure control setting within the SCHe system will supply the helium purge gas through port #3 (Axial Process Tube port). The return gas flow will then backfeed into the SCHe system's lower pressure supply headers, through pressure regulators, and into the process vent.

Under faulted conditions the pressure control arrangement will provide purge flow through any conceivable single line break. Under the condition of a pipe break within the safety class isolation valves to the MCO, the flow of helium is as follows.

- Process line break on the MCO port #3 (Axial Process Tube port) side with little or no bulk water in the MCO. Purge will be through the MCO from the MCO HEPA filter supply side. MCO pressure will be maintained at slightly positive with flowing helium through the line break and/or out the process vent, depending on the size of the leak.

- Process line break on the MCO port #3 (Axial Process Tube port) side with bulk water in the MCO. If bulk water exists within the MCO, water will be pushed through the broken line until the pressure of the purge gas is overcome by the static head of the water column in port #3 (Axial Process Tube port). At this point the MCO is maintained at a positive pressure to preclude oxygen ingress. Prior to the line break, a positive pressure SCIC trip assures no oxygen in the MCO.

- Process line break on the MCO HEPA filter side with little or no water in the MCO. Purge will be through the MCO from the MCO's port #3 (Axial Process Tube port) side then out the line break.

- Process line break on the MCO HEPA filter side with bulk water in the MCO. If bulk water exists in the MCO either the SCHe pressure will overcome the backpressure of the water and bubble through the water to maintain positive pressure or the MCO will be vented allowing the small inventory of He that was in the MCO to disperse into the bay.

A minimum of one hour of purge volume has been provided to allow time to initiate and complete recovery operations (e.g., isolation of the MCO at the plug valves). A safety class alarm is provided in the control room to signal that an actuation of the SCHe system has commenced. Administrative procedure will require that the proper purge time has been provided prior to MCO isolation. Note that these faulted conditions are not considered to occur during a seismic event because all safety class lines are seismically qualified.

3.2.1.3 Instrumentation.

Local safety class SCHe system bottle pressure gauges are provided at each SCHe system bottle, which provide supply capacity. Other instruments for local and remote monitoring are safety class for maintaining the pressure boundary but are non-safety for reading or electronic signals. The non-safety class systems are designed to require multiple failures to impact the safety class systems.

3.2.1.4 Alarms.

Safety class alarms consist of safety class isolation and purge initiation (discussed in the SCIC section). The system design description for the SCHe system is contained in SNF-3068.

3.2.2 System 93-2, Safety Class Instrumentation and Control System (SCIC)

3.2.2.1 General.

The SCIC system provides active detection and response to process anomalies that, if unmitigated, would result in a safety class event. Specifically, actuation of the SCIC system includes two portions. The isolation of the MCO and initiation of the SCHe purge, and the SCIC portion of the system that detects and stops excessive heat input to the MCO on high tempered water MCO inlet temperature.

- For the MCO isolation and purge, the SCIC receives signals from MCO pressure (both positive pressure and vacuum), helium flow rate, bay high temperature switches, seismic trips and time under vacuum trips. The MCO pressure and helium purge rates are used to prevent flammable accumulations of hydrogen and oxygen. The bay high temperature is used to protect against the effects of high bay temperature on the accuracy of the safety class instrumentation. Separate temperature switches are provided that, if exceeded, will initiate the safety class isolation and SCHe system purge.

- The TW high temperature trips remove power from the water heater through the heater starter. A safety-class alarm is provided to the CVDF control room on low water level in the Cask-MCO annulus and an activation of the SCIC system.

In addition to the above trips, the SCIC provides alarms for the PWC pre and post purges. Should either of these two purges fail to be completed or are interrupted, the operator will be notified and corrective action is required. These alarms in conjunction with operator action prevent explosive gas (H_2 and O_2) accumulations in the PWC receiving tanks.

The system design description for the SCIC system is contained in SNF-3091.

3.2.2.2 Actuation of Safety Class Instrument and Control System.

The SCIC system will isolate the MCO and start a SCHe system purge if any of the following occur.

a. Seismic event of sufficient magnitude, 0.05g SCIC setpoint, 0.06g parameter limit.

b. Manually initiated isolation and purge from one of the SCIC "ISO & PURGE" buttons (administratively controlled).

c. Loss of Electrical Power to the SCIC (fail-safe condition)

d. MCO reaches an incorrect pressure state without adequate, verified purge volume. The MCO must be maintained above a positive pressure (≥ 0.5 psig) to prevent oxygen ingress unless a purge of adequate volume has been completed. During bulk water draining and the subsequence rinse, the MCO must remain above atmospheric pressure.

e. MCO is below atmospheric pressure and the helium flow is below the minimum required to keep hydrogen less than the lower flammability level (LFL). When MCO pressure is below 12 torr there is insufficient hydrogen to exceed the LFL and no purge is required. A five-minute time delay on low flow allows flow to be stopped in order to reach < 12 torr. The 12 Torr Bypass setting for the SCIC is set at ≤ 7.5 and reset at ≥ 8 torr. Once set, reaching the reset value will remove the bypass for low flow and cause a SCIC Iso & Purge trip.

f. Bay temperature exceeds the high temperature operating point <89 °F SCIC setpoint 89°F parameter limit of 95 °F FHA limit [105 °F sensor calibration (115°F design limit)], which would impact safety class instrument calibration.

g. During the transition from above atmosphere [0.5 psig SCIC trip setpoint, >0.24 psig parameter limit] to vacuum, time to reach less than -11.7 psig (~155 torr) shall not exceed 5 minutes.

h. During the transition from below -11.1 psig (~185 torr) back to greater than 0.5 psig pressure, the time shall not exceed 5 minutes.

i. MCO is above the high-pressure setpoint (11.5psig).

j. Exceeding 8 hours at vacuum the first vacuum cycle or 4 hours at vacuum all subsequent vacuum cycles without re-pressurizing the MCO for a minimum of 4 hours. This is referred to as the 8/4/4 requirement and provides thermal equilibrium within the MCO.

k. SCIC Programmable Logic Controller (PLC) error, includes watchdog timer and internal diagnostics. This trip will be indicated on the SCIC PLC by an "error" light. A mode switch failure code will cause an ISO and Purge. This code will be sent to the MCS for diagnostics.

3.2.2.3 Interlocks.

The following safety class interlocks are provided by the SCIC system.

- During the **7 PRESSURE TEST** mode, valves VPS-GOV 1*09 and -1*05 are interlocked closed to preclude the potential of water addition which would invalidate the final pressure rebound test.

- PWC-GOV 1*30 and -1*03, isolation valves from the MCO to the PWC system are interlocked in **2 HEATUP, 5 DRYING, 6 PROOF,** and **7 PRESSURE TEST** modes to isolate potential water and air sources from the MCO.

- SCHe-GOV-5*12 and 5*31 are temporarily opened for two minutes during the PURGE/FLUSH mode to blow down any water that may have collected from the drain sequence.

- VPS-GOV-1*17 and VPS-GOV-1*11 are interlocked closed in **2 HEATUP, 5 DRYING, 6 PROOF**, and **7 PRESSURE TEST**. This precludes water addition during heatup or after rinse is completed. Water addition after the Initial Pressure Rebound Test would invalidate this test and may lead to Safety Class consequences in the Canister Storage Facility.

3.2.2.4 Non PLC Trip Functions

- The tempered water heat temperature switches TSH-1*28 and -1*29 upon actuation will remove power from the TW Heater to preclude overheating the Cask-MCO. This failure would be equivalent to a loss of annulus water and would result in a thermal excursion under worst case conditions. The contacts of the TSHs are in the circuit with the heater starters, which when opened, will de-energize the 480Vac power to the heater.

- Seismic event of sufficient magnitude (below the *Uniform Building Code* levels) will isolate the MCO, initiate ISO Purge and will remove power from the PWC re-circulation pumps and trip the general service starter to preclude a water spray in the PWC tank room.

- High bay temperature trip will cause an Iso & Purge trip as a means to protect the assumptions in the Fire Hazards Analysis, preclude adverse affects on safety class instrument calibration and protect the environmental limits of the SCIC equipment.

3.2.2.5 System Description.

The SCIC consists of two logic trains and redundant instruments and control functions. A total of four programmable logic controllers are utilized to perform the various setpoint comparisons and to provide all timing functions. The programmable logic controller in bay 4 serves as train "A" for both bay 4 and 5. The bay 5 controller serves as train "B" for both bays 4 and 5. Two local control panels in each bay provide access to both train A and B or access to that bay's safety class system. The following functions are provided by the SCIC:

- Local bay SCIC system, isolation and purge, activation switch
- Control switches for Train A and Train B for the seven different process modes are provided in the CVDF control room. The modes are "**1 BYPASS**", "**2 HEATUP**", "**3 DRAIN**", "**4 PURGE/FLUSH**", "**5 DRYING**", "**6 PROOF**" and "**7 PRESSURE TEST**".
- Indication alarm lights for under-pressure, low purge, tempered water high temperature, seismic trips, Cask-MCO annulus water level low, or bay high temperature
- Logic test and reset switches

Sensors and transmitters providing inputs to the SCIC system consist of the following:

- MCO pressure PT-1*08 and PT-1*10 (vacuum levels)
- MCO higher vacuum pressure or above atmospheric pressure PT-1*36 and PT-1*37
- Normal helium purge rates FIT-1*20 and FIT-1*21
- Cask-MCO annulus water low-level switch LSL-1*24 and LSL-1*25
- Tempered water high temperature switch TSH-1*28 and TSH-1*29
- Process bay high temperature switch TSH-1*38, TSH-1*39, TSHH-1*38, and TSHH-1*39
- Seismic trip sensors and auctioneering circuitry (ATR-5235, ATR-5336, ATR-5437, CP-120, CP-121)

NOTE: The seismic trips are independent of safety class PLC logic. The seismic trip directly controls the final output relay which either is closed to allow power to the safety class valves or is opened on a trip or loss of power. Once a seismic trip is activated, all other logic is circumvented and no longer has a safety class function. These electrical circuits are seismically qualified.

3.2.2.6 Alarms.

Safety class control room alarms consist of:

- BAY * ANNULUS LOW LEVEL
- BAY * PURGE

NOTE: The control room safety class annunciator is required for non-seismic events only. During a seismic event the SCIC system isolates and purges the MCO with no required operator action. Because all safety class lines are seismically qualified, no line breaks can occur within the safety class isolation boundary. A purge of at least 30 minutes ensures that any air that may potentially have entered the MCO prior to the trip/activation is purged out and a helium environment is established. NOTE: If General Service Helium is available to the SCHe system, the actual purge will continue until the SCIC system is reset. Without the General Service Helium supply, the SCHe system is designed to maintain the MCO pressurized for at least 96 hours to allow adequate time for operator response.

3.2.2.7 Alarms.

Defense in depth control room alarms consist of:

- BAY * PWC LOW FLOW

Note: This alarm serves to monitor and alarm the PWC Pre-Drain purge and Post Drain purge to preclude explosive levels of hydrogen and oxygen in the PWC receiving tanks. Manual operator action is required upon an alarm.

3.3 COLD VACUUM DRYING FACILITY AND UTILITY SYSTEMS

3.3.1 System 05-1, Radiation Monitoring System (RM)

Area radiation monitors are provided to monitor radiation levels in of the process bays and in routinely occupied or restricted access areas. The area radiation detector type is rated for medium- to high-energy gamma fields. Continuous air monitors are provided to monitor airborne radiation levels within the process bays and within routinely occupied or restricted access areas. In accordance with HSRCM-1, *Hanford Site Radiological Control Manual*, they continuously monitor airborne beta and gamma radioactivity levels. Alpha monitoring is also provided by the continuous air monitors. Personnel contamination monitors are provided at entrances to the process area for personnel monitoring and contamination control. All area radiation monitors, continuous air monitors, and personnel contamination monitors provide local indication of contamination level (refer to P&ID H-1-82243). The area radiation monitors and continuous air monitors are interfaced with the CVDF MCS. Remote indications and alarms will be displayed at the operations control stations in the control room and in the health physics technician room.

Eberline[3] AlPHA 5/5A and AMS-4 (alpha and beta) continuous air monitors are located in the process bays (1 set at bay 1{CAM-1311}, 2 sets at bays 2 through 5{CAM-1281, -1282, -1251, -1252, -1221, -1222, -1191, -1192}), the Mechanical Room (1 set, {CAM-2071}), in the transfer corridor (1 set, {CAM-1161}), and the tank room (1 set {CAM-1321}). A total of 12

Eberline Instruments Company, Santa Fe, New Mexico.

sets of continuous air monitors are provided. Eberline EC4-8 (with modifications) area radiation monitors (gamma) are located in each process bay (1 set in bay 1, 2 sets at bays 2 through 5, {ARM-1311, -1281, -1282, -1251, -1252, -1221, -1222, -1191, -1192}) and the tank room (1 set, {ARM-1321}). A total of 10 area radiation monitors are provided. Five Eberline PCM-1B walk in portal monitors (one at each process bay access room, {PM-1181,-1211, -1241, -1271,-1301}; access to the tank room is controlled through the process bay 1 access room) and one Eberline PM-6A walkthrough monitor (located at the exit from the transfer corridor in room 115, PM-1151) are provided.

The radiation monitoring system requires an initial startup action and stays online during the life of the project. No maintenance activities are anticipated during the CVDF three-year operating period. Periodic retest of the alarm circuits is required. The system design description for the radiation monitoring system is contained in SNF-3060.

3.3.2 System 05-2, Room Air Quality System (AQ)

The process bay atmosphere is monitored for low oxygen with local and remote alarms via the MCS (refer to P&IDs H-1-82243). Gas Tech[4] oxygen sensors (eight per bay) are located in bays 2 through 5 and in the PWC tank room (4 for the room).

The room air quality system requires an initial startup action and stays online during the life of the project. No maintenance activities are anticipated during the CVDF three-year operating period. Periodic retest of the alarm circuits is required. The system design description for the room air quality system is contained in SNF-3060.

3.3.3 System 06, Civil/Structural System (CIV)

The CVDF main building consists of a single-story, steel-frame building containing a second-level mezzanine. Immediately adjacent to the process building on the west is a two-story structural steel metal building that encloses the transfer corridor, process bay support areas, and mechanical equipment room. Immediately adjacent to the process building on the south is a single-story, pre-engineered metal building that encloses administrative and change room functions. Immediately adjacent to the process building on the north is a single-story, concrete and structural steel building that encloses a process water tank room. The exterior composed of pre-stressed concrete panels for the process building and process water tank room, and composed of insulated metal panels for the transfer corridor and mechanical equipment building and administration building.

Construction material types utilized are durable, cleanable, and maintainable. The construction of the CVDF is in accordance with the *Uniform Building Code* and DOE Order 6430.1A, *General Design Criteria*, with egress requirements conforming to NFPA 101, *Safety to Life from Fire in Buildings and Structures.*

Gas Tech, Incorporated, Newark, California.

The configuration of the CVDF includes a building footprint of approximately 12,800 ft^2 for the process bays and support areas and approximately 3,000 ft^2 for administrative and change room areas.

The occupancy of the CVDF has been identified as 20 persons. The system design description for the civil/structural systems is contained in SNF 3061.

3.3.3.1 Process Bays.

Each process bay is designed to enclose a Cask/MCO trailer without the tractor attached. Process bay construction is designed to provide radiological separation and confinement within each bay.

The process bay building design utilizes a steel frame and prestressed concrete panel system that has a bay width of 30 ft and a rigid steel frame system that has a nominal length of 60 ft. The height of the process bays is nominally 32 ft, which is dictated by the manned access working level of the shipping cask, the crane access to remove the cask lid, and the physical and functional requirements for all of the operations necessary in the CVDF.

Access to the process building is accomplished with a corridor that is contiguous with the main change room for radiological control of access and egress from the process area. Individual process bay access and egress control is through a change room.

3.3.3.2 Process Bay Space Requirements.

Each process bay provides ground floor space for the following.

- Enclose a cask trailer without the tractor attached.
- Personnel circulation and functional space around the cask trailer.
- Vacuum drying skid equipment and pump assemblies.
- Access to the working level of the cask trailer.
- Radiological control between a process bay and the access corridor where operators change clothing and are monitored for radiological contamination prior to admittance to the access corridor.
- Bridge crane access to remove the cask lid and perform maintenance on equipment.
- A cabinet for supplies.
- Storage locker for special tools and equipment.

- Electrical and SCIC panels.

- Health physics technician work table.

- Access to the working level of the cask is accomplished using a mezzanine level with space for the following.

- Access to the working level of the cask transporter for connections from the vacuum drying module.

- Heating, ventilating, and air conditioning (HVAC) equipment.

- Process hood assembly.

3.3.3.3 Process Bay Support Areas.

The process bay support areas serve as airlock between the controlled process bay and the uncontrolled access corridor. Functional requirements for each support areas are as follows:

- Seating space for two allowing for the dressing/undressing of special work permit clothes

- Storage of clean special work permit clothing

- Storage of dirty special work permit clothing

- Space for personnel contamination monitor equipment.

3.3.3.4 Decontamination Room.

A single decontamination room serves all process bays. This space includes the following:

- Clear standing space for the decontamination process
- Storage of decontamination materials and detection equipment
- One decontamination shower with self contained drain tank.

3.3.3.5 Swipe and Count Room.

A swipe and count room is provided to analyze and store samples taken from process bays or areas that have the potential for contamination. This space includes the following:

- Desk space for preparing testing reports
- File storage of records
- Wall space for the mounting of gas bottle equipment.

3.3.3.6 Process Water Conditioning Tank Room.

Water removed from an MCO has the potential for being contaminated, thus it will be stored in a tank located in an isolated room with controlled access. The process water conditioning tank room is located directly adjacent to a process bay to allow a tanker trailer to enter the bay and receive the transfer of MCO water, after processing, from the storage tank to the tanker truck.

3.3.3.7 Deionized Water Equipment and Instrument Air Equipment Room.

Approximately 120 ft^2 of enclosed floor space in the support area is provided for the deionized water equipment and storage tank and the instrument air system equipment.

3.3.3.8 Security System Equipment Room.

Approximately 120 ft^2 of enclosed floor space in the support area is provided for Security system equipment.

3.3.3.9 Mechanical Equipment Room.

Approximately 3,000 ft^2 of enclosed floor space in the support area is provided for HVAC and miscellaneous utility system equipment.

3.3.3.10 UPS Room

Approximately 120 ft^2 of enclosed floor space in the support area is provided for UPS system equipment.

3.3.3.11 Administrative Area.

Personnel access into the CVDF will be provided by the administrative area. Other functions listed below are also provided:

- Lunch/conference room
- Quality assurance process engineer office
- Shift manager office
- Health physics technician and radiation monitoring room
- Control room
- Electrical and telecommunications room
- Fire riser room
- Men's and women's restrooms
- Men's and women's change rooms
- Access and egress control and personnel control monitoring of the process bays.

3.3.3.12 Lunch and Conference Room

A lunch and conference room is provided with space for seating 12 people, space for refrigerator, and casework with sink and storage.

3.3.3.13 Quality Assurance and Process Engineering Office

Provides office space for two persons performing quality assurance and process engineering duties. Work spaces contain desks and associated equipment.

3.3.3.14 Shift Manager Office

Provides office space for one person performing shift management duties. Work space contains desk and associated equipment.

3.3.3.15 Health Physics Technician and Radiation Monitoring Room

Provides office space for one health physics technician performing radiation monitoring. This monitoring room provides:

- Work space with desk and associated instrumentation equipment
- Storage space for health physics technician equipment
- Wall space for the mounting of gas bottle equipment.

3.3.3.16 Control Room

Provides space for process bay control room functions:

- Computer monitoring stations
- MCS programmable logic controller cabinet space
- SCIC system annunciator and Mode control panels
- Security monitors (two) and egress alarm panel
- HVAC Control panels.

3.3.3.17 Electrical and Telecommunication Room

Provides space for electrical and telecommunication systems and equipment.

3.3.3.18 Fire Riser Room

Provides space for fire protection system alarm check valve riser and accessories.

3.3.3.19 Men's and Women's Restrooms

Restroom facilities are provided for both men and women employees in close proximity to the respective change rooms. Restrooms provide:

- Men's toilet and urinal fixtures
- Women's toilet fixtures
- Men's and women's lavatory fixtures.

3.3.3.20 Men's and Women's Change Rooms

Change room facilities are provided for men and women employees in close proximity to the respective restrooms. Change rooms provide:

- Men's shower facilities
- Women's shower facilities
- Men's and women's storage lockers and benches
- Space for change room supplies storage.

3.3.3.21 Standby Power Building

Approximately 648 ft^2 of enclosed floor space in the support area is provided for Standby Power System equipment and support utilities. There are two cells of equal area in the building for two diesel generator sets. Only one generator will be operational. The Standby power building is located on the northwest corner of the CVDF fenced area.

3.3.3.22 Miscellaneous Structures and Equipment Pads

The following miscellaneous structures and equipment pads are provided as part of the CVDF:

- GSHe concrete pad
- Sanitary Waste tank and Local Alarm panel
- HVAC system Exhaust Stack
- Effluent Drain Collection basin
- Electrical Transformer pad
- Reference Air Enclosure
- MCO-Cask Trailer Access pad
- Security perimeter fence

3.3.4 System 11, Communications System (COMM)

The communications system provides the operations personnel the ability to communicate within the facility for the efficient operation of the facility systems. The communications system interfaces with the 100 K Area communications, the Hanford Local Area Network system, and the local telephone network. The CVDF communications system consists of a voice paging system, a telephone system, and Hanford Local Area Network computer connections.

The communications system is designed to send and receive routine CVDF operations messages between the CVDF administrative locations and the respective process and utility areas of the CVDF. In addition, the system is capable of transmitting and receiving emergency warning signals and messages to and from the 100 K Area alarm station. The CVDF communications system layout is shown on diagram H-1-82243. The CVDF communication system is provided by U.S. West in accordance with HNF-S-0403, *Standard Specification for Hanford Site Telecommunications Systems and Facilities*.

The voice paging system includes the following features.

a. The voice paging system is controlled from the operations control room. The system is capable of paging from the control room to the CVDF work locations. These areas include the process bays, process water tank room, transfer corridor, mechanical equipment room, administrative annex, and the external equipment pads.

b. The voice paging system is one-way. Multiple Remote Headsets with microphones or two-way radios will be provided only in the process bays. Wall-mounted speakers are located throughout the rest of the facility.

c. The voice paging system is able to receive and translate alarm initiation codes from the 100 K Area alarm station. The voice paging system will recognize the codes for evacuation and take-cover alarms and is capable of broadcasting the standard Hanford Site signals for these alarms over the speaker and/or horns. The CVDF is connected to the existing 100 K Area Valcom[5] voice paging system.

d. The voice paging system is able to send alarm initiation codes and public address messages to multiple remote alarm stations. Codes for evacuation and take-cover signals are included in the voice paging system code list. The voice paging system includes a voice handset or provisions for a microphone to be used for the public address function.

e. The link between the 100 K Area emergency warning signal base station and the remote alarm station at the CVDF is a radio base station. This radio will carry modulated codes to differentiate among the different emergency signals that must be generated. Additionally, to send emergency messages, the radio is able to transmit voice signals to the speaker and/or horn at the remote alarm station at the CVDF. The remote alarm station is in the

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Valcom Incorporated, Roanoke, Virginia.

control room.

f. The sound level produced by the speakers and/or horns will at least be 10 dB above background noise in all CVDF areas covered by the system. In areas where intermittent high-noise conditions exist or normal background noise exposure requires workers to wear ear protection, flashing lights of a distinctive color will be triggered with any alarm signal or with any public address message. Provisions to reduce background noise interference are made at intercom stations in high-noise areas.

The telephone system includes the following features.

a. The telephone system provides standard telephone service to the CVDF. Standard outside line telephones are to be provided in the shift operations manager office (one), the process engineer and quality assurance office (two), the health physics technician office (two), the operations control room (one), the administrative annex entrance (one), and the conference room (one). Phones are also provided in the process bays transfer corridor and the mechanical room.

b. The intercom and voice paging systems are integrated with the standard telephone. The system is capable of paging from every station. Control of the intercom and voice paging is from the control room. Each intercom station can be individually addressed from the control room station. The intercom and voice paging systems consist of a mixture of remote headsets, radios, or speakers located in each of the five process bays (two each remote headsets), each of the five bay access rooms (one each speaker phone), the tank room (one speaker phone), transfer corridor (one speaker phone), mechanical equipment room (two speaker phones), at exit of the transfer corridor (one speaker phone), men's change room (one speaker phone), and women's change room (one speaker phone).

c. A telephone with autodial features is located in each process bay, in room 126, and two are located in the control room. These telephones have outside line connections

d. In addition to standard telephone service, a crash alarm phone is provided for the facility. A crash alarm phone system is available to operations personnel to use in relaying emergency messages. The crash alarm is located in the control room.

e. Each telephone outlet (for outside line service) includes a telephone jack and data communications jack (Hanford Local Area Network).

f. A fax machine is located in the administrative annex.

g. No backup up power is required in the CVDF for the telephone system.

h. Paging system

Hanford Local Area Network service is extended to the CVDF to support routine operations administrative activities. Hanford Local Area Network service is located in the shift operations manager's office (two), the process engineer and quality assurance office (two), the health physics technician office (one), the operations control room (one), and the conference room (one). NOTE: All telephone outlets (for outside line service) have Hanford Local Area Network service.

The communication system requires an initial startup action and stays online during the life of the project. No maintenance activities are anticipated during the CVDF three-year operating period. The system design description for the communications is contained in SNF-3065.

3.3.5 System 12, Instrument Air System (CA/IA)

The instrument air system (refer to P&ID H-1-82222) supplies dry, filtered, oil-free instrument air at approximately 115 psig to the process equipment skid gas operated valves (GOV) and GOVs throughout the facility. This air is used to operate the spring return automatic valves, to inflate the Cask-MCO seal ring bladders, and to purge the Cask-MCO annulus following the cold vacuum drying operation. Instrument air at 25 psig is supplied to the solenoid-operated valves and damper position controls for isolation, volume, and backdraft in the HVAC system. The IA system provides air for monitoring and control of the HVAC system, PWC samplers, process instruments, gas-operated valves, and solenoid-operated items. The IA system also delivers air for operating hand tools in each of the process bays.

The Instrument air system supplies air for pneumatic tools at 115 psig. Instrument air is required for the trailer air ride suspension operation.

The instrument air system consists of duplex two stage piston type compressors, CA-CMP-5019-1/-2, a 250 gal receiver tank CA-TK-5019, pressure control valve CA-PCV-5006, a refrigerated air dryer, CA-DRY-5020, automatic regenerative desiccant beds CA-DRY-5021, pressure relief valve CA-SRV-5007, low pressure alarm PAL-5008, and associated distribution piping and valves. The instrument air system has a specified rating of 25.1 cfm at 175 psig. Air with a -40°C (-40°F) dewpoint, as measured by XE-5009, and oil free (less than 10ppm of oil) has been specified for the air quality. The instrument air system is to be run in automatic mode continuously. Only local start and stop of the compressor is provided (no remote operation). Sufficient supply of instrument air to accommodate a four-hour compressor downtime has been specified.

The instrument air system requires an initial startup action and stays online during the life of the project. No maintenance activities are anticipated for the IA system during the CVDF three-year operating period. The system design description for the instrument air system is contained in SNF 3066.

3.3.6 System 13-1, General Service Helium System (He)

The general service helium system (refer to P&IDs H-1-82160, H-1-82161, and H-1-82222) is designed to allow control of flow or of pressure to multiple points within the process. Flowrate to the VPS is measured by FE-1*19, FE-1*20 and FE-1*21. The required flowrate is sent to He-FV-1*20 by remote setpoint from FIC-1*20 which is computed in the MCS from FE-1*20 or FE-1*21, whichever is lower. The actual injection point is He-GOV-1*12 for vacuum pump condenser input; He-GOV-1*06 and He-GOV-1*02 for MCO port #3 (Axial Process Tube port) inlet; He-V-*026/*063 for VPS vacuum pump interstage purge; He-V-*016/*066 for MCO purge; He-V-*126, VPS-GOV-1*11/1*17 for PWC line purge and He-V-*026/He-V-*071, He-V-*026/He-V-*072, He-V-*026/He-V-*073, and He-V-*026/He-V-*074 for SCHe supply.

The General Service He system consists of two helium tube transporters that supply helium to the system. The tube trailers are parked outside the west wall of the CVDF, and are connected to an outside piping system with the necessary valves, etc., that in turn couples to a through-wall-penetration delivery pipe into the CVDF for further distribution. Inside the CVDF, the helium is further distributed via a header that runs the full length of the east wall of the transfer corridor. Branch piping connects each process bay to the helium header; flexible piping is used to distribute the helium to the PES, the process hood and support stand, the SCHe system and the PWC transfer header. The GSHe system includes the necessary pressure regulators, pressure and flow indicators, control valves, and pressure relief valves to enable it to perform its functions. The trailer supplies approximately 3000 psig helium and is contained in 12 individually valved bottles per trailer. Regulator and relief valves are provided with the leased trailers. Minimum capacity of 50-scfm at a pressure set to 100 psig. (The use of two tube trailers allows staged use, such that the empty helium tube can be replaced by a full one while the other unit is providing helium to the system). Helium will not be drawn from both trailers at one time.

The supply header normally operates at 20 psig as controlled by He-PCV-5028 with low level alarms, PAL-5030 set at 15 psig and a high level alarm, PAH-5030, set at 25 psig. Safety class relief valves, He-SRV-5026 and –5027, are set at 25 psig to provide pressure control protection of the MCO in case of failure of the normal pressure control valve in the helium supply header.

A backup helium purge to the PWC receiver tank comes off He-101-SS-3/4" and through valve He-V-001. After the valve, the helium line passes through flow indicator FI-5031 and check valve, He-CKV-001. The helium line then interfaces with the PWC system through line PWC-001-SS-1". This helium connection is also used to break the PWC receiver tank vacuum during all drain operations. Access to He-V-001 is in the transfer corridor outside of the decontamination room.

The general service helium system requires an initial startup action and stays online during the life of the project. No maintenance activities are anticipated during the CVDF three-year operating period. Periodic changeout of depleted tube trailers is required (estimated on a biweekly basis). The system design description for the helium system is contained in SNF 3067.

3.3.7 System 14, Cranes and Hoists (HOI)

The CVDF has four overhead trolley cranes. The crane is utilized to remove and install the Cask lid from the Cask and to install and remove the process hood from the top of the Cask-MCO. The cranes can also be used to assist in maintenance activities within the process bay when required. The bay 2 bridge crane is labeled HOI-520; bay 3 bridge crane, HOI-530; bay 4-bridge crane, HOI-540; and bay 5-bridge crane, HOI-550.

The CVDF cranes have a service rating of 4,000 lb. The cranes are designed in accordance with the criteria included in CMAA 74, *Specifications for Top Running and Under Running Single Girder Electric Overhead Traveling Cranes Utilizing Under Running Trolley Hoist*, with Class "D" heavy service rating. The cranes are top running, single girder with capping channel. The bridge, trolley, and hoist are driven by electric motors and are capable of operation from the mezzanine level by the use of a pushbutton station. The cranes are controlled with a NEMA 12-rated, 3-motion, 8-button and 1-toggle unit enclosure. The controls are marked HOIST UP, HOIST DOWN, TROLLEY NORTH, TROLLEY SOUTH, BRIDGE EAST, BRIDGE WEST, INCH ON/OFF, and EMERGENCY STOP. Speed control of the bridge and trolley is provided through an inverter based variable frequency drive. The movements of the hoist are controllable to within ¼ in. from a complete standstill. The pushbutton unit is permanently mounted to the mezzanine guardrail. The crane has brakes in accordance with CMAA 74. The crane has limit switches to prevent over travel of the hoist in the raise direction only. The crane has removable seismic stops, which prevent the end trucks from lifting off the runway rail.

The crane is designed in accordance with performance category 3 criteria utilizing the criteria for seismic analysis and is qualified for seismic 3/1 criteria in accordance with HNF-SD-SNF-DRD-002, Section 6.3.4. The crane support structure is anchored for the design basis seismic performance category 3 criteria in accordance with HNF-PRO-097. Lifts involving the Cask-MCO equipment may be classified as critical lifts. Crane operating procedures and load testing are in accordance with DOE-RL-92-36, *Hanford Site Hoisting and Rigging Manual.*

The cranes require an initial startup action and stay online during the life of the project. No maintenance activities are anticipated during the CVDF three-year operating period. The system design description for the cranes and hoists system is contained in SNF 3072.

3.3.8 System 18, Effluent Drains System (EFS)

Surface drains in the process areas will serve to provide spill confinement and to collect fire discharge water. All of the spill containment fire and discharge water will be routed in piping to an above ground retention basin located west of the facility (refer to P&ID H-1-82223). The containment piping is routed from a monitoring sump, sized for 200 gal, where the spill discharge occurrence may be detected by a periodic inspection. The discharge may then be tested by plant personnel for contamination. The spill containment monitoring box has a discharge opening to drain the sump. If contamination is detected in the sump, then this water will be pumped to the PWC system by a suction wand or to a storage drum by a specialty equipment pump, SE-FAC-007, (system 100). The drum will be transported to the KW basin for processing by operations personnel.

In case of fire detection, the monitoring sump has an isolation valve that will allow the high water flow of the fire sprinklers to pass through the monitoring sump into the 20,000 gal retention basin. The fire water requirement is 20 minutes of water flow at the largest area 7,200 gal. The 20,000 gal retention basin is a concrete structure. Pump out of the basin will be performed by operations personnel.

The effluent drains system requires an initial leak test and stays online during the life of the project. No maintenance activities are anticipated during the CVDF three-year operating period. Periodic retest of the floor sump circuits may be required. The system design description for the effluent drains system is contained in SNF 3073.

3.3.9 System 19, Condensate Collection System (CCS)

Condensate from the process bay HVAC system is routed in piping to a collection tank located on the floor of the process bay. Water from the collection tanks will periodically be drained and sampled as required. If contamination is detected in the tank, then this water will be pumped to a storage drum by specialty equipment pump, SE-FAC-007, (system 100). The drum will be transported to the KW basin or ETF for processing by operations personnel.

The Condensate collection system requires an initial leak test and stays online during the life of the project. No maintenance activities are anticipated during the CVDF three-year operating period. The system design description for the Condensate collection system is contained in SNF 3074.

3.3.10 System 20-1, Electrical Power Distribution System (EPD)

The electrical power distribution system provides electrical power distribution for the CVDF, equipment, and instruments as required. Normal power is provided with a grounding system to ensure safety to personnel and equipment, to provide a connection to earth for transformer neutrals, to provide a discharge path to ground through lightning and surge arresters, and to provide a reference point for electronic systems.

The electrical design follows the guidelines and incorporates the following regulations and requirements. The applicable portions are included in the construction specifications:

- DOE Order 6430.1A, *General Design Criteria*, Division 16, "Electrical"
- NFPA 70, *National Electric Code*
- *Fire Resistance Directory.*

All electrical equipment is energy efficient where applicable and available.

The design includes the extension of an overhead 13.8 kV primary circuit from existing poles at a point adjacent to the site. The existing circuit is extended and routed overhead to a point near the south edge of the construction site. Using fused cutouts and lightning arresters; the extended overhead circuit is converted to an underground circuit to supply the new building pad-mounted transformer.

All underground primary conduit is concrete encased and buried a minimum of 2 ft below finished grade. A conduit marking tape is provided above the underground conduit route at a depth of 1 ft below finished grade.

A Rtemp, oil-filled, with factory mutual approval, FMS-4/8-7 pad-mounted transformer is located on the southwest side of the facility. The transformer is sized to accommodate the electrical requirements. Secondary power at 480 V is routed into the building through underground conduits.

Power is distributed by a free-standing, metal-enclosed switchboard. Phase, neutral, and ground bussing is provided. The switchboard bussing has the capacity to accommodate a 20% increase in electrical demand. Switchboard main and feeder circuit breakers have adjustable solid-state trip units responsive to long-time, short-time, instantaneous, and ground-fault current characteristics.

A primary meter measuring kilowatt-hour is installed on the overhead power pole to measure power usage.

Motor loads that are not part of prepackaged equipment are powered from a 480 V, 3-phase motor control center located in the mechanical room. The motor control center is free-standing; metal enclosed with modular plug-in combination motor controllers. Assembly and wiring complies with the National Electrical Manufacturer's Association NEMA type IB wiring. All wiring is extended to terminal compartments for ready access. Controllers are National Electrical Manufacturer's Association-rated and contain spare interlocks.

Panel boards for power distribution, lighting, receptacles, and small loads are constructed in accordance with Federal Specification W-P-115, Type 1, Class 1. Main circuit breakers are provided in panel boards. Panel board circuit breakers are the molded case bolt-on type. Selected feeder breakers are provided with GFCI/GFPE feature for loads such as heat trace.

Duplex receptacles are provided around the inside perimeter of the bays for 120 VAC loads. Ground fault circuit interrupting type receptacles are provided for the receptacles located within 5 ft, 0 in. of wet surfaces and sinks as required by NFPA 70 and are located in bays 1 through 5 and the tank room due to decontamination activities. Office areas are provided with 120 V duplex receptacles. Appropriate receptacles are provided for cord-connected equipment such as lunchroom equipment, computer equipment, and radiation monitoring equipment.

The design provides for installation of feeders (conduit and wire) adequately sized for equipment to be installed. Where equipment packages (e.g., the process equipment skid) have several motors or electrical loads, not all of which will operate simultaneously, the feed was sized for the loads expected to operate simultaneously.

Generally, all power and control conduits used within the facility are rigid galvanized steel, with the exception of those used in the alarm systems.

The electrical power distribution system requires an initial startup action and stays online during the life of the project. No maintenance activities are anticipated during the CVDF three-year operating period. Periodic retest of the distribution circuits may be required. The system design description for the electrical power distribution system is contained in SNF 3075.

3.3.11 System 20-2, Lighting System

3.3.11.1 Interior Lighting

Interior facility lighting consists of energy-efficient fixtures typically operated at 120 V. Lighting levels are as recommended in the Illuminating Engineering Society *Lighting Handbook.* High-bay area lighting consists of metal-halide fixtures when ceiling height permits good lighting design. Lighting for storage areas and mechanical areas are high-output industrial fluorescent fixtures. Other interior lighting consists of surface or flush-mounted commercial fluorescent fixtures. Multiple-level switching is generally provided for areas with fluorescent fixtures. The facility interior lighting is detailed on drawing H-1-82241.

The interior lighting system requires an initial startup action and stays online during the life of the project. No maintenance activities are anticipated during the CVDF three-year operating period. Periodic changeout of failed lights will be required.

3.3.11.2 Exterior and Security Lighting

Exterior building lighting is provided. Metal-halide, wall-mounted fixtures are installed at all exterior doors. Exterior lighting is controlled by a photocell installed in a weatherproof enclosure. The facility exterior lighting is detailed on drawing H-1-82241.

The exterior lighting system requires an initial startup action and stays online during the life of the project. No maintenance activities are aniticipated during the CVDF three-year operating period. Periodic changeout of failed lights will be required.

3.3.11.3 Exit Lighting System

Exit signs are provided at the interior of each building exit. In areas where means of egress are not readily apparent, directional exit signs are provided. Exit signs include integral chargers, batteries, and relays to provide illumination automatically upon failure of the normal power source. The facility exit lighting is detailed on drawing H-1-82241.

The exit lighting system requires an initial startup action and stays online during the life of the project. No maintenance activities are anticipated during the CVDF three-year operating period. Periodic retest of the charging circuits are required.

3.3.11.4 Emergency Lighting System

Emergency lighting is provided inside the facility in accordance with NFPA 101. Emergency lighting in areas with fluorescent lighting is provided by use of fluorescent fixtures with integrally mounted backup battery packs with a 90-minute capacity. The facility emergency lighting is detailed on drawing H-1-82241. Emergency lighting required during the extended periods (exceeding 90 minutes) of normal power outage are provided with standby power from diesel generator, see PNL-3, DWG. H-1-82247, Sheet 3.

The emergency lighting system requires an initial startup action and stays online during the life of the project. No maintenance activities are anticipated during the CVDF three-year operating period. Periodic retest of the charging circuits is required.

The system design description for the lighting system is contained in SNF 3075.

3.3.12 System 20-3, Grounding System

A grounding electrode system is constructed in accordance with NFPA 70, Article 250. Interconnected elements include building reinforcing steel, water piping, and a concrete-encased grounding electrode. A separate equipment ground conductor is routed with all power conductors and lighting circuits. The facility grounding system is detailed on drawings H-1-82242, H-1-82246, and H-1-83981.

The system design description for the ground system is contained in SNF 3075.

3.3.13 System 20-4, Facility Uninterruptible Power Supply System

One 30 kVA, 480 Vac to 208/120 Vac, facility UPS system is provided. The facility UPS system is complete with batteries, static battery disconnect switch and circuit breaker, voltage inverter, and a battery charger. The facility UPS system is detailed on drawing H-1-82247, sheet 3. Uninterruptable power from the facility UPS unit UPS-1 is provided in the case of site normal power outages. UPS by-pass power will be provided from the facility Diesel Generators standby power. All MCS programmable logic controllers, process bay remote I/O panels, operator control stations, continuous air monitors, area radiation monitors, and oxygen monitors are provided with a UPS system with a minimum of one hour run time at full load. The facility UPS is located in Room 129.

One 3.1 kVA, 208/120 V to 208/120 V, UPS system complete with battery packs, battery disconnect switch and circuit breaker, and maintenance bypass cabinet is provided to the security system for continuous power during but not after a design basis accident. All security sensors, cameras, and sensor and video transmission equipment is provided with a UPS system with a minimum of eight hours run time at full load. The security UPS is located in Room 126.

The SCIC system local control panels (one each in bays 2 through 5) and annunciator panel (in the control room) do not require a UPS directly; a power conditioning device is required which is derived from a UPS device. The SCIC system UPS is provided as part of the CVDF design (H-1-82301 sheets 1 and 13). Seismic trip equipment is provided with a self-contained UPS. Design requirements are specified in HNF-SD-SNF-DRD-002.

Other backup power is provided for specific systems only by use of direct current battery systems and battery chargers. The battery backup systems are provided for:

- Fire alarm control panel (integrally mounted)
- Emergency egress and exit illumination (integrally mounted)
- Communications system (at the site level).

The various UPS systems require an initial startup action and stay online during the life of the project. An annual inspection of the UPS unit will be performed which includes removal of dirt or foreign materials deposited on electrical components and retorquing of major power connections. Periodic retest of the UPS systems is required. The system design description for the facility UPS system is contained in SNF 3075.

3.3.14 System 20-5, Lightning/Surge Protection System

Lightning and surge protection is provided for the building using pole mounted lightning arresters as detailed on diagram H-1-83981. Lightning protection also includes roof-mounted air terminals (rods and copper downcomer wires), a minimum of four downcomers, and bonding of exposed building metal to the building ground grid. Lightning protection is also provided to the Standby Power building and the HVAC Exhaust stack. The lightning/surge protection system complies with all requirements of the latest edition of NFPA 780, *Lightning Protection Systems*. The lighting/surge protection system is passive and thus requires no startup activities. The system design description for the lightning/surge protection system is contained in SNF 3075.

3.3.15 System 20-6, Standby Power System

The CVDF has a 480 Vac, 100 kW standby diesel generator set. The standby power system provides loads to the following systems:

- Process bay local exhaust HVAC system (fans),
- UPS system,
- Instrument air system.

The diesel generator is designed to performance category 2 seismic criteria. The standby power system is designed to restart the process bay local exhaust HVAC system to reestablish the required minimum dilution airflow rate within 1 minute following loss of normal electrical power to the local exhaust fans. A standby power building located west of the main CVDF buildings houses the diesel generators, compressors, compressed air tanks, diesel fuel tanks, control/electrical panels. There are two diesels in the building; however, only one is fully installed. A speaker is provided in the Standby Power building to allow personnel to hear the paging system. The loads requiring DG standby power are fed from Panel and DG-DP-001, DWG H-1-82247, Sheet 3 and H-1-83978, Sheet 1. Normal power to this panel is fed from MCC-1.

3.3.16 System 23, Service Water System (SWS)

Service Water is supplied to the CVDF from existing 100 K Area service water system on the west side of the 165-KW Building. Fire sprinkler service is supplied from the facility service water. Reduced pressure backflow preventers are installed at the interface locations. All service water piping is designed and constructed in accordance with ASME B31.3, *Process Piping Code*, or ASME B31.9, *General Services Piping Code.*

3.3.17 System 24, Fire Protection System (FPS)

The CVDF fire protection water system (refer to drawings H-1-82092, H-1-82094, H-1-82237 to H-1-82240, and H-1-82244) includes the required isolation valves, two fire hydrants, a post indicator valve, and supervisory functions. The transfer line to the CVDF Fire Protection supply water is an 8 in. diameter polyvinyl chloride main service line, which originates in the 165-KW cross tie tunnel. A 6 in. diameter building service line is connected to the new main service to supply the building sprinkler system (H-1-82237 to H-1-82240). The CVDF fire protection alarm system is detailed on drawing H-1-82244. The fire alarm control panel and radio fire alarm reporter are located near the main building entrance as depicted on drawing H-1-82244. Inputs to the fire alarm panel originate from photoelectric detectors dispersed throughout the CVDF facility and from the temperature sensors in the HVAC ducting.

The fire protection system requires an initial startup action and stays online during the life of the project. No maintenance activities are anticipated during the CVDF three-year operating period. The system design description for the fire protection system is contained in SNF-3077.

3.3.18 System 25, De-Ionized Water System (DI)

Deionized water is supplied to the process via a packaged deionized water unit (refer to P&ID H-1-82222). The deionization unit is sized for a peak flow of 10 gal/min. The unit is located in the DI/CA room, feed water is supplied from the facility's potable water system through a backflow preventer. The system shall contain four deionization tanks, a holding tank, an expansion tank, and a transfer pump. The DI system contains alarms for holding tank high water level, low header pressure and high conductivity. All alarms are monitored by the MCS.

The deionized water system requires an initial startup action and stays online during the life of the project. Maintenance of the system will be contracted to the supplying vendor. The system design description for the deionized water system is contained in SNF-3078.

3.3.19 System 26, Potable Water System (PW)

Potable water is supplied to the CVDF from the existing 100K Area sanitary water loop on the west side of 165-KW. The sanitary water service main is a 2-inch diameter polyvinyl chloride pipe. Backflow preventers and pressure-reducing valves are inside the CVDF (refer to P&ID H-1-82222). Potable water feeds the administrative building plumbing fixtures in standard copper piping. The potable water also feeds two residential-type 52-gal hot water heaters to provide adequate hot water for the four showers (hot potable water). The potable water supplies the process deionized water unit via a reduced pressure backflow preventer and the chilled water makeup connection (non-potable water). All potable water lines are insulated.

The potable water system requires an initial startup action and stays online during the life of the project. Annual inspections and testing of the reduced pressure backflow preventor is required during the CVDF three-year operating period. The system design description for the potable water system is contained in SNF-3079.

3.3.20 System 27, Sanitary Sewage Collection System (SANS)

Sanitary sewage from the CVDF is gravity drained to a 5,000-gal underground holding tank located west of the building (refer to P&ID H-1-82222) and has a fluid level sensor. The pipe material is acrylonitrile-butudiene-styrene, except where exposed, which is galvanized steel. The holding tank is to have the capacity to store three days of sanitary water with maximum occupancy of the facility. A high level alarm will be initiated at a preset level in the tank. The alarm is displayed locally by means of a flashing red light. The tank is expected to be pumped by using a pumper truck designed for such purposes.

The sanitary sewage collection system requires an initial startup action and stays online during the life of the project. The system design description for the sanitary sewage collection system is contained in SNF-3080.

3.3.21 System 30-1, Administration Building Heating, Ventilation, and Air Conditioning System (HVAC)

The Administration Building is conditioned with air from a dedicated air handling unit for this area (refer to P&ID H-1-82195). Air is re-circulated in this system with a minimum of make-up air to maintain air quality and provide air for the change room and shower area exhaust system. Air from the change room and shower areas is exhausted directly to the outside and is not re-circulated. To prevent possible contamination, air in the room connecting the administration area to the transfer corridor is not re-circulated but is directed toward the transfer corridor and the HEPA filtered general exhaust system. The HVAC control system is located in the CVDF control room which provides alarm and monitoring of all HVAC functions according to the detailed HVAC operational control description included in SNF-3081. The system design description for the Administration Building HVAC system is contained in SNF-3081.

3.3.22 System 30-2, Process Bay Re-Circulation Heating, Ventilating, and Air Conditioning System (HVAC)

Each process bay is served by an independent supply air system which filters and conditions the supply air (refer to P&ID H-1-82204). A majority of the bay air is re-circulated to conserve energy. The supply and return air passes through a prefilter and two HEPA filter stages to control contamination. Make-up air is supplied, as required, to maintain air quality in the bay and to provide air for the local exhaust system. Each process bay air intake system is provided with a confinement isolation damper and backdraft damper to prevent backflow of air to the outside. The Automatic Temperature Control (ATC) system is located in the CVDF control room which provides alarm and monitoring of all HVAC functions according to the detailed HVAC operational control description. The system design description for the process bay re-circulation HVAC system is contained in SNF-3081.

3.3.23 System 30-3, Process Bay Local Exhausts Heating, Ventilating, and Air Conditioning and Process Vent System (HVAC/PV)

A local exhaust system is provided to serve all of the active process bays (refer to P&ID H-1-82206). This system serves the MCO process hoods and the process system exhaust and vent streams that may be normally contaminated. Confinement isolation dampers are provided on all duct branches connecting to the hood system to prevent back flow in the event of system shutdown. The process vents are opened to the HEPA filters during operation. Fully redundant exhaust fans are provided for the process bay local HVAC and process vent exhaust system. The air in this exhaust system passes through an air handling unit (located in the mechanical equipment room) containing a prefilter and two HEPA filter stages before exhausting through the stack.

The process vent system is part of an integrated, multi-zone HVAC venting system (refer to P&ID H-1-82206). The process vent system removes offgas from the process equipment skid (VPS exhaust), SCHe system, Cask Vent, and PWC system skid equipment, and provides a sweep function for the process vent hood located on the top of the MCO.

The process bay local exhaust HVAC and process vent system require an initial startup action and stays online during the life of the project. No maintenance activities are anticipated during the CVDF three-year operating period. The HVAC control system is located in the CVDF control room which provides alarm and monitoring of all HVAC functions according to the detailed HVAC operational control description. The system design description for the process bay local exhaust HVAC and process vent system is contained in SNF-3081.

3.3.24 System 30-4, Process General Supply/Exhaust Heating, Ventilating, and Air Conditioning System (HVAC)

The transfer corridor, associated support rooms, the tank room, and the mechanical room are supplied with conditioned air from the process general supply/exhaust HVAC system (refer to P&ID H-1-82205). The air in this system is not recirculated. Confinement isolation dampers are provided on the outside air intake and tank room supply duct to prevent backflow of air in the event of system shutdown.

Each process bay is served by the process general supply/exhaust HVAC system (refer to P&ID H-1-82205) with sufficient capacity to ensure adequate controlled ventilation flow as required to contain contamination in the event of a credible breach in the secondary confinement barrier (process bay local exhaust system). The system controls exhaust air flow and maintains a negative pressure differential in the process bays with respect to all other areas external to the secondary confinement barrier. Air from the transfer corridor, associated support rooms, the tank room, and the mechanical room is also exhausted into the process general supply/exhaust HVAC system. Confinement isolation dampers are provided on all duct branches connecting to the general exhaust system to prevent backflow in the event of exhaust system shutdown. Fully redundant exhaust fans are provided for the system. The air in the system passes through a prefilter and two HEPA filter stages before exhausting through the stack. The HVAC control system is located in the CVDF control room which provides alarm and monitoring of all HVAC functions according to the detailed HVAC operational control description located in SNF-3081. The system design description for the process general supply/exhaust HVAC system is contained in SNF-3081.

3.3.25 System 30-5, Reference Air System (RA)

The pressure in the active process bays and the PWC system tank room are maintained at a negative pressure with respect to the remainder of the CVDF by the general and local exhaust systems. The reference air system consists of a series of static differential pressures sensors, located throughout the CVDF (refer to P&ID H-1-82207), that are interconnected by copper tubing. The reference pressure is measured from shielded static pressure sensor RA-BAF-001 located in a ground level enclosure on the southeast corner of the CVDF MCO staging area. Each process bay pressure differential is monitored on PDIT-8*20; in the tank room on PDIT-8080; in the transfer corridor and access rooms on PDIT-8073 through PDIT-8078; in the mechanical equipment room on PDIT-8070; and in the administration access corridor on PDIT-8079. The HVAC control system monitors all reference air pressures. The nominal setpoints are that the process bays are -0.20 in. water gauge, tank room is -0.25 in. water gauge), transfer corridor access rooms are -0.15 in. water gauge, the transfer corridor and mechanical equipment rooms are -0.10 in. water gauge, and the administration access corridor is 0.01 in. water gauge.

The reference air system requires an initial startup action and stays online during the life of the project. No maintenance activities are anticipated during the CVDF three-year operating period. The system design description for the reference air system is contained in SNF-3081.

3.3.26 System 47-2, Tempered Water Cooling System (TWC)

The tempered water cooling system (refer to P&ID H-1-82224) is used to supply cooling water at 10°C (50°F) and 20 gal/min to tempered water system cooler TW-CLR-3*10. The system cools the tempered water re-circulation loop during the Cask-MCO cooling operational phase. The cooling water source is a closed water loop supplied by heat exchanger TWC-HX-7051 and pumps TWC-P-7055 and TWC-P-7058 (refer to P&ID H-1-82224). The facility chilled water system removes the heat from the closed loop. The chilled water supply for the tempered water cooler is supplied by an intermediate cooling loop interfaced with the facility chilled water system through a process heat exchanger. The intermediate loop consists of a circulation loop with spare pumps. The system is designed to remove 73 kW (250,000 Btu/h). The cooling circuit provides cooling to the MCOs in each process bay at any given time. The system design description for the tempered water cooling system is contained in SNF-3085.

3.3.27 System 47-3, Chilled Water System (CHW)

The chilled water system (refer to P&IDs H-1-82201 and H-1-82208) serves the cooling coils in the process bay re-circulation HVAC system and the process general supply/exhaust HVAC system and serves the process heat exchanger for tempered water cooling. The chilled water distribution system has two fully redundant pumps. Two-way control valves are used on each cooling coil distribution loop.

The chilled water refrigeration sub-system is comprised of two partially redundant, split system, air-cooled water chillers with remote condensing units. Each chiller has a dedicated primary pump, piped in parallel to provide standby protection. The refrigerant system incorporates a chiller sequencing controller, staged compressors, bypass flow line, and back pressure valves to accommodate varying chilled water demand. This system interfaces directly with the chilled water system.

The chilled water system requires an initial startup action and stays online during the life of the project. No maintenance activities are anticipated during the CVDF three-year operating period. The system design description for the chilled water system is contained in SNF-3086.

3.3.28 System 47-4, Vacuum Purge System Chilled Water System (VPSCHW)

The VPS chilled water system (refer to P&ID H-1-82224) is used to supply chilled water at 3°C (37°F) and 4 gal/min to the VPS condenser, VPS-COND-2*13, and VPS condenser rundown tank cooling jacket, VPS-CLR-2*17 (refer to P&ID H-1-82162). The system allows the VPS condenser to condense water from the process stream during the vacuum pumping and helium gas purge operational phases. VPSCHW-FCV-2*01 controls the flow at 4 gal/min without MCS intervention. The chilled source is a closed loop water/propylene glycol loop supplied by VPSCHW-CHR-7075. The chilled water supply for the VPS condensers is a dedicated, low-temperature chiller (one chiller package for all process bays, with no redundancy). This chiller is capable of supplying 13.2 kW (45,000 Btu/h) of 1.5°C (35°F) water to all condensers. A total of 4 gal/min is available to each process bay.

The VPS chilled water system requires an initial startup action and stays online during the life of the project. No maintenance activities are anticipated during the CVDF three-year operating period. The system design description for the VPS chilled water system is contained in SNF-3087.

3.3.29 System 50, Stack Monitoring System (SM)

The stack monitoring system is a Gaseous Effluent Monitoring System (GEMS), microprocessor-based particulate and iodine monitor, and particulate and iodine collector mounted in a two-component, open-frame skid and cabinet assembly. The primary purpose of the system is to collect particulate effluent on fixed media for later laboratory analysis and documentation of emissions. The stack monitoring system is also designed to monitor real time alpha and beta particulate and iodine-129 gamma radiation effluent in the CVDF HVAC ventilation exhaust stack. The system provides early warning of out-of-ordinary emissions to plant personnel. Visual digital and alarm indications and contact output for remote alarms are provided for high radiation and failure conditions. Analog and digital outputs are provided to the MCS. A computer data logging system is provided to record monitored functions for later download as appropriate.

The stack monitoring system consists of an open frame skid and cabinet with a sample probe subassembly. The stack monitoring system is comprised of the following subassemblies:

a. Stack sample probe assembly and piping

b. Sampler skid assembly with record sampler and alpha, beta, and gamma monitors

c. Redundant sample pumps

d. Auxiliary instrumentation including stack flow rate and temperature and sample flow rates

e. Control console with electrical power interface, microprocessor, and MCS interface

f. Local alarm indication.

The stack monitor skid is located in the CVDF mechanical equipment room near the exhaust stack. Piping to and from the stack to the skid is routed in a structural steel support assembly.

The SM system requires an initial startup action and stays online during the life of the project. No maintenance activities are anticipated during the CVDF three-year operating period. The system design description for the SM system is contained in SNF-3088.

3.3.30 System 54, Security System (SEC)

The security system for the CVDF contains security sensors, closed circuit television, and access control sub-systems. The system's main purpose is to provide reasonable assurance that breaches of security boundaries are detected and that assessment information is provided to protective personnel. In addition, the system will be utilized by operations to support reduced personnel radiation and possible contamination goals (as low as reasonably achievable) and provide reasonable assurance that only authorized personnel are allowed to enter and exit the designated security areas. Security access system, components, installation, and testing shall meet the applicable requirements of NFPA 70.

The SEC system requires an initial startup action and stays online during the life of the project. No maintenance activities are anticipated during the CVDF three-year operating period. The system design description for the SEC system is contained in SNF-3089.

3.3.31 System 93-1, Monitoring and Control System (MCS)

The MCS consists of a total of three control room computers, two operator workstations, and one engineering workstation. A fourth computer station is provided as a supervisor station in the manager's office. The main programmable logic controller control panel is also located in the control room and includes a local alarm and silence button. The remotely controlled I/O modules with termination panels are located in the bays (four), mechanical room (one), and the PWC tank room (one).

The operator interfaces are object-oriented color graphic displays on computer screens. All central processing units are connected on a local area network, which allows simultaneous access to the control system from multiple graphic displays. The field-mounted remote I/O modules are individually controllable from the central control room.

The MCS interfaces with the following processes in each active process bay:

- General Service Helium system (He)
- Tempered Water system (TW)
- Vacuum and Purge system (VPS)
- Deionized Water system (DI)
- Process Water Conditioning system (PWC).

In addition, the MCS receives signals from the SCIC system in bays 2 through 5 and, under normal circumstances, is allowed to control MCO isolation valves used by the SCIC system. The SCHe system isolation valves are not controlled by the MCS but are directly controlled by the SCIC system. The SCIC system does not require the support or operability of the MCS to perform its required functions. The MCS also interfaces with the CVDF utility systems, excluding HVAC and Chilled Water. This includes radiation monitoring, stack monitoring, tempered water cooling, VPS chilled water, PWC, and instrument air. The system design description for the MCS is contained in SNF-3090.

3.3.32 System 100, Specialty Equipment and Special Tools

Several items of specialty equipment and special tools are required to operate the CVDF. The following is a list of known specialty equipment and special tools that is required to operate the process. This list is not intended to be all-inclusive, nor does it identify all necessary components for maintenance of the process skids or facility.

Table 3-2 CVD Special Tooling List		
Item	Tool Description/System Interface	Tool Basic Requirements/General Purpose
Facility (System 100-1)		
SE-FAC-001	I & C Calibration Tools/Cart	Start-up will provide specifications for instrumentation
SE-FAC-002	I & C Calibration Tool Storage	Store tools in organized manner with minimal footprint
SE-FAC-003	CHW Charging Pump	Pump to fill CVD water systems minimum 5 gpm at minimum 40 psig with flex hose and hose bib to facility systems. Also include tygon hose capable of draining from high point vent for fill indication.
SE-FAC-004	Standard Hand Tool Sets (Electrical, Pneumatic, and Mechanical)	Socket set and combination wrenches from 1/4 to 1 1/2"
SE-FAC-005	HVAC HEPA Filter changeout Tools	HEPA Filter Banding Kit
SE-FAC-006	Storage for HVAC HEPA changeout Tools	Store tools in organized manner with minimal footprint
SE-FAC-007	Contaminated Water/HVAC Slurp Pump and Container	Connect to PWC-QD-*020 with a PWC Lower port connector (SE-CASK-005) home position and provide flex hose with a 1/2 tubing wand 4 ft long and one Wet/Dry HEPA filter vacuum
SE-FAC-008	Decon Shower	Self contained drain. Tie in to facility potable water. Full shower/eyewash.
SE-FAC-009	CHW Refill Water Storage Container	5 gal container to interface with facility potable water hose bib and CHW charging pump.
SE-FAC-010	Pneumatic Valve Manual Override Tools	Tooling to override springs in GOVs to be held in position by quick ties or pinning
SE-FAC-011	Steel rolling platform ladders Interface with facility mezzanine high side	To Reach hood components when transport trailer is removed from bay
SE-FAC-012	Steel rolling platform ladders Interface with trailer	For access to trailer deck when transport trailer is in bay
SE-FAC-013	Man Lift	To Reach hood components when transport trailer is removed from bay
SE-FAC-014	Mezzanine Tool Storage	Standard tool box permanently tied to process bay mezzanine
SE-FAC-015	SRV overflow containers	20 liter containers to be located at selected SRVs (CHW, TWC, VPSCHW systems)
SE-FAC-016	GSHe Trailer wheel chalks	Standard removable wheel chalks
Rad Monitoring (System 100-1)		
SE-RAD-001	Storage Rack for Rad. Mon Tools	Store tools in organized manner with minimal footprint
SE-RAD-002	Rad Survey/Swipe Tools	Standard RPT Swipe tools
SE-RAD-003	Shielded Pig for Swipe Counting	Lead Shielding container for swipe counts
SE-RAD-004	Floor Drain/HVAC Sampler	Connect to PWC-QD-*020 with a PWC Lower port connector (SE-CASK-005) home position and provide flex hose with a 1/2 tubing wand 4 ft long and one Wet/Dry HEPA filter vacuum

Table 3-2 CVD Special Tooling List		
CASK (System 100-2)		
SE-CASK-001	Cask Lid Vent Tool, Pressure Monitor, and Sampler	Interface with facility and cask lid to prevent excess hydrogen release to HVAC. Measure temperature and pressure. Provide pressure/vent cycling and purging of cask lid envelope without lifting cask lid. Provide sample bottle cylinder for gas composition analysis
SE-CASK-002	Cask Lid Inspection Tool	Interface with trailer and CVDF, laydown and tilt fixture for cask lid, permanently mounted to trailer
SE-CASK-003	Cask Lower Port Cover Installation and Removal Tool	Interface with cask and facility, long reach to remove/reinstall cover plate and bolting. Torque requirement
SE-CASK-004	Cask Lower Port TW Quick Disconnect Tool	Interface with cask and hood. Double containment required and verification of water in cask above fuel line in MCO, part of TW system, Torque requirement
SE-CASK-005	Cask Lower Port PWC Quick Disconnect Tool	Interface with Cask and PES, cask annulus water drain, connection to the PWC system. Torque requirement
SE-CASK-006	Cask Annulus Refill Tool(s)	Flex line to connect DI water QD and Seal Ring QD, preferred tool for cask annulus
SE-CASK-007	Cask Annulus Refill Storage Container and Truck	Seal ring QD/Funnel and 6 each 20 liter liquid container (per active bay)
SE-CASK-008	Cask Vent Port Cover Tool	Removes/re-installs cask lid small vent port and large upper port. Torque Requirement
SE-CASK-009	Transport Wheel Chalks	Standard removable wheel chalks
SE-CASK-011	Transport Air Glad-hand	Interface with Facility CA system and Cask Transport for landing leg activation
SE-CASK-012	Cask Lid Lifting Fixture	Interface with facility crane, cask, and cask lid inspection tool
SE-CASK-013	Cask Lid Lifting Fixture Storage Rack	Interface with Cask lid lifting fixture and facility
SE-CASK-014	Transporter Exhaust Trunk	Interface with cask transporter trailer
SE-CASK-015	Cask Lid Bolt Torquing Sockets and Reducers	2 1/4" Impact Sockets 3/4" drive and 1/2" to 3/4" inverted adapter
SE-CASK-016	Cask Lid Bolt Torquing Tool	Torque Wrench and 3.3 X torque multiplier. Torque requirement
SE-CASK-017	Lower Port Connector Installation Tools	Attachment handles (4 per set, 2 for TW lower port connector and 2 for PWC cask drain connector) to the lower port connector and alignment tray and spanner socket for torquing hand tightened T-handles
SE-CASK-018	Cask Transporter Level Indicator	Small attached bubble tube level glued to the transporter
SE-CASK-019	Cask Lid Purge port tools	Cap screw socket and port cover bolt retainer and quick disconnect tool to interface with SE-CASK-001
SE-CASK-020	Seal ring installation tool	Crows foot with 26 ft lb torque limiter
MCO (System 100-2)		
SE-MCO-001	MCO Vent Tool	Interface with MCO shield plug at port #2 and cask venting tool
SE-MCO-002	MCO Process Plug Closing Tool	Interface with MCO shield plug. Torque requirement

Table 3-2 CVD Special Tooling List		
SE-MCO-003	MCO Locking Ring/Jack Bolt Torquing Tool	Tighten cap screws on MCO/Interface with MCO shield plug
SE-MCO-004	MCO Aux Vacuum Leak Checking Equipment and Tooling and Cart	Interface with seal ring and facility power and HVAC. Aux. Vac. System
SE-MCO-005	Storage Rack for MCO/Cask Tools	Store tools in organized manner with minimal footprint
SE-MCO-006	MCO Port Cover Installation/Removal Tool	Removes port covers (suction cups)
SE-MCO-007	Storage Rack for Aux. Vacuum/MSLD and tools	Store tools in organized manner with minimal footprint
PWC (System 100-3)		
SE-PWC-001	PWC-TK-4001 to IXM Flex Line	Tie into quick disconnects at PWC-QD-052 and PWC skid at PWC-QD-053
SE-PWC-002	PWC IXM Jumper/Connection Tools	Line Backer Gaskets 1 1/2" for raised face flanges(DCN W441-184 paragraph 2.3.4)
SE-PWC-005	PW Tanker Truck	Spec number HNF-2635 Hold and transport 4000 gal of potentially contaminated water to IWTS or ETF
SE-PWC-006	PWC to Tanker Truck Flex Hose	Tie into quick disconnects (paragraph 2.3.6 and 2.3.7) in Installation Package (DCN W441-184) at PWC-V-008 and tanker truck (Spec HNF 2635) at truck (2" Maxi Dry QDs).
SE-PWC-008	PWC Sample Bottle Cask	Transport PWC sample bottles (same as K Basin cask)
SE-PWC-009	PWC Sample Bottles	500 ml bottles with small neck (28 mm). Also requires hard piping attachment to samplers with spill containment
SE-PWC-011	Storage for tools, hoses, and Rigging	Store tools in organized manner with minimal footprint
SE-PWC-012	IXM Venting Apparatus	Active vent system on IXM. H-1-51851 sht 1-4. Interface with IXM and PWC receiver tanks
SE-PWC-013	PWC/IWTS Tanker Truck HEPA Filter or vent line	Interface with IWTS tanker vent port
SE-PWC-014	Bay 1 boom for IWTS truck	Interface with IWTS truck and CVD facility bay 1
SE-PWC-015	IXM resin funnel	Provide for filling IXM with resin. Interface with IXM
SE-PWC-016	Dual level Sensor for PWC-TK-4032	Provide redundant level indication for the PWC receiver tanks
Hood (System 100-3)		
SE-HOOD-001	Ventilation Hood Lifting Fixture	Lift hood from home position on piping stand to processing position on cask. Interface with drawing H-1-82364 all shts and H-1-82181 sht 2 (W441-P4 and DCN W441-184)
SE-HOOD-002	Process Connector Bolt Wrench	Ratchet and TBD1" Socket with spacer in socket to prevent center shaft entering. Interface with H-1-82366 sht 1 & 4 and H-1-82368 sht 4. (W441-P4)
SE-HOOD-003	Process Connector Plug Valve Actuator Wrench	Ratchet and 1 1/8" Socket with spacer in socket to prevent center shaft entering. Interface with H-1-82366 sht 1 & 4 and H-1-82368 sht 4. (W441-P4)
SE-HOOD-004	Storage for tools	Store tools in organized manner with minimal footprint

Table 3-2 CVD Special Tooling List		
SE-HOOD-006	Simulated Line Break	Interfaces with hood hosing and process connectors
SE-HOOD-007	Helium flow calibration RTD	Interface with hood flanges on He-*01-SS-1"
SE-HOOD-008	SCIC TW switch calibration	Interface with hood flanges on TW-*01-SS-1 1/2" outlet. Inlet is covered in SE-CASK-004
PES (System 100-3)		
SE-PES-001	RGA Calibration Cart	Pressure instrumentation and known gas composition cylinders for calibrating RGA
SE-PES-002	VPS Skid Tools	Store tools in organized manner with minimal footprint
SE-PES-003	TWS Jumper	Use permanent mount to connect TW-QD-*018 to when not in use and tie into hood piping assembly needs hand isolation valves (requires DCN to W441-P4). Interface with drawings H-1-82161
SE-PES-004	TWS Jumper No Hood (Required only if Hood assembly, seal ring, or cask or TWS jumper not ready for testing)	A jumper that simulates the system pressure loss of hood and cask and ties only to the flanges on the PES for TW-*01 and TW-*02. Interface with H-1-82161 and W441-P1. Have control valve and directional isolation valves to facilitate flow meter calibration
SE-PES-005	PWC/Cask Drain QD Hose Reel/Hook	Hold Flex Hose from PES to cask drain connection
SE-PES-006	Reach Rods	Reach rods to actuate SCHe isolation valves on the end of the PES skid

3.4 COLD VACUUM DRYING SYSTEMS OPERATIONS OVERVIEW

NOTE: In the following descriptions an asterisk (*) will appear in the second digit of a component or instrument tag number. The asterisk denotes the CVDF bay number in which the component or instrument will reside (e.g., DI-GOV-1*01 represents valves DI-GOV-1201, DI-GOV-1301, DI-GOV-1401, and DI-GOV-1501 in bays 2 through 5, respectively). All components or instrument tag numbers with a zero in the second digit will reside in a common area within the CVDF. An asterisk in the first numerical digit of a piping line number has the same connotation.

The normal operations process system is shown in the block flow diagrams, Figures 3-1 through 3-4, process flow diagram (H-1-82166), and P&IDs (H-1-82161 through H-1-82165). The following describes the operating sequences that will activate the functions embodied in the P&IDs. Note, indicated process step duration times are estimates based on a nominal MCO. Times are shown in both critical path time and time to complete step, ex. (25/100 min), since all or portions of the step can be performed in parallel or "offline". Definitive estimates will be provided during Pre-operational testing and the Process Validation operation.

The following operational sequences and procedures are for normal operating conditions within the CVDF. Procedures regarding off-normal events and alarm responses will be covered in the SNF-5390, *CVDF Off Normal Event Description and Alarm Response Manual*. The following steps operational sequences contain references to Limiting Conditions for Operation (LCOs). These LCOs are located within HNF-3673, *Cold Vacuum Drying Facility Technical Safety Requirements.*

Figure 3-1. Cold Vacuum Drying Facility Block Flow Diagram Estimated Average Cask-MCO Preparation Times Estimated Average MCO CVD and Cask-MCO Process Times

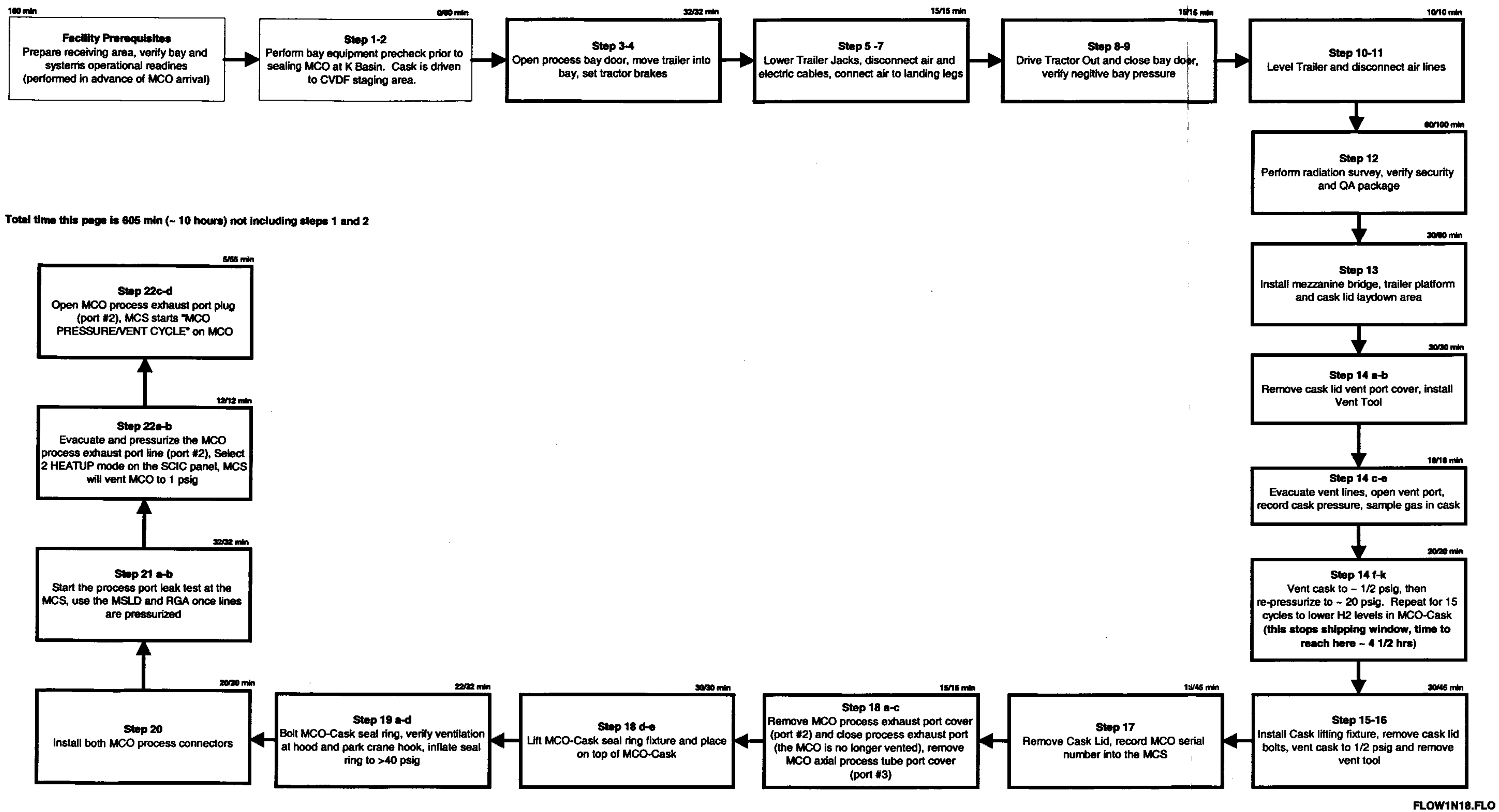


Figure 3-2. Cold Vacuum Drying Facility Block Flow Diagram Estimated Average Cask-MCO Preparation Times Estimated Average MCO CVD and Cask-MCO Process Times

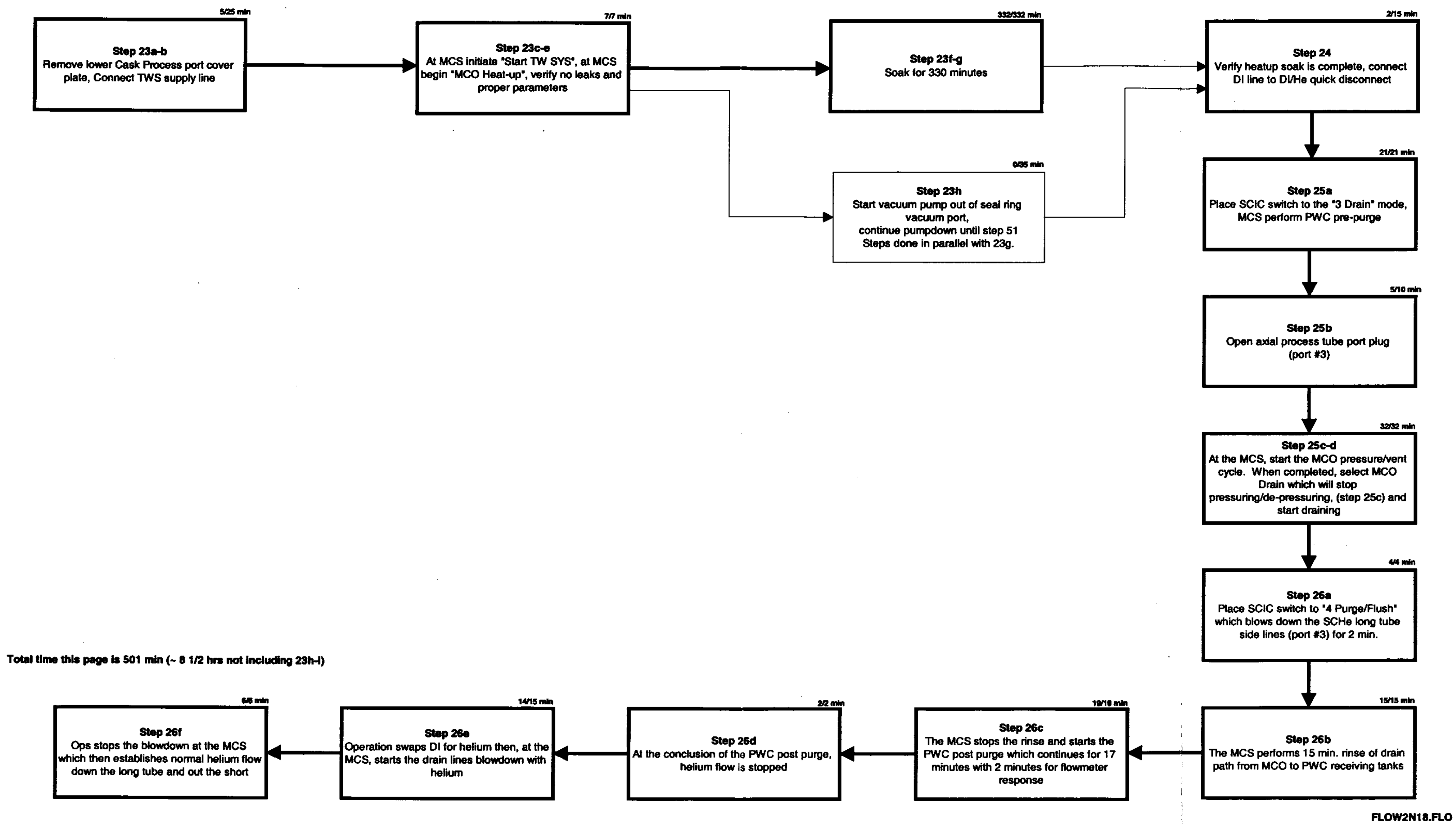
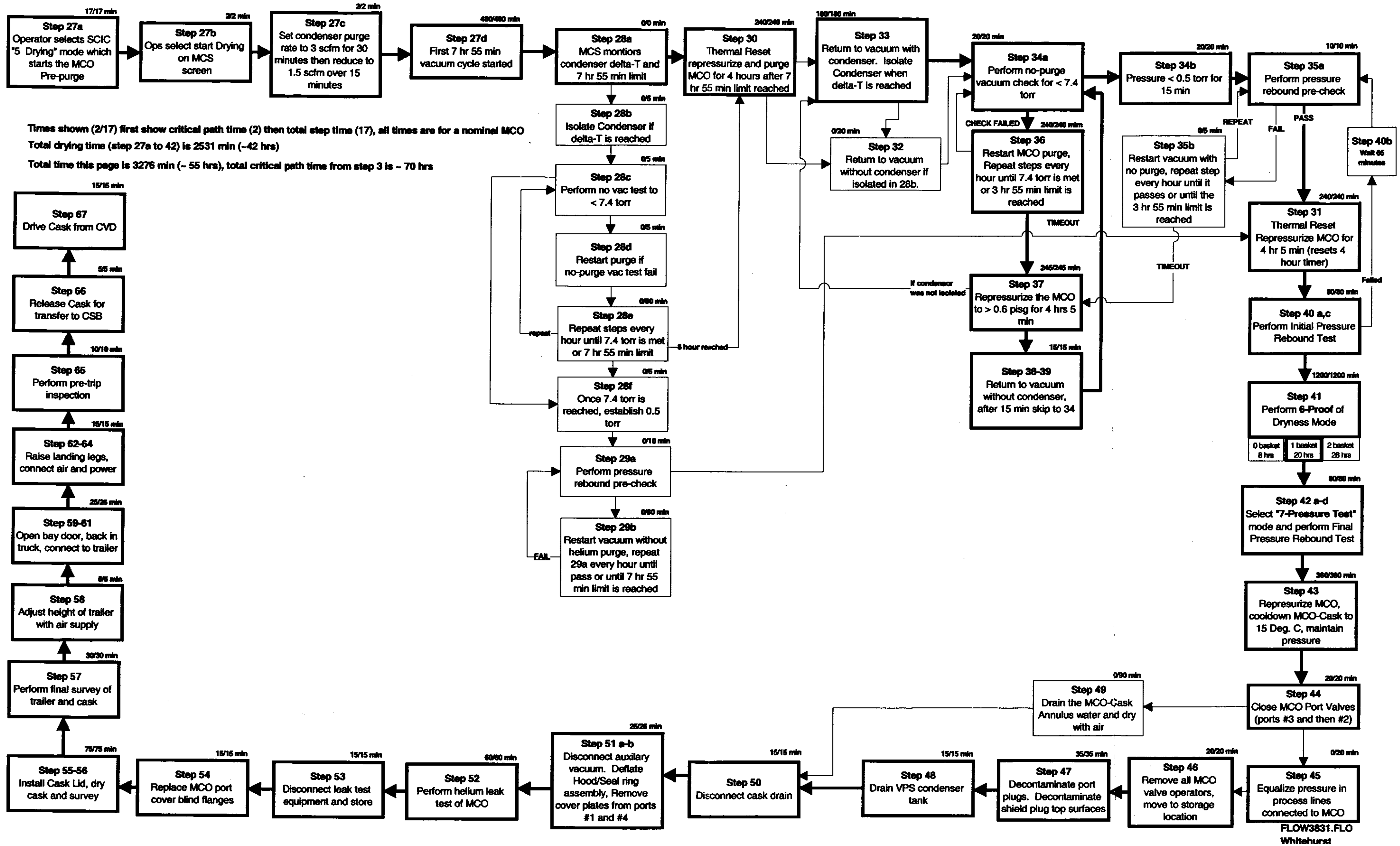


Figure 3-3. Cold Vacuum Drying Facility Block Flow Diagram Estimated Average MCO CVD and Cask-MCO Process Times



3.4.1 Cold Vacuum Drying Facility Prerequisites for the Cask-MCO Transporter Receipt Operation and Normal Cold Vacuum Drying Process Operation

The following activities must be completed prior to receipt of a Cask-MCO from the K Basins and before initiation of normal cold vacuum drying operation.

- Prepare cask transporter receiving area at the CVDF for cask and trailer receipt. Remove any obstacles and lay fire retardant plastic sheeting on floor surfaces (if required) to minimize spread of contamination.
- Verify that the electrical systems are operational.
- Verify that the process bay crane and telescoping door are operational, then locate the crane in its home position in front of the telescoping door.
- Verify that the Instrument Air system is operational.
- Verify that the general service Helium system (with two tube trailers) is operational.
- Verify that the Deionized Water system is operational.
- Verify that the HVAC, reference air, and stack monitoring systems are operational.
- Verify that the Chilled Water, Tempered Water Cooling, and VPS Chilled Water systems are operational.
- Verify that the MCS is operational.
- Verify that the Radiation Monitoring and Room Air Quality systems are operational.
- Verify that the Fire Protection system is operational.
- Verify that the Communications system is operational.
- Verify that the Security system is operational.
- Verify that the SCIC system is operationally ready with the mode switch in the **"1 BYPASS"** position for the selected bay.
- Verify that the PWC and Contaminated Water Sampling and Analysis system are operationally ready.

Time to complete operation: 0/180 minutes.

3.4.2 Cask-MCO Transporter Receipt Operation

3.4.2.1 Bay Equipment Pre-check (SCIC in "1 BYPASS" mode)

1. Perform the following prerequisites prior to authorizing the shipping of a Cask/MCO from K Basins.

   a. Verify that both MCO valve operators are bolted to the hood seal ring storage location. This allows bypass flow to test the VPS and Hood components.

   b. Verify the SCIC Mode switches (Train A and B) for this bay is in the "**1 BYPASS**" position in the control room.

   c. At the MCS start the "BAY PRE-TEST" which will:

   - Evacuate all VPS lines to remove air from the lines.

   - Perform a full vacuum base pressure test and vacuum pump down performance test. The MCS will print a trend of the pump down test. Perform full vacuum base pressure test without condenser valved in. If base pressure > 0.5 torr inform operations, if > 1.0 torr the test failed. Perform a pressure rebound test in the same configuration as the MCO rebound test, i.e. with all SC isolation valves closed but with port connectors in their home position and the bypass valve, VPS-V-*015 open. Inform operations if pressure increase is > 0.6 torr in 30 minutes once the SC valves are isolated, test fails if pressure rise is > 1.3 torr in 30 minutes, per HNF-4301, Calculation 18). Perform an entire VPS leak test as requested when approved by the shift manager.

   - Run system with condenser valved in and at full vacuum condenser base pressure should be < 0.5 torr. Note: This is a gross check for leakage with condenser volume added to the test. Perform channel check of pressure indication from PT 1*08 and PT 1*10 per ***SR*** 3.1.2.1. The MCS will print a print screen during this base pressure test and operations will inform MCS of completion of check.

   - Verify proper RGM operation at the EWS computer

   - Verify proper flow control and proper flow indication on FIT-1*20 and 1*21 for both 1.5 scfm [SCIC setpoint 1.1 scfm (Parameter limit of 0.7scfm)] and 10 scfm on FIC-1*20. Route flow through VPS-PCV-2*37 and verify pressure control at 1 ± 0.2 psig on PT 1*36 and PT 1*37. (He-GOV-1*02, He-GOV-1*06, VPS-GOV-1*09, VPS-GOV-1*05, VPS-GOV-2*03 and VPS-GOV-2*04 open). Perform channel check of FI 1*20 and FI 1*21 per ***LCO*** 3.1.3.1.

   - Verify 4 ± 0.5 psig pressure control when He-PCV 1*27 is in-line and VPS-PCV-

2*37 is isolated. Perform channel check of pressure indication from PT 1*36 and PT 1*37 per ***SR*** 3.1.2.1.

- Install the DI line from DI-GOV 1*01 to DI/He-QD-*110.

d. Verify the tempered water (annulus) system refill capability (***SR*** 3.1.5.1), that the system is leak tight and operationally ready, tank > 40% full.

e. Verify that the SCHe system is operable (***LCO*** 3.2.1). This includes cycling and verifying operation of all Hood safety class gas operated valves (GOVs). Note that PWC-GOV-1*30 and PWC-GOV-1*03 are electrically interlocked by the MCS to preclude opening if any other bay is using the PWC system. If these valves are unavailable at the time of the test, they will have to be tested prior to completing the bay pre-checks. The MCS will not open both PWC-GOV-1*30 and PWC-GOV-1*03 at the same time and VPS-GOV-2*07 (vacuum pump isolation valve) will be operated separately from the other GOVs to prevent excessive helium flow to the vacuum pump and subsequent potential for overheating.

f. Cycle non-safety class gas operated valves (GOVs) to assure correct indication and operation.

g. Verify that the process hood/seal ring assembly, and MCO valve operators are operationally ready.

h. Verify that the helium MSLD and auxiliary vacuum system is operationally ready.

NOTE: An administrative bypass of these prerequisites shall be available.

Time to complete operation: 0/60 minutes.

i. Additionally, the SC GOV valve seats must be checked annually to ensure a seal to within acceptable limits (***SR*** *3.2.1.3*).

<u>Check valve seat for VPS-GOV-1*05</u>

- With vacuum pump on, open 2*07, 2*03, 1*02, 1*06, and 1*09. With 1*05 and closed, there is 20 psig helium on one side of 1*05 and vacuum on the other.
- Close 2*07, plot pressure from PIT 2*09 for 10 minutes. Operator will determine if it passed or failed (Acceptable if pressure rise is below 50 torr in 10 minutes).

<u>Check valve seat for VPS-GOV-1*09</u>

- Close 1*09, open 1*05 and 2*07 to re-evaluate the lines up to 1*09.
- Close 2*07, lot pressure from PIT 2*09 for 10 minutes. Operator will determine if it

passed or failed (Acceptable if pressure rise is below 50 torr in 10 minutes).

Check valve seat for VPS-GOV-1*02, 1*17, 1*30, 5*12, 5*31, 5*51, and 5*71

- Open 1*17, 1*11, 1*30 to establish pressure across these valves.
- Close 1*02, 1*17, 1*30 and open 1*09 and 2*07 to evacuate up to these valves.
- Close 2*07, plot pressure from PIT 1*08 and 1*10 for 10 minutes. Operator will determine if it passed or failed (Acceptable if pressure rise is below 50 torr in 10 minutes).

Check valve seat for VPS-GOV-1*02, 1*11, 1*06, 1*03

- Close 1*06, 1*11, open 1*30, 1*02, 2*07, and 1*17 to evacuate up to these valves.
- Close 2*07, plot pressure from PIT 1*08 and 1*10 for 10 minutes. Operator will determine if it passed or failed (Acceptable if pressure rise is below 50 torr in 10 minutes).

NOTE: Due to the low pressure on the upstream side of 1*03, the test should be run longer than 10 minutes. The PWC vacuum will be detected if there is a leak. If this doesn't work, the two PWC pumps will need to be shutdown.

VPS VALVE LINEUP: All process GOVs closed.

3.4.2.2 Cask Transporter Operations. (SCIC in "1 BYPASS" mode)

2. Drive the cask trailer to the CVDF staging area at eastside of the CVDF and back the trailer into position in front of the required process bay (determined by the CVDF shift operations manager).

   Time to complete operation: 0 CVDF minutes.

3.4.2.3 Positioning and Preparing the Trailer for the Cold Vacuum Drying Process. (SCIC in "1 BYPASS" mode)

3. Perform the following steps for the trailer:

   a. Line up tractor/trailer with their respective painted lines.

   b. Open the process bay door.

   c. Back loaded cask trailer into facility until it rests against trailer stops at the back of the bay. The trailer is to be located within ±4 in. of the longitudinal centerline and

±4 in. of the lateral centerline (positioned by the trailer stop and install wheel chocks).

d. Verify that center of Cask is centrally located with respect to the CVDF floor markings (AC 5.10) and that the Cask lower port is properly aligned on the transporter.

   Time to complete operation: 30/30 minutes.

4. Set the tractor and trailer brakes. Shut off the tractor engine.

   Time to complete operation: 2 minutes.

5. Disconnect the tractor airlines and electrical cable from the trailer and disengage trailer.

   Time to complete operation: 5/5 minutes.

6. Connect the building air supply to the landing leg air supply glad hands using the CVDF compressed air flex line and mating glad hand.

   Time to complete operation: 5/5 minutes.

7. Lower the trailer hydraulic jacks until the weight of the trailer is lifted off the tractor. Release the fifth wheel

   Time to complete operation: 5/5 minutes.

8. Start the tractor engine. Release the tractor brakes and drive tractor forward then close the door (AC 5.12). Verify that the security system is in place. The bay becomes a secured area.

   Time to complete operation: 10/10 minutes.

9. Verify that the process bay ventilation system achieves the required negative pressure (LCO 3.4.3).

   Time to complete operation: 5/5 minutes.

10. Position trailer jacks to level trailer from front to back.

    Time to complete operation: 5/5 minutes.

11. Disconnect the glad hand from landing leg.

    Time to complete operation: 5/5 minutes.

12. a) Utilizing the CVDF portable radiation meters, perform radiation surveys
    b) Post the exposure rates

Time to complete operation: 60/100 minutes.

13. a) Install the mezzanine bridge

    b) Configure work platform handrails (removable sections)

    c) Prepare the trailer work platform and Cask lid laydown area for work (lay down contamination control covers).

Time to complete operation: 30/60 minutes.

3.4.2.4 Cask Preparations for Cold Vacuum Drying - Cask Venting (SCIC in "1 BYPASS" mode)

During this operation the MCO will contain SNF covered with water, the nominal temperature of the MCO-SNF will be 13°C.

14. a) Remove cask lid vent and purge port covers using T-handle wrenches provided with the trailer. Store covers in storage box to protect them from loss and damage.

    b) Install purge and vent equipment including special tool (containing flow orifice), isolation valve, local pressure gauge, sample cartridge and auxiliary vacuum source (if required for the SNFP validation program), process purge line (He-*02-ST-1/4"), and process vent line (PV-*04-ST-1/4) to the Cask lid purge and vent ports.

Time to complete operation steps 14a, 14b: 30/30 minutes.

    c) If required for the SNFP validation program, evacuate the vent line and sample cartridge, isolate the vacuum source (Evacuate with Aux. Vacuum and PV-V-*128).

    NOTE: The next step opens the Cask vent port to the vent tool. The Cask pressure is an indication of thermal changes from the basin but may also be an indication of highly reactive fuel in the MCO. Caution should be taken when opening the connection to the Cask. Trends will be made for the Cask pressure upon receipt in the MCS for comparison.

    d) Open vent port connection and record Cask pressure from PI-1*32 and Cask gas temperature from TI-1*45. Record data into the MCO traveller.

e) Verify PI-1*32 is less than 45 psig, if not, stop work until this condition is reviewed. The cask vent tool shall be connected to the transportation cask and venting must be completed within 24 hours of completing the helium purge of the MCO headspace at the K Basins (***LCO*** 3.6.1). Take a gas sample using the sample cartridge, open and then isolate the sample cartridge using PV-V-*128 (if required for the SNFP validation program). Send the sample cartridge to lab for later analysis and trending. The sample results are not required to continue with the CVD process.

Note: Gas samples may only be required for the first group of MCOs processed during the validation program.

Time to complete operation steps 14c - 14e: 18/18 minutes.

f) At the MCS, select "Start Cask Pressure/Vent", the MCS will then perform the following steps.

g) Open PV-SOV-*312 for 3 minutes to vent the initial cask lid headspace volume. In order to terminate the shipping window from the K Basins (LCO 3.6.1), the cask must have an open vent path and the pressure must be at a steady state (i.e. pressure no longer decreasing). This can be performed anytime during the time the cask venting tool is installed, up to and including step 16a.

h) Close PV-SOV-*312 and then open He supply He-SOV-*325 for 30 seconds to increase cask lid pressure to ~20 psig.

i) After 30 seconds, close He-SOV-*325 and open PV-SOV-*312 (vent 20 psig through orifice).

j) After 90 seconds, the ~20 psi added to the headspace will be vented and PV-SOV-*312 should be closed.

k) The MCS will then repeat steps h-j an additional 14 times while the operator periodically verifies pressure cycling from 1-19 psig to decrease H_2 concentration in the MCO and cask lid headspace to the minimum amount practical.

l) To prepare for cask lid removal, after 15 cycles the MCS opens PV-SOV-*312 to establish a vent path. Bypass orifice by opening valve PV-V-*322. Operations then opens manual valve He-V-*066 to purge He through the cask lid. Operations verifies PI-1*32 indicated between 2/3 psig and 2 psig.

Time to complete operation steps 14f – 14l: 30/30 minutes.

15. Retrieve Cask lid lifting fixture (CVDF-provided design) from the CVDF process bay

storage location and attach to the CVDF crane. Translate lift fixture to the Cask lid and attach to lid lifting eyes installed on the Cask lid.

Time to complete operation: 15/15 minutes.

3.4.2.5 Cask Preparations for Cold Vacuum Drying - Cask Lid Removal. (SCIC in "1 BYPASS" mode)

Note: There can be no delay between the removal of potential H_2 within the Cask-MCO and the removal of the lid other than physical limitations to this operation. If this operation is not completed within 1/2 hour, evaluate repeating the hydrogen purging steps or completion of the lid removal process. All Cask lid removal preparations steps shall be done in parallel with the hydrogen purge steps.

16. a) Following Cask purging and final vent (LCO 3.6.1), utilizing the CVDF-provided wrenches, de-torque and verify the retraction of Cask lid bolts (bolting is self captured) in the sequence indicated on the Cask lid. Close He supply He-V-*066.

    Note: In order to terminate the shipping window from the K Basins, the cask must have an open vent path and the pressure must be at a steady state (i.e. pressure no longer decreasing). This must be observed prior to disconnecting the cast vent and purge connections.

    b) Remove vent and purge connections and remove venting equipment from the Cask lid ports to equalize pressure to atmosphere (leave vent port open, close following lid removal). Decon (as required) the Cask vent tools and store in process bay storage locker.

    Time to complete operation: 15/30 minutes.

17. a.) Remove the Cask lid and place the lid in the storage location on the cask transporter. Take care to protect the Cask and lid sealing surfaces. Remove crane hook from the lid-lifting fixture. Close the lid vent plug and then replace Cask lid port covers and bolting (lubricate threads with Neolube), torque bolting to the specified value of 15 ± 3 ft/lb. Survey bottom of Cask lid and decontaminate as required to meet contamination limits. Inspect and replace, as needed, each "0" ring.

    Note: Closing the cask lid vent plug may be done at any time prior to shipping the Cask from the CVDF.

b) Verify and record the MCO serial number into the MCS. Verify process port alignment within the Cask, if not, stop work until this condition is reviewed.

Time to complete operation: 15/45 minutes.

3.4.2.6 Cask-MCO Hood/Seal Ring Installation (SCIC in "1 BYPASS" mode)

The process connections are made after moving the process hood into place and removing the flange covers from the MCO using torque wrenches. The MCO has two process ports, port #3 for the Axial Process Tube that communicates with the bottom of the MCO and port #2 for the Process Exhaust that communicates with the headspace of the MCO. As received from the K Basins, port #3 (Axial Process Tube port plug) is in the closed position while port #2 (Process Exhaust port plug) is received in the open position but closed in step 18b.

Note: There can be no significant delay (max. of 1/2 hr.) between the removal of the Cask lid and closing of port #2 (Process Exhaust port plug) (or installation and purging with the MCO valve operator). Air entry into the open MCO port could allow flammable concentrations to exist inside the MCO after 9 hours.

There can be no significant delay between the closing of port #2 and opening of port #2 on the process connector. Delays in opening the MCO vent greater then 24 hours could result in actuation and release from the MCO rupture disk.

18. a) Remove the port cover from port #2 (Process Exhaust port).

b) Close port #2 (Process Exhaust port plug) VPS-V-*010 hand snug using the MCO Special tool (T-Handle socket).

c) Remove port covers from port #3 (Axial Process Tube port). Store cover and bolting in the process bay storage locker.

Time to complete operation steps 18a - 18c: 15/15 minutes.

d) Install the crane-lifting fixture onto the Cask-MCO process hood/seal ring assembly and hook to the crane.

e) Move process hood/seal ring assembly onto top of Cask.

Time to complete operation steps 18d - 18e: 30/30 minutes.

19. a) Install process hood/seal ring assembly bolts (lubricate threads with Neolube) and then torque to 26 ± 2 ft-lbs.

b) Verify ventilation flow through the process hood (flow is on continuously)

c) Remove lifting fixture from the process hood/seal ring assembly and translate crane to parking position (AC 5.14).

d) Inflate Cask-MCO process hood/seal ring assembly, seal ring inflatable seals to 45 psig by manually actuating IA-V-*022 and observe PIT-1*04. The MCS will verify > 40 psig. Anytime the seal is inflated (based on sequence step) and pressure drops < 40 psig an alarm will sound. Should an alarm occur, the TW pump will be stopped.

Time to complete operation: 22/32 minutes.

3.4.2.7 MCO Vacuum Purge System Hookup (SCIC in "1 BYPASS" mode)

20. The MCS will permit removal of the MCO valve operators, prevent a pressurized condition, and equalize pressure to atmosphere in the process lines connected to the MCO. For the Axial Process Tube port (port #3) MCO valve operator, if the PWC system is in recirculation mode through the ejector, de-energize the PWC pumps PWC-P-4035 and 4036 (removes ejector vacuum) and open PWC-GOV-1*03 and PWC-GOV-1*30 for 1 minute then re-close and then restart PWC pumps. For the Process Exhaust port (port #2) MCO valve operator, open the following valves to depressurize the lines, VPS-GOV-1*09, VPS-GOV-1*05, VPS-GOV-2*03, VPS-GOV-2*05, wait 1 minute then re-close. Remove the two MCO valve operators that are stored in the process hood/seal ring assembly and install the MCO valve operators onto MCO ports #2 and #3. Verify the 30 psig vent path (VPS-PSE-1*33) is installed and connected to the local exhaust (***SR*** *3.3.1.1*) Torque bolting to 15 ± 3 ft-lbs.

Time to complete operation: 20/20 minutes.

21. a) At the MCS, select "PROCESS PORT LEAK TEST" (***SR*** 3.3.1.2) which will secure the vent and start the leak test. This provides helium at 20 psig to port #3 (Axial Process Tube port) and 4 psig helium to port #2 (Process Exhaust port) and then monitors the pressured regions for loss of pressure. The MCS will verify pressure at > 10 psig on PI-1*34 and 3.0-4.5 psig on PI-1*36 and 1*37.

b) Verify MCO valve operators are leak tight utilizing the helium MSLD in accordance with COGEMA-SVLT-INS-003.13. Each process connector shall be verified to have a leak rate of less than 1xE-4 sccs, He. If the process ports fail the leak test, at the MCS select "FAIL" which will vent the process ports as described in step 20 to allow removal of the connectors. If the leak passes, select "PASS" on the MCS.

VALVE LINEUP: VPS-GOV-2*03, VPS-GOV-1*05, VPS-GOV-1*09, He-GOV-1*12 open (4 psig on vent side piping). He-GOV 1*06, He-GOV-1*02 open with FIC 1*20 set at 1

scfm (supplies 20 psig helium on port #3 (Axial Process Tube port)). PWC-GOV-1*03 and PWC-GOV-1*30 closed (LCO 3.1.8).

Time to complete operation: 32/32 minutes.

22. Following successful completion of the leak test, purge the VPS suction line (with the Process Exhaust Port plug (port #2) closed) with helium to reduce residual air in the line.

   a. Evacuate the VPS suction line by drawing a vacuum (~ 0.5 torr) on the port #2 (Process Exhaust port) MCO valve operator with the VPS vacuum pump. Re-pressurize this line with helium to 4 psig from He-PCV 1*27. Close the 4 psig supply by shutting He-GOV-1*12.

   b. Place the SCIC system switch in the "**2 HEATUP**" position. The MCS will open VPS-GOV-2*04 to line up the 1 psig pressure control vent.

   Time to complete operation steps 22a - 22b: 12/12 minutes.

   c. Open port #2 (Process Exhaust port plug), using valve operator VPS-V-*010. This will immediately open the MCO to the 1 psig vent path.

   d. At the MCS start the "MCO PRESSURE/VENT CYCLE" to reduce the hydrogen concentration in the MCO. This will cycle He-GOV 1*12 and VPS-GOV 2*04 every 15 seconds to alternate pressure between 4 psig and 1 psig. This sequence will continue 30 times. The MCS will verify pressure cycles from 1 ±0.3 psig to 3.0-4.5 psig on PI-1*36 and PI-1*37, an alarm will be generated if these cycles do not occur or if pressure is outside the expected range.
   Note: The MCS shall have a means to allow Operations to select an automatic pressure/vent cycle (4 psig helium to 1 psig vent on the MCO vent plug) during the "2 HEATUP" and "3 DRAIN" modes.

   Time to complete operation steps 22c - 22d: 5/55 minutes.

3.4.2.8 Cask-MCO Tempered Water System Hookup and Heatup (SCIC in "2 HEATUP" mode)

Caution: If water is present after removing the lower port Cask port cover, this could indicate a leaking quick-disconnect or piping connection. This "leak" must be assessed for the need for repair prior to proceeding.

23. a) Utilizing special remote handling tool, remove Cask process port (at lower end of Cask) cover plate (de-torque and verify retraction of cover plate bolts; bolting is self-captured with tool). Store cover plate and tool in storage box to protect from loss and damage.

b) Connect the tempered water system supply line (TW-*01-SS-1-1/2) to the lower Cask process port TW-QD-*018 (utilize cask lower port TW disconnect tool SE-CASK-004) and quick disconnect. Torque lower port assembly bolting to 15 ± 3 ft-lbs (lubricate threads with Neolube).

Time to complete operation steps 23a - 23b: 5/25 minutes.

c) At the MCS initiate the "START TW SYS" sequence. Immediately verify no leakage at the skid or Cask.

d) Verify tempered water flow (FI-3*16 > 15 gpm) and correct water level in the tempered water system surge tank (LI-3*04 between 20 and 80%) with the system running.

e) At the MCS, begin the MCO HEAT-UP process using a setting of 45°C tempered water as monitored on TIC-3*05 (TW System Heater outlet) (LCO 3.1.4).

Time to complete operation steps 23c - 23e: 7/7 minutes.

f) The MCO will be allowed to heat to a temperature of 45°C for a period of 5 1/2 hours.

CAUTION: If the PWC system is being used in another bay, the draining will not be allowed to start at step 25a. If possible, secure or complete other bay operation as quickly as possible to reduce corrosion production inside the MCO.

g) Connect the auxiliary vacuum pump (from the MCO helium leak test equipment) to the seal ring vacuum port. (May be performed in parallel with step 23e)

Time to complete operation steps 23f - 23g: 332/332 minutes.

h) Initiate and verify vacuum service to this port (vacuum of less than 60 torr should be achieved within 10 minutes, if not evaluate cause). (May be performed in parallel with step 23g) Continue vacuum pump out of the seal ring until step 51.

Time to complete operation steps 23h: 0/35 minutes.

24. a) Verify that the mandatory operation duration of 5 1/2 hours at the 45°C is accomplished prior to step 25 to equalize the MCO contents at the required temperature. Close the 1 psig vent path (VPS-GOV-2*04) and open the 4 psig helium supply (He-GOV-1*12) to pressurize the MCO in preparation for draining.

Time to complete operation: 2/15 minutes

3.4.2.9 MCO Bulk Water Drain Operation (SCIC in "2 HEATUP" mode)

Drain Starting Conditions

- All support systems (e.g., MCS, instrument air, electrical, radiation monitoring, security) are operational
- The PWC system is ready and the receiving tanks are between a 6 and 10% level.
- The PWC suction pressure is < 100 torr on PIT 4031 and no other bay requires the use of the PWC system.

  CAUTION: If the PWC system is being used in another bay, the draining will not be allowed to start at step 25a. If possible, secure or complete other bay operation as quickly as possible to reduce corrosion production inside the MCO.

- The MCO is pressurized to 1 psig of helium
- Port #3 (Axial Process Tube port plug) is closed.
- The tempered water system is circulating water in the cask annulus at approximately 45°C with a 5 1/2-hour mandatory heatup completed (starts at the initiation of heatup from TIC-3*05).

VPS VALVE LINEUP: VPS-GOV-2*03,VPS-GOV-1*05, VPS-GOV-1*09 open. He-GOV 1*12 open to apply 4 psig on the MCO process exhaust port (port #2). DI/He-QD-*110 connected to DI line.

25. This following sequence will drain the free-flowing water from the MCO.

    Note: The PWC system cannot be used to perform any other processes while draining an MCO in any other bay.

    a. Place the SCIC system switch in the "**3 DRAIN**" position. The MCS will automatically start a PWC pre-purge by opening He-GOV-1*06, He-GOV-1*02, PWC-GOV-1*30 and PWC-GOV-1*03 with FIC-1*20 set at ~ 10 scfm helium flow. The purge will last for a total of 21 minutes (2 minutes to allow for flow meter response, 19 minutes of purge rate > 9.0 scfm,). The SCIC will monitor FI-1*20 and FI-1*21 for proper purge flow of > 8.4 scfm during the 19 minute pre-purge time. If after 21 minutes the flow requirement has not been met, an alarm is sent to the SCIC control room annunciator and remains locked in until either a) a continuous 19 minutes of >8.4 scfm purge is completed, or b) the mode switch is placed in any other position than 3 DRAIN.

Time to complete operation steps 25a: 21/21 minutes.

VPS VALVE LINEUP: VPS VALVE LINEUP: VPS-GOV-2*03,VPS-GOV-1*05, VPS-GOV-1*09 open. He-GOV-2*03, 1 psig vent open.

He-GOV-1*06, He-GOV-1*02, PWC-GOV-1*30, PWC-GOV-1*03 open with FIC 1*20 set at 10 scfm helium for the PWC pre-purge.

b. Once the PWC pre-purge is completed, FIC-1*20 is set to 0 scfm and PWC-GOV 1*30, PWC-GOV-1*03, He-GOV-1*02 and He-GOV-1*06 are closed. The Operator then opens port #3 (Axial Process Tube port plug) (VPS-V-*019). Fully open valve VPS-V-*019 (Back torque to 15±3 ft-lbs to ensure sealing). Once port #3 is opened, the MCO pressure is not allowed to equal or exceed 12 psig (LCO 3.1.1)

   Note: The operators should then leave the general vicinity of the drain line to minimize exposure.

   Time to complete operation step 25b: 5/10 minutes.

c. At the MCS, start the MCO PRESSURE/VENT CYCLE to reduce the hydrogen concentration in the MCO just prior to the start of MCO DRAINING. This will cycle He-GOV 1*12 and VPS-GOV 2*04 to alternate pressure between 4 psig and 1 psig. This sequence will continue 30 times prior to starting the drain cycle (step 25). The MCS will verify pressure cycles from 1±0.3 psig to 3.0-4.5 psig on PI-1*36 and PI-1*37, an alarm will be generated if these cycles do not occur or if pressure is outside the expected range. Once the 30 cycles are completed, the drain sequence can be started.

d. Verify the bay is clear of personnel. At the MCS, start the MCO DRAIN sequence which will stop the pressure cycle with PWC-GOV-1*12 open and PWC-GOV-2*04 closed. Verify >3 psig on PT-1*36 and PT-1*37 and then open PWC-GOV 1*30 and PWC-GOV-1*03 initiating the drain to the PWC tanks.

   NOTE: At a 5 gal/min design rate, approximately 30 minutes will be needed to drain the 150 gal of water from the MCO. Upon detection of water suction breakthrough (large increase (>400 torr) of PWC inlet pressure on PI-4031) the drain lineup will stay unchanged for an additional five minutes to remove residual water. This signifies the MCO is drained.

VPS VALVE LINEUP: VPS-GOV-2*03, VPS-GOV-1*05, VPS-GOV-1*09, He-GOV-1*12 open with 4 psig on the MCO vent port (port #2). PWC-GOV-1*30 and PWC-GOV-1*03 are open (drain starts as soon as these two valves are open).

Time to complete operation step 25d: 32/32 minutes

3.4.2.10 SCHe Purge, PWC Line Rinse and PWC Tank Post-Purge After Drain (SCIC in "3 DRAIN" mode)

26. The following steps outline the automatic sequences started after the "**4 PURGE/FLUSH**" mode is started.

    a. Place the SCIC mode switch in the "**4 PURGE/FLUSH**" position. This will automatically initiate a SCHe purge to port #3 (Axial Process Tube port) for 2 minutes to clear any collected water in these lines. (SCHe-GOV-5*12 and SCHe-GOV-5*31 cycle open).

    Time to complete operation step 26a: 2/2 minutes.

    b. After 2 minutes from the start of the "**4 PURGE/FLUSH**" mode, the MCS will automatically start a PWC line flush by lining up the DI water (DI-GOV-1*01, VPS-GOV-1*11 and VPS-GOV-1*17 open) to port #3 (Axial Process Tube port). The PWC suction will pull the water from the port to the receiving tanks through PWC-GOV-1*30 and PWC-GOV-1*03. The MCO pressure is maintained by the 4 psig helium on port #2 (Process Exhaust port). The rinse will run for 15 minutes to rinse ~ 80 gallons of DI water to the receiving tanks. NOTE: The MCS timer runs solely based on the time from the mode switch change. Interruptions in flow will not stop the timer.

    Time to complete operation step 26b: 15/15 minutes.

VPS VALVE LINEUP: VPS-GOV-2*03, VPS-GOV-1*05, VPS-GOV-1*09, He-GOV-1*12 open with 4 psig on the MCO vent port (port #2). PWC-GOV-1*30 and PWC-GOV-1*03 are open to the PWC. DI-GOV-1*01, VPS-GOV-1*11 and VPS-GOV-1*17 open to supply DI water rinse.

    c. After 17 minutes from the start of the "**4 PURGE/FLUSH**" mode, the MCS shuts the DI lineup (MCS closes VPS-GOV-1*11, VPS-GOV-1*17, and DI-GOV-1*01), and starts the PWC Post-Purge. At this time the MCS closes valves VPS-GOV 1*09 and VPS-GOV-1*05 to assure helium purge flow is going only to the PWC Receiver Tanks. FIC-1*20 is set to 10 scfm and He-GOV-1*06 and He-GOV-1*02 are open to supply 20 psig helium to the MCO

    Note: The MCS will automatically commence the PWC Post-Purge to remove collected hydrogen from the drain sequence. This takes 19 minutes @ > 9.0 scfm helium from FV-1*20 including 2 minutes to allow for flowmeter response. Since there is a manual method for performing this purge, an administrative bypass of this step is provided on the MCS to allow continuation of the sequence.

Time to complete operation step 26c: 19/19 minutes.

VPS VALVE LINEUP: He-GOV 1*06, He-GOV-1*02 open with FIC-1*20 set at 10 scfm (20 psig) supply. PWC-GOV 1*30 and PWC-GOV 1*03 are open to the PWC suction. PWC re-circulation pumps running (PWC-P-4035 or -4036). VPS-GOV-1*09 and VPS-GOV-1*05 are closed

d. At the conclusion of the PWC Post-Purge, 38 minutes from selecting "**4 PURGE/FLUSH**" mode, the MCS, will set FIC-1*20 to 0 scfm and close He-GOV-1*06 and He-GOV-1*02. The 4 psig helium pressure is re-established.

Time to complete operation step 26d: 2/2 minutes.

VPS VALVE LINEUP: VPS-GOV-2*03, VPS-GOV-1*05, VPS-GOV-1*09, He-GOV-1*12 open with 4 psig on the MCO vent port (port #2). PWC-GOV-1*30 and PWC-GOV-1*03 are open to the PWC suction. PWC re-circulation pump running.

e. Operations then swaps from DI to helium at the quick disconnect DI/He-QD-*110. At the MCS, select "**DI Blowdown**" which opens VPS-GOV-1*11 and VPS-GOV-1*17. This immediately starts a helium blowdown of the lines from the quick disconnect which has some water remaining in it. The operator will verify blowdown by monitoring FI-1*22 for greater than 10 scfm for 2 minutes. Operations will then disconnect and cap the helium line from VPS-GOV-1*11 and verify no lines connected to the VPS-GOV-1*11 quick disconnect.

Time to complete operation step 26e: 14/15 minutes.

VPS VALVE LINEUP: VPS-GOV-2*03, PWC-GOV-1*05, VPS-GOV-1*09, He-GOV-1*12 open with 4 psig on the MCO vent port (port #2). PWC-GOV-1*30 and PWC-GOV-1*03 are open to the PWC. VPS-GOV-1*11 and VPS-GOV-1*17 open to supply helium to blowdown the rinse line.

f. At the MCS select "DI Blowdown Complete", which will close PWC-GOV-1*30, PWC-GOV-1*03, VPS-GOV-1*17 and VPS-GOV-1*11 (LCO 3.1.8) and establish normal Axial Process Tube port (port #3) to process vent (port #2) helium flow. The MCS will open He-GOV-1*02 and open He-GOV-1*06, set FIC-1*20 to 10 scfm, then close He-GOV-1*12 and open VPS-GOV-2*04 to control MCO pressure at ~ 1 psig. Wait at least 2 minutes before proceeding to the next step to give the flowmeters time to reach a stable reading. After reaching 10 scfm, the MCS will reduce flow to 1.5 scfm.

Time to complete operation step 26f: 6/6 minutes.

VPS VALVE LINEUP: He-GOV-1*06, He-GOV-1*02, VPS-GOV-1*05, VPS-GOV-1*09, VPS-GOV-2*03, VPS-GOV-2*04 open with FIC-1*20 set at 1.5 scfm helium through VPS-PCV-2*37, 1 psig pressure control vent.

3.4.2.11 Eight Hour Vacuum/Purge Drying Operation (SCIC in "4 PURGE/FLUSH" mode)

Starting Conditions Vacuum/Purge Drying Operation

- All support systems (e.g., MCS, instrument air, electrical, radiation monitoring, security) are operational.
- The SCIC system switch is in the "**4 PURGE/FLUSH**" position and the blowdown operation is complete.
- The MCO is pressurized at ~ 1 psig with ~ 1.5 scfm normal helium purge (LCO 3.1.1), from He-FV-1*20, supplied to MCO Axial Process Tube port (port #3) and out the HEPA filter and Process Exhaust port (port #2), and through pressure-regulating valve VPS-PCV-2*37.
- The VPS vacuum pump is operational. Operation of the vacuum pump is verified from PI-2*08 (the vacuum pump will be operated continuously except for maintenance downtime). Pump inlet pressure with isolation valve VPS-GOV-2*07 closed will be less than 0.5 torr.
- The VPS condenser chilled water is operational, FI-7078 > 5-20 gpm, TI-2*35 and TI-2*36 are < 2°C.
- The condenser drain tank is ready to receive condensate (this is verified administratively)
- Tempered water is running at 45 ± 2°C [SCIC setpoint 48.1°C (Parameter limit of 50°C)] (LCO 3.1.4)
- The deionized water flex hose is disconnected from DI/He-QD-*110.

VPS VALVE LINEUP: He-GOV 1*06, He-GOV-1*02, VPS-GOV-1*09, VPS-GOV-1*05, VPS-GOV-2*03, VPS-GOV-2*04 open with FIC-1*20 set at 1.5 scfm helium through VPS-PCV-2*37, 1 psig pressure control vent.

27. a. The Operator selects "**5 DRYING**" on the SCIC mode panel. The MCS will increase flow to 10 scfm. As soon as flow is > 9 scfm the MCS will start a timer for the MCO Pre-purge. Based on switching to the Drying mode, the MCS will monitor for completion of the MCO Pre-Purge prior to going below atmospheric conditions. At the MCS, if the condenser delta-T is less than 2 °C, zero the reading. This removes

any bias or offset in the reading. If the delta-T is greater than 2 °C, investigate cause.

NOTE: Failure to complete the Pre-purge would cause a SCIC ISO & PURGE. The Pre-purge will take ~ 17 minutes, 2 minutes to get above 9 scfm and 15 minutes for the purge. A flow of less than 9.0 scfm will reset the 15-minute timer. The SCIC monitors for ≥ 8.4 scfm for 15 minutes which when satisfied will bypass the Low Pressure trip.

Time to complete operation step 27a: 17/17 minutes.

b. At the MCS the operator starts the drying sequence by selecting the "START MCO DRYING" button.

   Note: The "**START MCO DRYING**" button on the MCS will not be active until the SCIC "**5 DRYING**" mode is selected, the MCS monitored MCO Pre-purge is met, and helium flow is above the Low Purge Flow trip, >1.1 scfm.

Time to complete operation step 27b: 2/2 minutes.

c. The MCS sets helium flow to 3.0 scfm on FIC-1*20 to control the MCO internal HEPA flow. VPS-GOV-2*21 and VPS-GOV-2*22 are then opened and VPS-GOV-2*03 is closed to establish condenser flow. VPS-GOV-2*04 is closed (isolates 1 psig PCV vent path) and VPS-GOV-2*07 is opened (vacuum pump is lined up). The helium flow rate will remain at 3.0 scfm for 30 minutes then automatically decrease to 1.5 scfm over the next 15 minutes.

Time to complete operation step 27c: 2/2 minutes.

d. The above actions start the vacuum cycle with expected MCO pressures < 100 torr after 10 minutes. The MCS 7-hour 55-minute Vacuum Limit Timer (7 hrs 55 min) is started and continues to count the first time MCO pressure is < 0.6 psig.

   Note: Anytime when the MCS 8-hour Vacuum Limit Timer is counting, if pressure in the MCO goes above 0.4 psig, as measured by the MCS, a Thermal Reset must be completed.

   Going above 0.5 psig, as monitored by the SCIC, then back below 0.5 psig without completing the Thermal Reset will result in a SCIC Vacuum Limit Timer trip. This assures that the maximum allowed time under vacuum, 8 hours, is continuous which assures controlled temperatures of the MCO fuel.

   Note: The SCIC Pressure Rise Fail trip is active whenever MCO pressure has gone ≤ –11.7 psig (~155 torr), The SCIC trip becomes active whenever pressure increases above –11.1 psig (~185 torr) for 5 seconds. The MCS will monitor for this condition and automatically close VPS-GOV-2.07, open He-GOV-1*06, open VPS-GOV-2*04 and set FIC-1*20 to 10 scfm. This will repressurize the MCO to 1 psig within 5 minutes of exceeding the –11.1 psig setpoint. Failure to perform these steps will result in a SCIC ISO & PURGE. SCIC timer and pressure trip functions are associated with LCOs 3.1.1 and 3.1.2.

VPS VALVE LINEUP: He-GOV-1*06, He-GOV-1*02, VPS-GOV-1*09, VPS-GOV-1*05, VPS-GOV-2*21, VPS-GOV-2*22, VPS-GOV-2*07 open with FIC-1*20 set at 1.5 scfm helium through the condenser and vacuum pump.

Time to complete operation step 27d: 480/480 minutes.

e. The DI/VPS Flush line contains a small amount of water at this time. To drain this water to the PWC system, PWC-QD-*020 must be connected to DI/HE-QD-*110. Once this connection has been established, open valve PWC-V-*048. Instruct the MCS to open valve VPS-GOV-1*11. This will allow the residual water from the DI/VPS Flush line to drain to the PWC system. Wait 10 minutes and instruct the MCS to close VPS-GOV-1*11. Close PWC-V-*048 and disconnect PWC-QD-*020 from DI/HE-QD-*110.

Time to complete operation 27e: 30/30 minutes. (Operation can be done in parallel with steps 27a-d)

28. a. The MCS monitors both condenser differential temperature (Delta-T) and the total time the MCO is < 0.6 psig (i.e. under vacuum).

Note: If during the drying process the MCS 8-hour Vacuum Limit Timer (7 hrs 55 min) is reached; the MCS will reestablish MCO pressure at 1 psig for 4 hours and 5 minutes per step 30.

Time to complete operation step 28a: 0/0 minutes.

b. When condenser Delta-T is less than 0.2°C for at least 5 minutes the MCS isolates the condenser by first opening the condenser bypass valve VPS-GOV-2*03 and then closing VPS-GOV-2*22 and VPS-GOV-2*21, the condenser isolation valves. As an option, the operator may choose to isolate and bypass the condenser at anytime during drying. This allows for drying should the condenser be unavailable or if the time to reach the Delta-T criteria is excessive.

Time to complete operation step 28b: 0/5 minutes.

VPS VALVE LINEUP: He-GOV-1*06, He-GOV-1*02, VPS-GOV-1*09, VPS-GOV-1*05, VPS-GOV-2*03, VPS-GOV-2*07 open with FIC-1*20 set at 1.5 scfm helium through the condenser bypass and the vacuum pump.

c. The MCS will perform the No Purge Vacuum Check by setting FIC-1*20 to 0 scfm then closing He-GOV-1*06. This isolates the normal helium flow. If the MCO pressure decreases below the 12 Torr Bypass setting, (7.4 torr) within 4.0 minutes the helium purge will not be restarted, skip to step 28f, otherwise continue.

Note: Once the initial 12 Torr Bypass is satisfied (< 7.4 torr for 10 seconds) if MCO pressure exceeds 7.9 torr for more than 10 seconds without a minimum helium purge, the MCS will automatically restart the helium purge to 1.5 scfm, regardless of the process step.

Note: A SCIC ISO & PURGE will occur after 2 minutes without a purge > 1.1 scfm once the MCO is above 8 torr.

Time to complete operation step 28c: 0/5 minutes.

VPS VALVE LINEUP: VPS-GOV-1*09, VPS-GOV-1*05, VPS-GOV-2*03, VPS-GOV-2*07 open with FIC-1*20 set at 0 scfm helium.

d. If 7.4 torr is not reached within the 4 min period, the MCS re-opens He-GOV 1*06 and sets FIC-1*20 to 3 scfm to restart helium purge. Once flow indication is > 1.1 scfm the FIC 1*20 is reduced to 1.5 scfm.

Time to complete operation step 28c: 0/5 minutes.

VPS VALVE LINEUP: He-GOV 1*06, He-GOV-1*02, VPS-GOV-1*09, VPS-GOV-1*05, VPS-GOV-2*03, VPS-GOV-2*07 open with FIC-1*20 set at 1.5 scfm helium through the condenser bypass and the vacuum pump.

e. The MCS will automatically repeat steps 28c and 28d every 60 minutes until the MCO pressure can be reduced below < 7.4 torr with flow stopped. When < 7.4 torr is achieved, proceed to step 28f. If the MCS 8-hour Vacuum Limit Timer (7 hrs 55 min) is reached skip to step 30.

Note: As an option, an administrative "Start THERMAL RESET" button is provided by the MCS to re-pressurize and purge the MCO anytime during Drying or Proof Modes.

Time to complete operation step 28e: 0/60 minutes.

f. After the 12 Torr Bypass (set 7.4 torr) is reached, the MCS will monitor MCO pressure for a value of < 0.5 torr for at least 15 minutes. Once this pressure is reached proceed with step 29, Pressure Rebound Pre-Test.

Time to complete operation step 28f: 0/5 minutes.

VPS VALVE LINEUP: VPS-GOV-1*09, VPS-GOV-1*05, VPS-GOV-2*03, VPS-GOV-2*07 open with FIC-1*20 set at 0 scfm helium.

29. a. The MCS automatically performs the Pressure Rebound Pre-Test by isolating the MCO by closing VPS-GOV-1*05, VPS-GOV-1*09, and He-GOV-1*02. The MCS monitors the MCO vacuum pressure; if pressure rate of rise change is less than 0.4 torr over the 10-minute period skip to step 31. The MCS will display a plot of MCO vacuum pressure (PI-1*08, PI-1*10) and TW temperatures (TI-3*05, TI-3*12) for 15 minutes from the start of the test. At the conclusion of the test a hard copy of the plot will be printed.

Time to complete operation step 29a: 0/10 minutes.

b. If the pressure rise from step 29a is greater than 0.4 torr, resume vacuum service by opening valves VPS-GOV-1*05 and VPS-GOV-1*09 and continuing vacuum pumping without helium purge, provided the MCO pressure is < 7.4 torr. Repeat the Pressure Rebound Pre-Test (29a) every hour until it passes then skip to step 31 or until the MCS 8-hour Vacuum Limit Timer (7 hrs 55 min) is reached then proceed to step 30.

Note: Excessive time or an excessive number of attempts to reach 7.4 torr may be an indication of a leak or vacuum pump degradation. An operator initiated "START THERMAL RESET" at the MCS to repressurize the MCO and start a minimum purge may be used for investigation.

Time to complete operation step 29b: 0/60 minutes.

3.4.2.12 Four Hour MCO Pressure Operations (Thermal Reset) (SCIC in "5 DRYING" mode)

30. At the completion or interruption of the MCS 8-hour Vacuum Limit Timer (7 hours 55 min) the MCS will initiate a Thermal Reset. The MCS opens He-GOV-1*06 and He-GOV-1*02, if not already open, sets the purge flow on FIC-1*20 to ~10 scfm and isolates the vacuum pump by closing VPS-GOV-2*07 and opening VPS-GOV-2*04 (1 psig vent path). This will cause a rapid re-pressurization of the MCO. After MCO pressure is above 0.6 psig on PI-1*36 and -1*37, and purge flow above 9.0 scfm is maintained for at least 15 minutes, (MCO Pre-Purge is satisfied), the MCS reduces flow to 1.5 scfm. Skip to step 32 if the condenser was previously isolated or step 33 if not isolated.

Note: The Thermal Reset is a repressurization of the MCO, which is continuously maintained for a minimum of 4 hrs and 5 min by the MCS. Flow is maintained during the Thermal Reset to satisfy the SCIC Low Flow trip (LCO 3.1.1).

Note: The increased purge flow of ~10 scfm is necessary to prevent a SCIC Pressure Rise Fail trip which will result in a SCIC ISO & PURGE (LCO 3.1.1).

VPS VALVE LINEUP: He-GOV-1*06, He-GOV-1*02, VPS-GOV-1*09, VPS-GOV-1*05, VPS-GOV-2*03, VPS-GOV-2*07 open with FIC-1*20 set initially at 10 scfm then to 1.5 scfm helium through the condenser bypass and VPS-PCV-2*37 (1 psig vent).

Time to complete operation: 240/240 minutes.

31. At the completion of the MCS 4-hour Vacuum Limit Timer (3 hours 55 min) or as a prerequisite for the Pressure Rebound Test, the MCS will perform a Thermal Reset (4 hrs 5 min). The MCS opens He-GOV-1*06 and He-GOV-1*02, if not already open, sets the purge flow on FIC-1*20 to ~10 scfm and isolates the vacuum pump by closing VPS-GOV-2*07 and opening VPS-GOV-2*04 (1 psig vent path). This will cause a rapid re-pressurization of the MCO. After MCO pressure is above 0.6 psig on PI-1*36 and -1*37, and purge flow above 9.0 scfm is maintained for at least 15 minutes, (MCO Pre-Purge is satisfied), the MCS reduces flow to 1.5 scfm. During the Thermal Reset prior to the Initial Pressure Rebound Test (step 40), the MCS shall record MCO pressures and TW temperatures as a function of time. This data shall be transferred to the CVDF process Engineers for analysis. Skip to step 40.

    Time to complete operation: 240/240 minutes.

3.4.2.13 Four Hour Vacuum/Purge Drying Operation (SCIC in "5 DRYING" mode)

32. If the condenser was isolated in step 28b, restart the vacuum mode with process flow bypassing the condenser. After 15 minutes at vacuum, skip to step 34, no purge vacuum check.

VPS VALVE LINEUP: He-GOV 1*06, He-GOV-1*02, VPS-GOV-1*09, VPS-GOV-1*05, VPS-GOV-2*03, VPS-GOV-2*07 open with FIC-1*20 set at 1.5 scfm helium through the condenser bypass and the vacuum pump.

Time to complete operation: 0/20 minutes

33. If the condenser was not isolated in step 28b, re-start the vacuum mode with process flow through the condenser.

VPS VALVE LINEUP CONDENSER IN LINE: He-GOV-1*06, He-GOV-1*02, VPS-GOV-1*09, VPS-GOV-1*05, VPS-GOV-2*21, VPS-GOV-2*22, VPS-GOV-2*07 open with FIC-1*20 set at 1.5 scfm helium through the condenser and vacuum pump.

When condenser Delta-T is less than 0.2°C for at least 5 minutes the MCS isolates the condenser by first opening the condenser bypass valve VPS-GOV-2*03 and then closing VPS-GOV-2*22 and VPS-GOV-2*21, the condenser isolation valves. Verify helium flow at > 1.5 scfm. After 15 minutes at vacuum, skip to step 34, no purge vacuum check.

Note: As an option, the operator may choose to isolate and bypass the condenser at anytime during drying. This allows for drying should the condenser be unavailable or if the time to reach the Delta-T criteria is excessive. Follow step 30 for MCO re-pressurization.

VPS VALVE LINEUP CONDENSER BYPASSED: He-GOV-1*06, He-GOV-1*02, VPS-GOV-1*09, VPS-GOV-1*05, VPS-GOV-2*03, VPS-GOV-2*07 open with FIC-1*20 set at 1.5 scfm helium through the condenser bypass and the vacuum pump.

Time to complete operation: 180/180 minutes

3.4.2.14 No Purge Vacuum Check (SCIC in "5 DRYING" mode)

34. The no purge vacuum check consists of the following steps:

    a. The MCS will perform the No Purge Vacuum Check by setting FIC-1*20 to 0 scfm then closing He-GOV-1*06. This isolates the normal helium flow. If the MCO pressure decreases below the 12 Torr Bypass setting (7.4 torr) within 4.0 minutes, the helium purge will not be restarted, skip to step 34b, otherwise skip to step 36.

    Note: Once the initial <u>12 Torr Bypass</u> is satisfied, set at < 7.4 torr for 10 seconds, if MCO pressure exceeds the reset value of >7.9 torr for more than 10 seconds without a minimum helium purge, the MCS will automatically restart the helium purge to 1.5 scfm, regardless of the process step.

    Note: A <u>SCIC ISO & Purge</u> trip will occur after 2 minutes without a purge > 1.1 scfm once the MCO is above 8 torr (LCO 3.1.1).

    Time to complete operation step 34a: 20/20 minutes.

b. Once MCO pressure decreases to less than 0.5 torr for a minimum of 15 minutes, perform pressure rebound pre-test in step 35 unless returning from step 39 then skip to step 40. If time under vacuum reaches 3 hours and 55 minutes go to step 37.

Note: The series of steps from 34 through 39 are repeated as either the Pressure Rebound Pre-test fails or the time under vacuum limit is reached. The pre-test needs only to be passed once and not repeated, however the No Purge Vacuum Check is performed each time the MCO pressure exceeds 7.9 torr.

Time to complete operation step 34b: 20/20 minutes.

35. a. The MCS automatically performs the Pressure Rebound Pre-Test if the pressure conditions from step 34b are met by isolating the vacuum by isolating the MCO by closing VPS-GOV-1*05, VPS-GOV-1*09, and He-GOV-1*02. The MCS monitors the MCO vacuum pressure; if pressure rate of rise change is less than 0.4 torr over the 10-minute period skip to step 31. Thermal Reset (4 hrs 5 min). The MCS will display a plot of MCO vacuum pressure and TW temperatures for 15 minutes from the start of the test. At the conclusion of the test a hard copy of the plot will be printed.

Time to complete operation step 35a: 10/10 minutes.

b. If the pressure rise from step 35a is greater than 0.4 torr, resume vacuum service by opening valves VPS-GOV-1*05 and VPS-GOV-1*09 and continuing vacuum pumping without helium purge, Proceed to setup 36. If the 3 hours and 55 minute under vacuum is reached skip to step 37.

Time to complete operation step 35b: 0/5 minutes.

36. Open He-GOV-1*06 and set FIC-1*20 to 3.0 scfm until flow reaches 1.1 scfm, then set FIC-1*20 to 1.5 scfm and continue vacuum purge mode with helium flow. Each hour repeat the No Purge Vacuum Check (go to step 34).

Note: Should the time to reach below 7.4 torr become excessive; this may be an indication of a leak or excess water. A decision for this off-normal condition will require some analysis and the RGA should be used to understand this condition.

Time to complete: 240/240 minutes.

37. At the conclusion of the MCS 4-hour Vacuum Limit Timer (3 hours 55 min) the MCS will initiate a Thermal Reset (4 hrs 5 min). The MCS opens He-GOV-1*06 and He-GOV-1*02, if not already open, sets the purge flow on FIC-1*20 to ~10 scfm and isolates the vacuum pump by closing VPS-GOV-2*07 and opening VPS-GOV-2*04 (1 psig vent

path). This will cause a rapid re-pressurization of the MCO. After MCO pressure is above 0.6 psig on PI-1*36 and -1*37, and purge flow above 9.0 scfm is maintained for at least 15 minutes, (MCO Pre-Purge is satisfied), the MCS reduces flow to 1.5 scfm. Return to step 33 if the condenser was not isolated otherwise, continue.

Note: The 4 hour Vacuum Timer, MCS and SCIC, are accumulative timers. Total time under vacuum is measured without regards to time spent at pressure.

Time to complete operation: 245/245 minutes.

37. After the Thermal Reset and the MCO Pre-Purge are met, proceed to next step.

Time to complete operation: 0/0 minutes.

38. Re-start the vacuum mode with process flow through the condenser bypass. After 15 minutes at vacuum, stop the purge and perform no purge vacuum check (go to step 34).

Note: Steps 34 through 39 may need to be repeated several times until the Pressure Rebound Pre-Test (step 35) is successful. Failure of step 35 may require administrative action to determine if a system leak or other malfunction has occurred.

Time to complete operation: 15/15 minutes.

3.4.2.15 <u>Initial Pressure Rebound Test</u> (SCIC in "5 DRYING" mode)

Note: The Initial Pressure Rebound Test is MCS controlled but the test performance verifications are all done administratively. AC 5.17 is associated with dryness testing beginning with the initial pressure rebound test.

39. Starting Conditions Initial Pressure Rebound Test

- A Thermal Reset has been completed, step 31 completed.
- Vacuum is < 0.5 torr for at least 15 minutes
- Tempered Water inlet temperature has been maintained > 40 °C during the Thermal Reset, at least 4 hours.

a. As soon as the starting conditions are met the "START INI REBOUND TEST" button will become active on the MCS control screens. The selecting of this start sequence will close all open MCO isolation valves (He-GOV-1*02, He-GOV-1*06, VPS-GOV-1*09, VPS-GOV-1*05) and start the 65 minute plot of MCO pressure and TW temperatures (inlet and outlet). During the Initial Pressure Rebound Test, the MCS shall record MCO pressures and TW temperatures as a function of time. This data shall be transferred to the CVDF process Engineers for analysis.

VPS VALVE LINEUP: VPS-GOV-2*03, VPS-GOV-2*07 are open with FIC-1*20 set at 0 scfm.

Note: If the pressure rate of rise is above 2.0 torr (2.4 torr parameter limit) within 60 minutes, the test fails and more vacuum drying is necessary. In addition, if the plot shows an unfavorable result Operations may choose to abort the test and continue drying. In either case, the operator will direct the MCS whether the test passed or failed.

b. If the test fails, further helium purging and vacuum pumping is necessary. Wait for 65 minutes then return to step 35. Note: The RGA can be used to determine if the test failed because of leaks or because of water.

c. If the test passes proceed to step 41, Proof Mode.

Time to complete operation: 80/80 minutes.

3.4.2.16 Proof Mode (SCIC in "5 DRYING" mode)

40. Select "**6 PROOF**" mode on SCIC. The MCS will plot the TW temperatures and PT 1*08 and 1*10 over the Proof Mode period. Upon verification by operations that the Proof Mode has been satisfied, proceed to step 42. This data is important for long-term storage of spent nuclear fuel and is designated as OCRWM data. All records will be kept for the life of the MCO. During the Proof Mode, the MCS shall record MCO pressures and TW temperatures as a function of time. This data shall be transferred to the CVDF process Engineers for analysis.

Note: This will eliminate the need for the MCS Vacuum Limit Timer and SCIC trips (8/4/4). The Proof Mode provides an additional vacuum sequence which is required to determine if the fuel in the MCO is off gassing at ~ 45°C. The goal of this step is to maintain the MCO under vacuum less than 8 torr for a minimum cumulative period of 8, 20 or 28 hours for no scrap basket, one scrap basket or two scrap baskets, respectively.

Note: Should an unexpected pressure increase above the 7.9 torr reset value occur, the MCS will automatically start a helium purge by opening He-GOV-1*02, He-GOV-1*06 and setting FIC-1*20 to 3.0 scfm until flow is indicating > 1.1 scfm on the MCS, then the flow setting is set to 1.5 scfm. This increase of pressure may indicate an off gassing of the hydrates, a leak of air or helium, additional free water in the MCO being released or potential off-gassing from other sources. The RGA may be used to determine the source of pressure.

The following conditions exist:

The tempered water system circulation temperature is maintained at 45°C.

- The condenser is bypassed and isolated.
- The vacuum pump is running and open to the MCO.

Note: If the MCO pressure is greater than 7.9 torr and duration is less than 2 hours after passing the 1-hour pressure rise test then a fault condition (leak) must exist and recovery is required.

VPS VALVE LINEUP: VPS-GOV-1*09, VPS-GOV-1*05, VPS-GOV-2*03, VPS-GOV-2*07 open.

Time to complete operation: 1,200/1,200 minutes.

3.4.2.17 Final Pressure Rebound Test (SCIC in 6 PROOF mode)

41. This step confirms that bulk water was not re-introduced during the vacuum drying cycle. The MCO is isolated from potential water sources and the pressure rebound test is repeated the final time. This data is important for long-term storage of spent nuclear fuel and is designated as OCRWM data. All records will be kept for the life of the MCO.). During the Final Pressure Rebound Test, the MCS shall record MCO pressures and TW temperatures as a function of time. This data shall be transferred to the CVDF process Engineers for analysis.

    Note: The Final Pressure Rebound Test is MCS controlled but the test performance verifications are all done administratively. The MCS will plot the TW temperatures and PT 1*08 and 1*10 over a 65 minute test period.

    Starting Conditions Final Pressure Rebound Test

    - The Proof of Dryness Mode step 41 is completed.
    - Tempered Water inlet temperature must be maintained at 45°C.
    - MCO pressure is < 0.5 torr.

    a. As soon as the prerequisites are met, the Final Pressure Rebound Test start button will become active on the MCS control screens. The selecting of this start sequence will close all open MCO isolation valves (VPS-GOV-1*05 and VPS-GOV-1*09). VPS-GOV-2*07, 2*04, 2*05, 2*22, and 2*21 will be closed to isolate the vacuum pump and condenser. He-GOV-1*12 will be opened to supply

4 psig of Helium to line VPS-*02-SS-1" up to VPS-GOV-1*05. This will ensure the pressure rebound test results will not be misrepresentative of the actual condition of the MCO.

b. The Operator will place the SCIC mode switch in the **"7 PRESSURE TEST"** position. The SCIC also interlocks closed VPS-GOV-1*09 and VPS-GOV-1*05 to prevent water addition sources and the MCS starts a one-hour plot of MCO pressure and TW temperatures (inlet and outlet).

VPS VALVE LINEUP: VPS-GOV-2*03 open, all MCO isolation valves and VPS-GOV-2*07, 2*04, 2*05, 2*22, and 2*21 closed.

c. If the pressure rate of rise is above 2.0 torr (2.4 torr parameter limit) within one hour, the test fails and a recovery procedure is necessary. In addition, if the plot shows an unfavorable result, Operations may choose to abort the test. In either case, the operator will direct the MCS whether the test passed or failed.

d. After passing pressure rate of rise 2.0 torr (2.4 torr parameter limit) per hour pressure rebound test, re-pressurize the MCO with helium by opening He-GOV-1*02, He-GOV-1*06 and setting FIC-1*20 to 100% open until pressure is > 0.6 psig, then reduce the FIC setting to 30% open. Control the pressure in the MCO by cycling He-GOV-1*06 to maintain ~ 3.0 to 5.0 psig.

Time to complete operation: 80/80 minutes.

3.4.2.18 Cooldown to 15°C Operation (SCIC in 7 PRESSURE TEST mode)

42. The MCO requires cooling before final preparation for shipping. This is done by turning the heaters off and by starting cooling water flow through the tempered water system cooler (open TWC-GOV-3*01). This cooling water is derived from the HVAC chiller system. During cooldown, maintain MCO pressure to ~ 3 to 5 psig with FIC-1*20 set to 30% open, and cycling He-GOV-1*06.

Note: There is no established procedure to reduce MCO pressure, however the MCS must not exceed 11.5 psig during this pressure control mode to avoid an SCIC high pressure trip at 12 psig (LCO 3.1.1).

A mandatory minimum hold of 6 hours is required to allow the contents of the MCO to come to temperature equilibrium with the tempered water system. A further requirement is to document that the following conditions have been maintained (concurrently) for at least 5 hours of the 6-hour mandatory hold period:

1) A minimum tempered water flow of 15 gpm (FI-3*16) is required during the hold period

2) Maintain the tempered water system outlet temperature at less than 15 °C (TIC-3*05). The five-hour hold under prescribed conditions shall be documented for each MCO and placed in the MCO QA data package.

Following the 6 hour hold, the MCS will control MCO pressure to 11 ± 0.5 psig by setting FIC-1*20 to 30% open, and cycling He-GOV-1*06 (SL 2.1.1) . At the MCS select "RECORD MCO FINAL PRESS" which will print the present MCO pressure as indicated on PI 1*36 and PI 1*37.

Time to complete operation: 360/360 minutes.

43. Ops verify MCO pressure is at 11 ± 0.5 psig on PI-1*40 and PI-1*41 (*AC 5.16.2*). Close MCO Axial Process Tube port plug (port #3) VPS-V-*019. After waiting for at least 6 minutes (AC 5.15) close MCO Process Exhaust port (port #2), VPS-V-*010. Torque to a specified value of 60 ± 6 ft-lb. At the MCS select "RECORD PORT VALVE CLOSED" which will both record date and time in the MCS database as well as print this information. Close He-GOV-1*06, He-GOV-1*02 with FIC-1*20 at 0%. Position the SCIC system switches to "**1 BYPASS**" for this bay.

Time to complete operation: 20/20 minutes.

3.4.2.19 MCO Helium Leak Test (SCIC in "1 BYPASS" mode)

Process connections require disengagement after cool-down has completed.

44. To permit removal of the MCO valve operators and prevent a pressurized condition, equalize pressure to atmosphere in the process lines connected to the MCO. For the Axial Process Tube port (port #3) MCO valve operator, if the PWC system is in recirculation mode through the ejector, de-energize the PWC pumps PWC-P-4035 and 4036 (removes ejector vacuum) and open PWC-GOV-1*03 and PWC-GOV-1*30 for 1 minute then re-close and then restart PWC pumps. For the Process Exhaust port (port #2) MCO valve operator, close VPS-GOV-2*07open the following valves to depressurize the lines, VPS-GOV-1*09, VPS-GOV-1*05, VPS-GOV-2*03, VPS-GOV-2*05, wait 1 minute then re-close.

Time to complete operation: 0/20 minutes.

CAUTION
Assure step 45 is complete prior to removing any bolts, as pressure may exist which could lift the valve operator and spread contamination. In addition, any SCIC ISO & Purge would also cause pressurized helium to flow through both valve operators.

45. Remove all MCO valve operator-securing bolts then remove the MCO valve operators.

Wipe down and place the MCO valve operators in their storage sockets in the process hood and engage bolting to torque value (15±3 ft/lbs). Once complete, press "PROCESS PORT REMOVED" button which will instruct the MCS to close all open process valves and restart the PWC re-circulation pumps, PWC-P-4035 or PWC-P-4036.

Time to complete operation: 20/20 minutes

46. Decontaminate the MCO port plugs and cover plate flange surfaces for contamination and water residue. Decontaminate the MCO shield plug top surfaces. Hand dry areas around MCO ports to minimize potential for spread of contamination. Using special He leak test equipment, install the MCO port cover blind flanges on the Process Exhaust port (port #2), Axial Process tube port (port #3), and Rupture Disk port (port #4). Torque bolting to specified value (34 ± 4 ft-lb.). Conduct He leak test of MCO port 2, 3 and 4 in accordance with COGEMA-SVLT-INS-003.12, Rev. 0. Each process port shall be leak tight to 1xE-6 std cc/s, as defined in ANSI N14.5 -1987.

    Time to complete operation: 50/50 minutes.

47. VPS Condenser Tank Draining Starting Conditions

    - MCS verify PWC receiver tank level indication between 6-10%
    - PWC transfer pump PWC-P-4035/-4036 operational with flow at a minimum of 25 gal/min
    - PWC transfer pump discharge pressure at 40 psig or more
    - PWC ejector suction pressure at less than 200 torr
    - SCIC is in "1 Bypass" mode

    a. At the MCS, the operator selects "DRAIN CONDENSER" button. The MCS then closes or verifies closed, VPS-GOV-2*21, VPS-GOV-2*22, PWC-GOV-2*16, VPS-GOV-1*12, VPS-GOV-2*03, VPS-GOV-2*04, VPS-GOV-2*05, VPS-GOV-2*07, VPS-GOV-1*09, and VPS-GOV-1*05.

    b. The MCS pressurizes the condenser tank with helium to ~ 4 psig by opening He-GOV-1*12, pressure is verified at PIT-2*09.

    c. The MCS opens VPS-GOV-2*03, VPS-GOV-2*22 and PWC-GOV-2*16, this initiates water flow to the PWC receiver tank.

    d. Pumping is continued until breakthrough (large increase (>400 torr) of PWC inlet pressure on PI-4031) is detected and a 10 minute purge after breakthrough is completed. The MCS then closes PWC-GOV-2*16, He-GOV-1*12, VPS-GOV-

2*03 and VPS-GOV-2*22.

Note: With a water drain rate of 5 gal/min., the nominal transfer of 3.2 gallons (12 liters) of water to the PWC receiver tanks is accomplished in less than 1 minute. The maximum condenser tank working volume of 8.5 gallons (32 liters) would require a transfer time of less than 2 minutes. At the end of this step, the condenser tank is empty of water but has a 4 psig helium cover gas. The PWC receiver tanks have accepted an additional 8.5 gallons of water (maximum) that potentially has low levels of contamination.

Time to complete operation: 15/15 minutes.

48. The Cask-MCO annular space is isolated from the tempered water system and then the annular space between the MCO and the Cask is drained to the PWC system. The operator selects "Start Annulus Drain" button at the MCS. Water is drained by turning off the tempered water system circulation pump, TW-P-3*14, closing TW-GOV-1*14 and TW-GOV-3*14. With a RPT ready to collect up to 2 ounces of water, disconnect the tempered water supply line from the Cask lower port (TW-QD-*018) and connect the PWC system drain line to the Cask lower port (PWC-QD-*020). Open PWC-V-*048 and then pressurize the Cask-MCO annulus with instrument air to 20 psig by opening CA-GOV-1*15, this will the drain the annular area to the PWC system receiver tank. After break through detection at the PWC system (PI-4031), continue to purge the annulus with instrument air for two hours.

Note: This will cause a "BAY * ANNULUS LOW LEVEL" alarm on the SCIC Annunciator panel in the control room. Once this alarm is confirmed the "BAY * LVL" alarm bypass switch is placed in "ON".

Time to complete operation: 0/150 minutes (done in parallel with steps 45 through 48).

49. Close CA-GOV-1*15 and then close PWC-V-*048, this will depressurize the annular area to the PWC system receiver tank. Disconnect the Cask drain to the PWC line. Install the Cask lower port cover and bolt the cover with CVDF special tooling. Torque bolting (lubricate threads with Neolube) to specified values 15 ± 3 ft-lb.

Time to complete operation: 10/10 minutes.

50. a) Deflate hood/seal ring assembly inflatable seals by manually turning IA-V-*022 to vent, ensure PIT-1*04 is < 0.2 psig. Continue Aux. vacuum pumping until the pump pressure reaches less than 1 torr (read at PI-6*07) plus an additional 15 minutes. This will dry any residual water in the cask annulus.

    b) Isolate Aux Vacuum system by closing valve AUX-V-*606 and break cask annulus vacuum by disconnecting Aux. Vacuum equipment from the seal ring assembly at AUX-QD-*622 and installing open QD fitting at the seal assembly. QD. Install helium leak test equipment and conduct a helium leak test of the

MCO main seal in accordance with COGEMA-SVLT-INS-003.12, Rev. 0. The MCO main seal shall be leak tight to 1xE-6 std cc/s, as defined in ANSI N14.5 - 1987. Disconnect helium leak test equipment and transfer the test equipment to its storage location in the process bay.

c) Unbolt seal ring assembly. Install the crane lifting fixture onto Cask hood/ring. Move hood/ring onto its storage location on the process bay mezzanine.

Time to complete operation: 25/25 minutes.

51. Attach crane to test chamber, lift and install test chamber onto top of MCO. Install the MCO integrated leak rate test chamber onto the top of the MCO. Connect helium leak test equipment with Aux-QD-*621 to the test chamber. Conduct the integrated MCO He leak test in accordance with COGEMA-SVLT-INS-003.12, Rev. 0. (AC 5.16) Each MCO shall be verified leak tight to less than 1xE-5 std cc/s, as defined in ANSI N14.5 -1987.

Time to complete operation: 60/60 minutes.

52. Disconnect helium leak test equipment and transfer the test equipment to its storage location in the process bay.

Time to complete operation: 15/15 minutes.

3.4.2.20 Preparation of Cask for Departure (SCIC in "1 BYPASS" mode)

53. Dry MCO and cask top surfaces and perform radiological surveys of cask to verify contamination cleanliness of cask surfaces. Engage the crane to the cask lid lifting fixture and install the cask lid. Install and torque twelve Cask lid bolts in appropriate sequence, as indicated in an approved procedure. Torque bolting (lubricate threads with Neolube) to specified value 300 ± 30 ft-lb. using geared torque wrenches. At the direction of the CVDF Operations Manager, install an instrument air line to the Cask Lid QD vent port and pressurize the cask to 15 psig. Perform a soap bubble leak test on the cask lower port connector assembly. Following the leak test, depressurize the cask through the lid vent port. Install the Cask Lid vent port cover and bolt the cover with CVDF special tooling, torque bolting (lubricate threads with Neolube) to specified value of 15 ± 3 ft-lb.

Time to complete operation: 45/45 minutes.

54. Dry cask external surfaces and perform radiological surveys of cask to verify contamination cleanliness of cask surfaces.

Time to complete operation: 30/30 minutes.

55. Perform cask and trailer final radiological surveys. Decontaminate as required. The Cask-MCO is ready for shipment to the CSB.

    Time to complete operation: 30/30 minutes.

3.4.2.21 Preparation of Trailer for Transport (SCIC in "1 BYPASS" mode)

56. Connect building air supply to the landing leg air supply glad hand. Raise the front of the trailer to above the tractor fifth wheel height as directed by transportation supervisor.

    Time to complete operation: 5/5 minutes.

57. Secure security system for the process bay, open the telescoping process bay door, and back the tractor under the cask trailer. Engage trailer kingpin to the tractor fifth wheel and lock in place.

    Time to complete operation: 15/15 minutes.

58. Check to make sure the fifth wheel is latched (visual or tugging).

    Time to complete operation: 5/5 minutes.

59. Set the tractor brakes. Shut off tractor.

    Time to complete operation: 5/5 minutes.

60. Raise the landing legs. Change the building air supply from the landing leg air supply glad hand to the trailer supply glad hand.

    Time to complete operation: 5/5 minutes.

61. Change the override valve to automatic. Disconnect the building air supply.

    Time to complete operation: 5/5 minutes.

62. Connect tractor air lines and electrical cable.

    Time to complete operation: 5/5 minutes.

63. Perform standard pre-trip inspection per pre-trip inspection requirements.

    Time to complete operation: 10/10 minutes.

3.4.2.22 Transport Cask-MCO Out of the Cold Vacuum Drying Facility (SCIC in "1 BYPASS" mode)

64. Give the MCO quality assurance package to the truck driver. Release cask for transfer to CSB.

    Time to complete operation: 5/5 minutes.

65. Start tractor engine. Release tractor and trailer brakes. Drive out of the process bay. Close the process bay door and transport the Cask-MCO to the CSB.

    Time to complete operation: 15/15 minutes.

3.5 PROCESS WATER CONDITIONING SYSTEM OPERATION

The normal PWC system operations are shown in the process flow diagram (H-1-82166). The following describes the operating sequences that will activate the functions embodied in the PWC P&ID, H-1-82164. Note, indicated process step duration times are Average Basis engineering estimates, definitive estimates will be provided during Pre-operational testing and the Process Validation operation.

3.5.1 Process Water Conditioning Vacuum Pumping and Receiving - Starting Conditions

Operation of the PWC system vacuum pumping and receiving include controlling and monitoring PWC pump operation, flow loop performance, receiver tank conditions, and suction line performance. The PWC receiving system is online continuously to support the CVD process systems. Either of the two receiving system pumps are run continuously except for those periods when none of the process bays are processing a MCO or recovering from processing a MCO. Maintenance activities, including a shutdown to change out an IXM, will require the placement of any MCO, prior to bulk water drain, in a safe state. The system will allow completion of MCO drying operations for MCOs that have completed bulk water draining.

The PWC system is powered by two (one running and one spare) canned pumps (PWC-P-4035 and PWC-P-4036) capable of pumping 45 gal/min at a discharge pressure of 60 psig. The receiver tank must have a minimum heel of 24 gallons, >0.0% reading from LI-4033, in order to prevent cavitation of the PWC Pump. The receiving tanks are initially filled with deionized water from the DI system by directing DI valve DI-GOV-4057 to open and filling the tank until a 6-10% reading is indicated from PWC-LI-4033.

The PWC transfer pumps are then started from the MCS, the system initially starts in the recirculation mode with three port flow control valve, PWC-GOV-4039, positioned to route water from the pumps to the ejector, PWC-EJR-4031. The pump discharges water into receiver tanks PWC-TK-4032, with underflow balance line connection to PWC-TK-4033. Monitoring the pump operation is done by tracking the pump and valve status on the MCS. Pump PWC-P-4035 is the primary pump with three port flow control valves, PWC-GOV-4045 and PWC-GOV-

4046 ported to primary pump in the failed port position (no instrument air needed). If a trip is detected, the PWC system is considered not ready for continued operation. Operator intervention will be required to utilize the redundant pump by remote changeover from the operator control station in the CVDF control room.

Flow loop performance is a less direct way of monitoring pump operation. FIT-4037 and PIT-4038 are used to determine if adequate flow and pump discharge pressures are being maintained. If less than 25 gal/min. or 40 psig are being achieved, the PWC system is considered incapable of continued operation. The water temperature is also monitored at TI-4044, to verify that the temperature is less than the IXM resin temperature limit of 60 °C.

Receiver tank conditions measurements are used to determine if the PWC system is ready to receive additional water from the CVDF process systems. If a new MCO, or other process system, is ready to discharge water, the PWC receiver tanks must be at the lower level as measured by a 6-10% reading from LI-4033. The PWC pump is interlocked in the off position below a 2% level and above a 95% level as indicated on LI-4033(A and B). If an alarm on low-level below the minimum 2.0%level is detected, the PWC system requires operator attention. The receiver tanks have a combined total working capacity of 260 gallons as measured by LI-4033(A and B). If during operations, a 90% high level reading at LI-4033(A and B) occurs, the PWC system is considered not ready and the MCS directs the pump(s) to stop.

Suction line performance is verified to determine initial startup conditions and to monitor line operation. The ejector is capable of pulling at least 5 gal/min. of liquid at a vacuum of less than 200 torr. For initial startup before any MCO bulk water draining, tempered water expansion tank level adjustment, VPS condenser tank emptying, Cask-MCO annulus draining, or various line flushing, the process water suction line should be demonstrating adequate vacuum, PI-4031 less than 200 torr. 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 PIT-4031 from less than 200 torr to approximately 400 torr. The MCS is programmed to sense this change and proceed with the next processing step (with nominal holds of 1 to 2 minutes) as defined in the CVD operational sequences.

Utilization of the PWC for CVDF water draining and impurity removal operations is described in steps 3.5.2 through 3.5.11 below. The modes of operations are: a) PWC ejector recycle mode per section 3.5.2, 3.5.3, 3.5.4 or 3.5.5, b) Process Water Conditioning Impurity Removal per section 3.5.6 or c) Process Water Conditioning Transfer to PWC Storage Tank, PWC-TK-4001, per section 3.5.8.

3.5.2 Process Water Conditioning Vacuum Pumping and Receiving – MCO Bulk Water Draining

MCO bulk water draining can commence if the PWC system is ready to accept water, i.e. receiver tank level indication 6-10% level at LI-4033(A and B), transfer pump PWC-P-4035/-4036 operational with flow at a minimum of 25 gal/min. at FI-4037 and discharge pressure at 40 psig or more at PI-4038, ejector suction pressure at less than 200 torr at PI-4031. During

MCO bulk water draining, the full flow of water from the transfer pumps is directed through the PWC ejector and no flow is directed through the IXM or filter loop (three port valve, PWC-GOV-4039, directed to ejector). The PWC can only process one MCO during an 8-hour period, therefore scheduling of multiple MCO bulk water drain operations is required.

1. MCO bulk water draining and subsequent transfer line flush and receiver tank helium gas purging is performed in accordance with SNF-2356, section 3.4.2 steps 25a through 25d **(Vacuum Purge System Operation - Drain Operation)**. The MCO bulk water drain shall nominally transfer 230 gallons of water (150 gallons of MCO bulk water and 80 gallons of flush water) to the PWC receiver tanks.

2. At the end of the MCO bulk water drain, nominally 254 gallons (230 with 24 gallon heel) of contaminated water is in the receiver tanks. The receiver tanks have been purged of any potential hydrogen by a helium gas purge. The PWC is operating with full flow through the ejector loop. Note: The transferred water must be processed through the PWC IXM and filter and transferred to the storage tank, PWC-TK-4001, prior to another PWC water receiving operation.

   Time to complete operation: 80 minutes (steps 1 and 2).

3.5.3 Process Water Conditioning Vacuum Pumping and Receiving – VPS Condenser Tank Draining

VPS condenser tank draining can commence if the PWC system is ready to accept water, i.e. receiver tank level indication 6-10% level, transfer pump PWC-P-4035/-4036 operational with flow at a minimum of 25 gal/min and discharge pressure at 40 psig or more, ejector suction pressure at less than 200 torr. During VPS condenser tank draining, the full flow of water from the transfer pumps is directed through the PWC ejector and no flow is directed through the IXM or filter loop (flow is set to ejector port at PWC-GOV-4039). VPS condenser tank draining can be performed after CVD operations are performed on a MCO. Condenser tank draining can be done only after the SCIC is in "1 Bypass" mode.

VPS condenser tank draining shall nominally take 5 to 10 minutes. The VPS condenser tank draining shall nominally transfer 3.2 gallons (12 liters) of water to the PWC receiver tanks. The VPS condenser tank has a maximum working volume of 8.5 gallons (32 liters). Tank level alarm high, LAH-2*25, alarms when the tank level reaches this max working level. The response to this alarm requires that the CVD process to isolate the VPS condenser and condenser tank.

3. Condenser tank draining is accomplished by verifying that the tank is isolated by closure of VPS valves VPS-GOV-2*21, VPS-GOV-2*22 and PWC-GOV-2*16.

4. Condenser tank drain with PWC ejector operation assisted with a helium pressurization at the top of the condenser tank is accomplished by verifying that the CVD operation is complete with the SCIC in "1 Bypass" mode. The following VPS valves are verified

closed, VPS-GOV-1*12, VPS-GOV-2*03, VPS-GOV-2*04, VPS-GOV-2*05, VPS-GOV-2*07, PWC-GOV-2*16, VPS-GOV-2*21, VPS-GOV-1*09, VPS-GOV-1*05, and VPS-GOV-2*22. The PWC receiver tank is verified ready to receive additional water and the PWC ejector is verified operational. A helium pressurization of the condenser tank to 4 psig is accomplished by the MCS by opening He-GOV-1*12, pressure is verified at PIT-2*09. Then VPS-GOV-2*03, VPS-GOV-2*22 and PWC-GOV-2*16 are then opened by MCS command, this initiates water flow to the PWC receiver tank. The tank is empty when breakthrough is determined at the PWC ejector inlet pressure from PIT-4031. The drain tank is allowed to be purged with helium for 10 minutes after breakthrough, then the condenser tank drain valve, PWC-GOV-2*16, is closed, the helium purge valve, He-GOV-1*12, and condenser isolation tank valves, VPS-GOV-2*03, VPS-GOV-2*22, are closed. With a water drain rate of 5 gal/min., the nominal transfer of 3.2 gallons (12 liters) of water to the PWC receiver tanks is accomplished in less than 1 minute. The maximum condenser tank working volume of 8.5 gallons (32 liters) would require a transfer time of less than 2 minutes. At the end of this step, the condenser tank is empty of water but has a 4 psig helium cover gas. The PWC receiver tanks have accepted an additional 8.5 gallons of water (maximum) that potentially has low levels of contamination.

Time to complete operation: 15 minutes (steps 3 and 5).

3.5.4 Process Water Conditioning Vacuum Pumping and Receiving – Cask-MCO Annulus Draining

Cask-MCO annulus draining can commence if the PWC system is ready to accept water, i.e. receiver tank level indication 6-10% level, transfer pump PWC-P-4035/-4036 operational with flow at a minimum of 25 gal/min. and discharge pressure at 40 psig or more, ejector suction pressure at less than 200 torr. During Cask-MCO annulus draining, the full flow of water from the transfer pumps is directed through the PWC ejector and no flow is directed through the IXM or filter loop (flow is set to ejector port at PWC-GOV-4039). Cask-MCO annulus draining can commence only after the CVD process for a MCO is completed and the Tempered Water system is disconnected from the Cask-MCO annulus and the SCIC is in "1 Bypass" mode.

5. The drain line PWC-*03-SS-1" is connected to the Cask lower port using PWC-QD-*020. Inadvertent draining of the Tempered Water system during the CVD process is a Safety Class event and cannot be tolerated.

6. The Tempered Water system is verified in shutdown mode; the circulation pump, TW-P-3*14, is inactive, flow is not circulating (FIT-3*16 at zero), electric heater, TW-HTR-3*11, and cooler, TW-CLR-3*10, are inactive and isolation valves, TW-GOV-1*14, TW-GOV-3*14, TWC-GOV-3*01 and CA-GOV-1*15 are closed.

7. The draining of the Cask-MCO annulus with PWC ejector operation is accomplished by opening CA-GOV-1*15, PWC valve PWC-V-*048 (manual valve located on the PES in the Process Bay) per CVD operation sequence SNF-2356, section 3.4.2.17. For a full

Cask-MCO annulus, there will be approximately 28 gallons of water (Ref. HNF-SD-TP-SARP-017, Table BB-1) in the system that will be drained to the PWC. At 5 gal/min. drain rate, this will take approximately 6 minutes. Once breakthrough (indicated at PIT-4031) is achieved, continue drain operation for an additional 60 minutes and then direct the operators to close valves CA-GOV-1*15 and then PWC-V-*048. The additional 60 minutes of Instrument Air flowing through the annulus will dry the annulus of residual water. At the end of the drain sequence the affected Cask-MCO annulus is empty of water and 1 atmosphere of air is in the system. The PWC receiver tanks have accepted an additional 28 gallons of water (maximum) that potentially has low levels of contamination.

Time to complete operation: 65 – 80 minutes (steps 5 through 7).

3.5.5 Process Water Conditioning Impurity Removal

The PWC impurity removal consists of a flow branch for feeding 40 gal/min. of process water through IXM PWC-IXM-4037 or PWC-IXM-4038 and a separate particulate filter PWC-F-4042 (flow at 10 gpm), for final transfer to PWC-TK-4001. Automatic sampling is done utilizing PWC-SMP-4039, PWC-SMP-4040 and PWC-SMP-4041. Process water can be directed to the storage tank or returned to the receiver tanks.

Control of process water to the IXM is through PWC-GOV-4039 at a maximum rate of 40 gal/min. Prior to transfer of process water through the IXM initial sampling of water to be processed must be completed per section 3.5.6.

Process water through the IXM is not a once through operation. After the process water is passed through the IXM, the treated water is returned to the receiver tanks for re-circulation through the PWC process again. The water is circulated through the IXM for a sufficient time to achieve six water volume exchanges in the PWC receiver tanks, recirculating improves the overall impurity removal efficiency.

8. PWC-GOV-4047 will be positioned, by MCS action, to the PWC-008-SS-1" branch for recycle. For purifying the bulk water from the MCO, the water is circulated through the IXM for a sufficient time to achieve six water volume exchanges in the PWC receiver tanks. For a 254 gallon total volume (MCO drain case) in the receiver tanks and an IXM flowrate of 40 gal/min., a minimum processing time of 39 minutes is required. For an 86.5 gallon total volume (Condenser and Cask annulus drain case) in the receiver tanks and an IXM flowrate of 40 gal/min., a minimum processing time of 13 minutes is required. Following a minimum of six volume exchanges the conditioned water is ready for transfer to the PWC storage tank per operation 3.5. 7.

9. Transfer of the conditioned (purified) water from the receiver tank to the storage tank requires that a 24 gallon heel be left in the receiver tank. A DI water rinse of the tank is performed by adding 100 gallons of DI water, by the MCS cycling valve DI-GOV-4057 open for 20 minutes and then closing the valve. The water is circulated through the IXM

for a sufficient time to achieve six water volume exchanges in the PWC receiver tanks. For a 124 gallon total volume in the receiver tanks and an IXM flowrate of 40 gal/min., a minimum processing time of 19 minutes is required. Following a minimum of six volume exchanges the conditioned water is ready for transfer to the PWC storage tank per operation 3.5.7.

Time to complete operation: 88 minutes (steps 8 and 9).

3.5.6 Process Water Conditioning IXM Water Sampling

Water sampling is necessary to calculate the radionuclide loading on the IXM ion exchange media, (TRU and cesium limits are specified in the PWC SDD), in the PWC filter and in the PWC storage tank.

The MCS sends a momentary sample initiation signal to samplers PWC-SMP-4039, PWC-SMP-4040, and PWC-SMP-4041. Sampler PWC-SMP-4039 takes samples from the contents of receiver tanks PWC-TK-4032/-4033 (assumed to be concentration at the inlet of PWC-IXM-4037 or -4038). Sampler PWC-SMP-4040 takes samples from the outlet of PWC-IXM-4037 or -4038, and sampler PWC-SMP-4041 takes samples from the outlet of PWC-F-4042 (assumed to be the concentration at the inlet of PWC-TK-4001).

10. Prior to directing process water flow through the IXMs, a representative pre-purification sample shall be obtained of the contents of the receiver tank. While the contents of the receiver tank is recirculating, a 10cc sample shall be obtained via sampler PWC-SMP-4039 for each ~30 gallons of water to be processed. Note this will result in 9 sample plunges for the MCO water and flush (nominally 150 gallons for MCO water, 80 gallons of flush water and 24 gallons heel), 2 sample plunges for the ~ 52 gallons of cask annulus (nominally 28 gallons and ~24 gallon heel) and condenser tank water (nominally 4 gallons), and 4 sample plunges for the ~ 124 gallons PWC system flush processing (nominally 100 gallon rinse). These pre purification sample plunges should be withdrawn over a time period of ~5 minutes after the receiver tanks have been recirculated. Note; the amount of samples taken shall be determined based upon the actual amount of water present in the PWC receiver tanks. After the required processing through the IXM, post purification samples are collected in sampler PWC-SMP-4040.

    The same sample volumes are to be collected in this sampler as was collected previously with sampler PWC-SMP-4039. These post purification sample plunges should be withdrawn over a time period of ~5 minutes after the minimum required water purification through the IXM is completed. After impurity removal and during the transfer of water to PWC-TK-4001, sample plunges are withdrawn via sampler PWC-SMP-4041. The same number of sample plunges is used for this sampler as was used during sampling with the other two samplers, however these sample plunges should be obtained at a rate of approximately once every 2 minutes until the required number of sample plunges is obtained. Note: a definitive sampling program shall be developed by the CVDF project and implemented by the Operations staff. Elements of this program will provide direction on how and when to sample water at the IXM and how to sample for multiple pass processing of the water through the IXM.

Time to complete operation: 12 minutes per sample evolution (step 10).

3.5.7 Process Water Conditioning Transfer to PWC Tank, PWC-TK-4001

Following impurity removal as described above, water contained in the PWC receiver tanks can be transferred to the PWC Storage tank, PWC-TK-4001. PWC manual valves, PWC-V-013 and PWC-V-015 are administratively verified closed (normal positions), valves PWC-V-002 and PWC-V-019 (located in PWC Tank room) are to be administratively verified open (normal positions) and the MCS opens PWC header purge valve He-SOV-5089 prior to water transfers to PWC-TK-4001. The receiver tanks are emptied by routing water with a final pass (with sampling) through the IXM (described above), through the filter and ultimately to storage tank PWC-TK-4001. Nominally, 230 gallons of water will be transferred during MCO water transfers, 36.5 gallons during the Condenser tank/Cask annulus water transfers and 100 gallons for the PWC rinsing transfers. The PWC header purge valve He-SOV-5089 is opened to provide a vacuum break prior to all water transfers to PWC-TK-4001.

11. When there is a demand for a receiver tank level decrease, PWC-GOV-4047 must be positioned to the PWC-009-SS-1" branch (filter PWC-F-4042 inlet) and PWC-GOV-4039 to the PWC-007-SS-1 1/2" branch (IXM inlet) to force the treated process water stream into storage tank PWC-TK-4001. This operation is accomplished by MCS action. Initial draining of the receiver tanks is completed when a 5.0% reading is indicated on LI-4033.

12. Following draining and transfer of water to the Storage tank, PWC-GOV-4047 is instructed to close the transfer line to the filter and to open to the IXM recycle position. PWC-GOV-4039 is instructed to close the transfer line to the IXM and to open to the Receiver tank recycle position. Following the conditioned water transfer, the PWC system is rinsed in accordance with step 9 above (section 3.5.5). The rinse water is then transferred to PWC-TK-4001 per step 11 above. After the rinse water is transferred, the PWC header purge valve, He-SOV-5089, is closed.

Time to complete operation: 25 minutes (steps 10 and 12).

3.5.8 Process Water Conditioning Transfer from PWC-TK-4001 to KW Basin Tractor Trailer

The Conditioned Water Shipping system consists of (1) a tractor trailer with a ventilating high-efficiency particulate air (HEPA) filter; a quick disconnect flexible transfer line; valves, instruments, and controllers to receive conditioned water and transport it to K West Basin. The tractor trailer will be positioned in CVDF process bay #1 for transfer of the water from PWC-TK-4001. Just prior to and during transfer, no PWC receiving or impurity removal operations may be conducted as personnel entries into the PWC Tank room are required for this operation.

During this operation, the PWC skid is isolated from the storage tank by having valve PWC-GOV-4047 in the recycle position (closed to PWC-TK-4001, open to PWC-TK-4032).

13. To transfer water to the tractor trailer, the HEPA filter shall be installed on the trailer vent port and the transfer hose connected to the fill port.

14. The transfer line shall have isolation valves, PWC-V-008 (Process Bay #1), PWC-V-003 (Tank room), PWC-V-016 (Tank room), PWC-V-017 (Tank room), re-circulation line isolation valves, PWC-V-012 and PWC-V-018 (Tank room), and sample valve, PWC-V-012 (Tank room), previously verified in the closed position.

15. The trailer flexible transfer line shall be connected to the transfer line quick disconnect (Process Bay #1) and valve PWC-V-008 (Process Bay #1) opened. The operator shall enter the tank room and open valves PWC-V-003, PWC-V-016 and PWC-V-017 and exit the room.

16. The MCS shall be directed to start pump PWC-P-4001 to start the transfer of the water to the tractor trailer. The water will be transferred by the pump until level indications (LI-4014) show that 4000 gallons have been transferred or a storage tank low level alarm is received from LSL-4014, which is interlocked to the pump. At a flow of 45 gal/min., the transfer of 4000 gallons will take approximately 90 minutes.

17. After the pump shuts down, an IA blowdown of the transfer line will occur. The operator shall enter the tank room and install an IA jumper between IA-V-026 and PWC-V-012, close PWC-V-016, open IA-V-026 and PWC-V-012 and blowdown the transfer line into the water tanker for 10 minutes. The operator shall then close IA-V-026 and PWC-V-012, remove the IA jumper and exit the room.

18. After the IA blowdown is completed, operators close valves PWC-V-003 and PWC-V-017. Valve PWC-V-008 is then closed in Process bay #1, the flexible line is disconnected, the trailer fill port closed, and the HEPA filter port is closed. The tractor trailer is ready to transport the water to the KW basin.

    Time to complete operation: 3 hrs (steps 13 through 18).

3.5.9 Process Water Conditioning Vacuum Pumping and Receiving – Tempered Water System Draining

Tempered Water system draining can commence if the PWC system is ready to accept water, i.e. receiver tank level indication of 6-10% level, transfer pump PWC-P-4035/-4036 operational with flow at 25 gal/min and discharge pressure at 40 psig or more, ejector suction pressure at less than 200 torr. During Tempered Water system draining, the full flow of water from the transfer pumps is directed to ejector port at PWC-GOV-4039). Inadvertent draining of the Tempered Water system during the CVD process is a Safety Class event. This operation is not expected to be a routine operation at the CVDF, it is to be performed in the unlikely event that the TW system becomes contaminated with radiological materials.

Tempered Water system level adjustment can commence only after the CVD process for a MCO is completed and the Tempered Water system is disconnected from the Cask-MCO annulus and the SCIC is in "1 Bypass" mode.

19. The Tempered Water system is verified in shutdown condition; the circulation pump, TW-P-3*14, is inactive, flow is not circulating (FIT-3*16 at zero), electric heater, TW-HTR-3*11, is deenergized, and cooler, TW-CLR-3*10, TWC interface is isolated (TWC-GOV-3*01 is closed) and valves, TW-V-*021, TW-V-*033, TW-V-*048, TW-V-*133, TW-GOV-1*14, TW-GOV-3*14, CA-GOV-1*15, PWC-V-*048, PWC-V-*051, PWC-V-*053 are closed. For Tempered Water system draining to be necessary, the expansion tank, TW-TK-3*12, level must be at or near the high level alarm point, LAH-3*06, or near 100% at LIT-3*04, or water contamination is suspected or maintenance activities are required on the TW system.

20. The draining of the TW expansion tank with PWC ejector operation is accomplished by opening TW-GOV-1*14 and then PWC-V-*051 (manual valve located on the PES in the Process Bay). For a full expansion tank, there will be approximately 50 gallons of water in the system that will be drained to the PWC. At 5 gal/min. drain rate, this will take approximately 10 minutes. Once breakthrough (indicated at PIT-4031) is achieved, continue drain operation for an additional 5 minutes and then direct the operator to close valve PWC-V-*051 and the MCS will close CA-GOV-1*15 and TW-GOV-1*14. Note: At the end of the drain sequence the affected TW system is empty of water and 1 atm of air is in the system. The TW system can be refilled with DI water from the DI flush line located at the top of the TW expansion tank by opening DI-V-*049 and monitoring the level on TW-LI-3*04.

Time to complete operation: 47 minutes (steps 19 and 20).

3.5.10 Process Water Conditioning PWC-TK-4001 Recycle Operation

The Process Water Conditioning Storage Tank, PWC-TK-4001, may have to be periodically recycled to resuspend settled particulate or for decontamination purpose. This operation is accomplished by operating the transfer pump, PWC-P-4001 in recycle mode. During this operation, the PWC skid is isolated from the storage tank by having valve PWC-GOV-4047 in the recycle position (closed to PWC-TK-4001, open to PWC-TK-4032).

The storage tank, PWC-TK-4001, shall have a minimum of 1000 gallons ready for recycle as indicated on LI-4014. The transfer line shall have isolation valves, PWC-V-008 (Process Bay #1), PWC-V-003 (Tank room), PWC-V-016 (Tank room), PWC-V-017 (Tank room), re-circulation line isolation valve, PWC-V-011 (Tank room), PWC-V-018 (Tank room), and sample valve, PWC-V-012 (Tank room), previously verified in the closed position. Caution, this operation can not be done in parallel with other PWC operations.

21. Valves PWC-V-003, PWC-V-016 and PWC-V-018 are opened. Verify that valves PWC-V-002 and PWC-V-019 are in the open position.

22. The MCS shall be directed to start pump PWC-P-4001 to start the recycle of the water from and back to the storage tank. For six volume exchanges and a flow of 45 gal/min, the recycle of 1000 gallons will take approximately 2 ¼ hours. For every additional 1000 gallons add 2 ¼ hours.

23. Following the recycle, shut down the pump from the MCS. After the pump shuts down, close valves PWC-V-003, PWC-V-016 and PWC-V-018.

    Time to complete operation: 2 hr 15 minutes (steps 21 through 23).

3.5.11 Process Water Conditioning PWC-TK-4001 Recycle to PWC Skid Operation

The Process Water Conditioning Storage Tank, PWC-TK-4001 may have to be periodically recycled to the PWC skid for additional water cleanup through the IXM. This operation is accomplished by operating the transfer pump, PWC-P-4001 in IXM recycle mode.

The Storage tank, PWC-TK-4001, shall have a minimum of 1000 gallons ready for recycle as indicated on LI-4014. The transfer line shall have isolation valves, PWC-V-008 (Process Bay #1), PWC-V-003 (Tank room), PWC-V-016 (Tank room), PWC-V-017 (Tank room), re-circulation line isolation valve, PWC-V-011 (Tank room), PWC-V-018 (Tank room), PWC-V-048 (Tank room), PWC-V-049 (Tank room), and sample valve, PWC-V-012 (Tank room), previously verified in the closed position. Caution, this operation can not be done in parallel with other PWC operations.

24. Install special jumper assembly to the quick disconnects (PWC-QD-052 and PWC-QD-053) at valves PWC-V-050 (PWC IXM) and PWC-V-011 (Pump recycle line). Then open valves PWC-V-050 (Tank room), PWC-V-003 (Tank room), PWC-V-016 (Tank room), PWC-V-049 (Tank room), and PWC-V-011 (Tank room). Verify that valves PWC-V-002 (Tank room) and PWC-V-019 (Tank room) are in the open position.

25. The MCS shall be directed to shutdown PWC pumps PWC-P-4035 and PWC-P-4036.The MCS shall be directed to open valve PWC-GOV-4039 to the receiver tank and valve PWC-GOV-4047 to the storage tank (PWC-TK-4001). The operator then instructs the MCS to start pump PWC-P-4001 to start the recycle of the water from the storage tank to the PWC skid. For six volume exchanges and a flow of 10 gal/min, the recycle of 1000 gallons will take approximately 10 hours. For every additional 1000 gallons add 10 hours.

26. Following the recycle, direct the MCS to shut down the transfer pump (PWC-P-4001). After the pump shuts down, close valves PWC-V-016 (PWC-P-4001 inlet isolation valve). Open PWC-V-018 momentarily to ensure depressurization of special jumper assembly. Place special jumper assembly, SE-PWC-001 between IA connection at IA-V-

026 and PWC-V-012. Open IA-V-026 and PWC-V-012 and blow down recycle jumper for 10 minutes. Close IA-V-026, PWC-V-012, PWC-V-011, and PWC-V-050. Place liquid collection device under PWC-V-011 disconnect, PWC-QD-053. Remove jumper assembly disconnects from PWC-V-011 and PWC-V-012. Allow any liquid present to drain into the collection device. Place absorbent towel over the end of jumper disconnect, poly bag, and tape closure. Remove jumper assembly from disconnect PWC-V-050. Place absorbent towel over the end of jumper disconnect, poly bag, and tape closure. Remove IA jumper assembly from IA-V-026. Direct the MCS to close PWC-GOV-4047 (IXM to PWC-TK-4032). Direct the MCS to verify PWC-GOV-4045 and 4046 in their normal operating positions and to start normal PWC recycle operations by starting PWC-P-4035 or –4036.

Time to complete operation: 10 hrs (steps 24 through 26).

3.6 AUXILIARY SYSTEMS OPERATIONS

The process vent is part of an integrated, multi-zone HVAC venting system described in detail in SNF-3081. The process vent system removes offgas from the process module and provides a sweep function for the process vent hood located on the top of the MCO. The MCS controls all HVAC functions according to the detailed HVAC operational control description located in SNF-3081.

The chilled water supply for the tempered water cooler is supplied by an intermediate cooling loop interfaced with the facility chilled water system through a process heat exchanger. The intermediate loop consists of a circulation loop with spare pumps. The system is designed to remove 73 kW (250,000 Btu/h). The cooling circuit can provide cooling to the MCOs in each of the process bays at any given time.

The chilled water supply for the VPS condenser is supplied by a dedicated low-temperature chiller. This chiller is capable of supplying 13.2 kW (45,000 Btu/h) of 1.5°C (35°F) water to all condensers. A total of 4 gal/min is available to each process bay.

The instrument air system supplies dry, filtered, instrument air at approximately 115 psig to the process equipment skid. This air is used to operate the spring return automatic valves and to inflate the MCO hood/seal ring bladder.

The instrument air system supplies dry filtered instrument air for pneumatic tools. Instrument air is required for pneumatic wrenches for removal/installation of the Cask lid, and for the Cask transporter air ride suspension.

Deionized water is made up from potable water in a leased system. This water is used to flush lines, make up tempered water deficits, and flush the PWC system.

Helium is supplied from a leased high pressure tube trailer. High pressure helium is pressure-controlled to approximately 20.0 psig, safety relieved at 25 psig, and monitored for performance. Helium is used on the process equipment skids for purging and pressurizing liquids for removal to the PWC system. The helium is used for purging, heat-transfer fluid, and back-filling.

3.6.1 Operation of the Safety Class Instrument and Control System

The SCIC system is an automatic system that is designed to isolate the MCO (8 isolation valves are de-energized closed), start SCHe system flow and pressure to the MCO (4 isolation valves de-energize open) should process parameters exceed pre-established safety setpoints. See section 3.2.2 for a list of trips. In addition the SCIC will de-energize the TW heaters to limit heat input to the MCO fuel if the TW temperature exceeds its setpoint of 48.1 °C. Other SCIC functions include an alarm for low Cask-MCO annulus water level and bay high temperature alarm indication as part of the Iso & Purge trip alarm. Normal operation during the CVD processing of an MCO, is for the operator to place the SCIC system Mode switch into the mode appropriate for the processing stage. Each of the modes allows the SCIC system to monitor different sensors with setpoints and logic appropriate for that processing step as shown in the Table 3.3.

Table 3-3. Safety-Class Instrumentation and Control Trip, Interlock, and Alarm Summary

Mode	PLC trips (Note 1)	Non-PLC trips	Interlocks	Alarms
1 BYPASS	None	- Seismic - TW high temperature - Local and remote ISO & PURGE buttons - PWC pump seismic trip*	None	-Bay * purge -TW annulus low level (Note 2)
2 HEATUP	MCO high pressure	- Seismic - TW high temperature - Local and remote ISO & PURGE buttons - High bay temperature - PWC pump seismic trip*	PWC-GOV 1*30, 1*03, VPS-GOV-1*11, 1*17 (drain and rinse valves)	-Bay * purge -TW annulus low level
3 DRAIN	MCO high and low pressure	- Seismic - TW high temperature - Local and remote ISO & PURGE buttons - High bay temperature - PWC pump seismic trip*	None	-PWC low flow* -Bay * purge -TW annulus low level
4 PURGE/ FLUSH	MCO high and low pressure	- Seismic - TW high temperature - Local and remote ISO & PURGE buttons - High bay temperature - PWC pump seismic trip*	Note 3	-PWC low flow* -Bay * purge -TW annulus low level
5 DRYING	MCO high and low pressure MCO pre-purge MCO low purge flow MCO 12-torr purge bypass MCO low purge flow bypass MCO pressure decay fail MCO pressure rise fail MCO 8-hr vacuum limit timer MCO 4 hr vacuum limit timer	- Seismic - TW high temperature - Local and remote ISO & PURGE buttons - High bay temperature - PWC pump seismic trip*	PWC-GOV 1*30, 1*03, VPS-GOV-1*11, 1*17 (drain and rinse valves)	-Bay * purge -TW annulus low level
6 PROOF	MCO high and low pressure MCO pre-purge MCO low purge flow MCO 12-torr purge bypass MCO low purge flow bypass MCO pressure decay fail MCO pressure rise fail	- Seismic - TW high temperature - Local and remote ISO & PURGE buttons - High bay temperature - PWC pump seismic trip*	PWC-GOV 1*30, 1*03, VPS-GOV-1*11, 1*17 (drain and rinse valves)	-Bay * purge -TW annulus low level
7 PRESSURE TEST	MCO pressure rise fail	- Seismic - TW high temperature - Local and remote ISO & PURGE buttons - High bay temperature	VPS-GOV 1*05, 1*09 PWC-GOV 1*30, 1*03, VPS-GOV-1*11, 1*17 (drain and rinse valves)	-Bay * purge -TW annulus low level

*For defense in depth only (not safety class or safety significant)

Notes:
1. All PLCs have an associated PLC fault trip built into the PLC logic.
2. TW annulus low level is bypassed by operations when there is no MCO or when the annulus is drained for shipment.
3. During the PURGE/FLUSH mode the SCHe valves (SCHe-GOV 5*12 and 5*31) on the long process tube side are opened for 2 minutes (de-energized by the SCIC) to blow down any water that may have collected from the drain sequence.

4.0 REFERENCES

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