S

ENGINEERING CHANGE NOTICE

1. ECN 660511

Proj. ECN

2. ECN Category (mark one)	3. Originator's Name, Organization, MSIN, and Telephone No.	4. USQ Required?	5. Date
Supplemental [] Direct Revision [X] Change ECN [] Temporary [] Standby [] Supersedure [] Cancel/Void []	T Nuxall, CVDF, R3-86, 372-3739	[X] Yes [X] No (9/15/00)	6/1/00
	6. Project Title/No./Work Order No.: SNF W-441 Spent Nuclear Fuel/Cold Vacuum Drying Facility	7. Bldg./Sys./Fac. No.: 142-K	8. Approval Designator: S^NQ
	9. Document Numbers Changed by this ECN (includes sheet no. and rev.): SNF – 3081, Rev. 0	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

FACILITY – HVAC **SS**

Update to reflect current system design.

USQ: CVD-00-1650

14a. Justification (mark one)

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

14b. Justification Details

Update to reflect current system design.

The design verification method for SS/SC components is by independent review in accordance with EN-6-027-01. Documentation of this review is accomplished by the independent reviewer approval signature on page 2 of this ECN.

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

See Distribution Sheet.

RELEASE STAMP

DATE: SEP 22 2000

HANFORD RELEASE

STA: 19 ID: 25

ENGINEERING CHANGE NOTICE

1. ECN (use no. from pg. 1): 660511

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

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

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

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

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

21. Approvals

	Signature	Date		Signature	Date
Design Authority G. Singh	[signature]	9/15/00	Design Agent		
Cog. Eng. R.W. Harmsen	R.W. Harmsen [signature]	9/15/00	PE		
Cog. Mgr. C. S. Haller	John Dearing for C.S.H.	9/18/2000	QA		
QA H. Chafin	Hank M. Chafin K. Connell QA 9-10-00	9/8/00	Safety		
Safety J. Brehm	for Taber D Heupen [signature]	9/18/00	Design		
Environ.	[signature]	9-11-00	Environ.		
Other J. Kriskovich	Jim Kriskovich	9-16-00	Other		
Independent Review BM Parker	Bill M Parker	9/10/00			

DEPARTMENT OF ENERGY

Signature or a Control Number that tracks the Approval Signature

ADDITIONAL

DISTRIBUTION SHEET

To	From	Page 1 of 1
Distribution	SNF-CVD	Date 6/1/00
Project Title/Work Order: W-441, Cold Vacuum Drying Facility Heating, Ventilation, and Air Conditioning System Design Description		EDT No. N/A
		ECN No. 660511

Name	MSIN	Text With All Attach.	Text Only	Attach./ Appendix Only	EDT/ECN Only
K. McCracken	S1-53	x			
B. Ramsgate	R3-86	x			
L. Price	R3-26	x			
AVS - Patricia Morrell	G1-50	x			
AI - Mike Evarts	N1-29	x			
J. Irwin	R3-86	x			
P. Beaudet	X3-25	x			
D. Cole	R3-86	x			
M. Croskrey	R3-86	x			
W. Alaconis	X3-79	x			
J. Gregory	X3-78	x			
SNF Startup Library	B2-64	x			
CVD Library (A. Artzer)	R3-86	x			
CVDF Satellite Library	X3-25	x			
T. Nuxall	R3-86	x			
SNF Project Files	R3-11	x			
C. Van Katwijk	R3-47	x			
D. Whitworth	R3-11	x			
J. Brehm	R3-26	x			
C. Haller	X3-78	x			
G. Singh	X3-78	x			
C. Miska	R3-86	x			
B. Parker	R3-86	x			
Meier Enterprise (thru Lou Oliveros)		x			
C. Schweda	S2-45	x			
B. Shapley	R3-86	X			

SNF-3081
Revision 1

Cold Vacuum Drying Facility Heating, Ventilation, and Air Conditioning System Design Description

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
P.O. Box 1000
Richland, Washington

SNF-3081
Revision 1

ECN 660511

Cold Vacuum Drying Facility Heating, Ventilation, and Air Conditioning System Design Description

Project No: W-441 | Document Type: SDD | Division: SNF

G. Singh
Fluor Hanford, Inc.

Date Published
September 2000

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
P.O. Box 1000
Richland, Washington

Release Approval 9/20/00
Date

DATE: SEP 22 2000
STA: 19
HANFORD RELEASE
ID: 25

Release Stamp

Approved for public release; further dissemination unlimited

SNF-3081
Revision 1

Total Pages: 119

RECORD OF REVISION

RECORD OF REVISION	(1) Document Number SNF-3081	Page 1

(2) Title
Cold Vacuum Drying Facility Heating, Ventilation and Air Conditioning System Design Description.

Change Control Record

(3) Revision	(4) Description of Change - Replace, Add, and Delete Pages	Authorized for Release (5) Cog. Engr.	Authorized for Release (6) Cog. Mgr. Date
0	(7) EDT 626311, Initial Release		
RS 1	ECN 660511, Update to Reflect Current System Design.	G. Singh [signature]	C. Haller 9/21/00 [signature] for C. H

COLD VACUUM DRYING FACILITY
HEATING, VENTILATION, AND AIR CONDITIONING SYSTEM
DESIGN DESCRIPTION

SYSTEMS 30-1 through 30-5

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1.0 INTRODUCTION

1.1 System Identification

This System Design Description (SDD) addresses the HVAC system for the CVDF. The CVDF HVAC system consists of five subsystems:

- Administration building HVAC system
- Process bay recirculation HVAC system
- Process bay local exhaust HVAC and process vent system
- Process general supply/exhaust HVAC system
- Reference air system

The HVAC and reference air systems interface with the following systems: the fire protection control system, Monitoring and Control System (MCS), electrical power distribution system (including standby power), compressed air system, Chilled Water (CHW) system, drainage system, and other Cold Vacuum Drying (CVD) control systems not addressed in this SDD.

For generator building HVAC see Appendix E

See Figure 1.1, HVAC General Arrangement, for the general arrangement of the HVAC system.

1.2 Limitations of this SDD

This SDD, when used in conjunction with the other elements of the definitive design package, provides a complete picture of the HVAC system for the CVD Facility. Elements of SDD include functions, requirements, and descriptions. Other documents comprising the definitive design include:

- Project Design Requirements (HNF-SD-SNF-DRD-002),
- Fire Hazard Analysis (HNF-SD-SNF-FHA-003),
- Master Equipment List (SNF- 4148),
- Data and calculation matrix tracking list (SNF-3001) ,
- Construction Specification for Project W-441, Section 15400, *Plumbing/Piping*.(SNF-6209)

This SDD revision was prepared in accordance with the CVDF FSAR Revision One. The FSAR is a higher-level document than this SDD. Requirements that change will be incorporated into later revisions of this SDD. In addition, specific HVAC operating characteristics (determined from system testing) and specific operating procedures (as written) will be also incorporated and referenced in later revisions of this SDD.

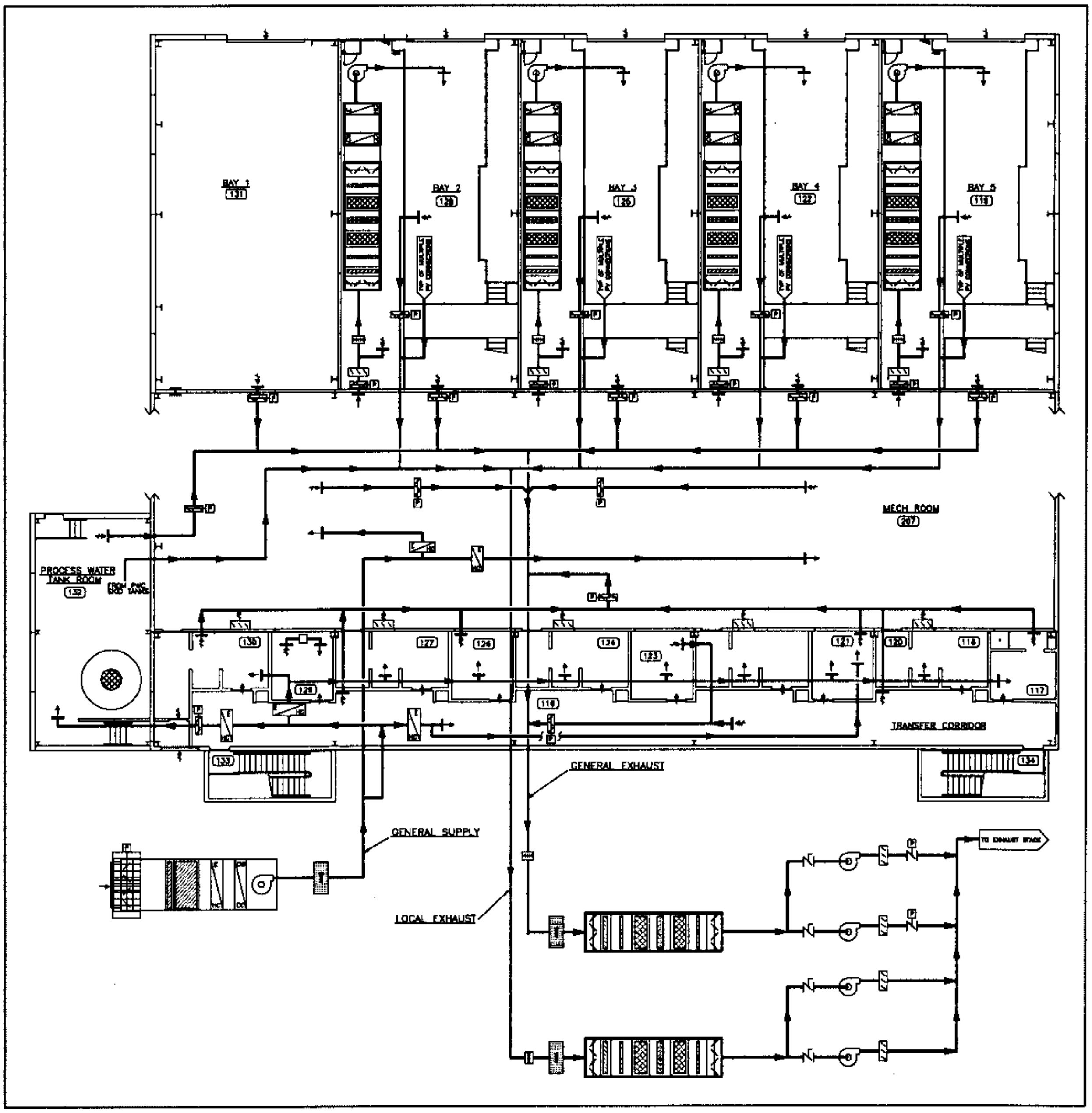
1.3 Ownership of this SDD

The CVD Design Authority assigned to the HVAC system is responsible for the accuracy and technical content of this SDD. Any questions on the system or content of this document shall be resolved through the design authority.

1.4 Acronyms

ALARA	as low as reasonably achievable
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ATC	Automatic Temperature Control (system)
CFR	Code of Federal Regulations
CHW	Chilled Water (system)
CVD	Cold Vacuum Drying
CVDF	Cold Vacuum Drying Facility
DBA	Design Basis Accident
DPIT	Pressure differential Indicating Transmitter
DRD	Design Requirements Document
FCS-OWS	Facility Control System-Operator Workstation
FHA	Fire Hazards Analysis
FSAR	Final Safety Analysis Report
HOA	Hand-Off-Auto (switch)
HEPA	High-Efficiency Particulate Air (filter)
HVAC	Heating, Ventilation, and Air Conditioning
IA	Instrument Air (system)
MCO	Multi-Canister Overpack
MCS	Monitoring and Control System
Pa	Pascal
PCV	Pressure Control Valve
PDIT	Pressure Differential Indicating Transmitter
PES	Process Equipment Skid
PLC	Programmable Logic Controller
psig	pounds per square inch gauge
PWC	Process Water Conditioning (system)
RA	Reference Air (system)
SCHe	Safety-Class Helium (system)
SAR	Safety Analysis Report
scfm	cubic feet (at standard temperature and pressure) per minute
SNF	Spent Nuclear Fuel
SRV	Safety Relief Valve
SSC	Structure, System, and Component
TBD	To Be Determined
TSR	Technical Safety Requirement
TW	Tempered Water (system)
VFD	Variable Frequency Drive
VPS	Vacuum Purge System

Figure 1-1. HVAC General Arrangement



2.0 GENERAL OVERVIEW

2.1 System Functions

The CVDF design includes the following five HVAC systems:

- Administration Building HVAC System
- Process Bay Recirculation HVAC System
- Process Bay Local Exhaust HVAC and Process Vent System
- Process General Supply/Exhaust HVAC System
- Reference Air System
- Generator Building HVAC (see appendix E)

Two HVAC systems, the process bay local exhaust HVAC and process vent system and process general supply/exhaust HVAC system, provide airborne radioactive material confinement within the radiologically controlled areas of the CVDF and provide HEPA-filtered discharge via the CVDF stack. Process and spare bays numbered 2, 3, 4, and 5 have independent process bay recirculation HVAC systems that provide outside air supply and HEPA-filtered recirculation for heating and air-conditioning. The humidity is monitored in all HEPA-filtered ventilation systems, and a humidity sensor alarms in the control room on high humidity. The CVDF administrative building has an independent supply and exhaust HVAC system that operates at a positive pressure to preclude in leakage from outside or adjacent areas.

All exhaust systems function during normal operation. Monitoring of the pressure differential, between a reference air system and building locations, facilitates maintaining confinement in the facility except when the telescoping door to a process bay is opened. The HVAC systems utilize isolation dampers to stop the flow of air to maintain confinement within the facility and preclude cross-contamination between areas during upset conditions.

The CVDF has been designated as a hazard category 2 nuclear facility.

The safety functions listed in this section are consistent with the safety functions listed in Chapter 4 of the CVDF Final Safety Analysis Report (FSAR). The safety functions are incorporated into the design of the system by defining related functional requirements in Section 3.1.1.2.

2.1.1 Administration Building HVAC System

2.1.1.1 General Function. The administration building HVAC system functions to provide HVAC to the administrative and control room areas of the facility, maintaining working areas within the administration building at a comfortable temperature. The system also keeps the administration building at a positive pressure relative to the CVDF transfer corridor to prevent possible contamination ingress into the administrative building.

2.1.1.2 Safety Function. There are no safety functions listed in Chapter 4 HNF-3553, Annex B, Rev. 1 (FSAR) for the administration building HVAC system.

2.1.2 Process Bay Recirculation HVAC System

2.1.2.1 General Function. The process bay recirculation HVAC system provides conditioned air to the process bays to meet the air quality and comfort conditions set forth in the design requirements. The air is filtered and heated/cooled upon recirculation. Make-up air is pre-filtered and supplied to maintain air quality in the process bays.

2.1.2.2 Safety Function. The process bay recirculation HVAC system supply isolation dampers at each process bay must fail closed upon facility loss of power to enable the process bay local exhaust HVAC and process vent system operating on standby power to maintain pressure differential in the process bays. This is applicable for the gaseous release, MCO internal hydrogen explosion, MCO external hydrogen explosion, and MCO over pressurization accidents.

2.1.3 Process Bay Local Exhaust HVAC and Process Vent System

2.1.3.1 General Functions. The role of the process bay local exhaust HVAC and process vent system is to provide protection to onsite personnel by removing any contamination discharged by the process vents or through the MCO connections on the hood and filtering it prior to release to the environment. The process bay local exhaust HVAC and process vent system draws exhaust air from the following areas in the process bays:

- Transfer cask top hood
- Process vents on
  - Vacuum pump exhaust
  - Vacuum Purge system (VPS) condenser tank
  - Process Water Conditioning (PWC) tank vent
  - Safety-Class Helium (SCHe) system vent

2.1.3.2 Safety Functions. The process bay local HVAC and process vent system performs the following safety functions to prevent or mitigate safety significant consequences from the bounding accident scenarios.

- Provides confinement of radioactive material released within the process bay during processing operations. The system's operation mitigates the radioactive release from the CVDF after the gaseous release, MCO external hydrogen explosion, MCO internal hydrogen explosion, and MCO over pressurization accidents by directing the flow from the process bays through ductwork to the HEPA filters, prior to discharge from the facility. The hood isolation dampers fail closed and are provided with a instrument air reservoir for operation on standby power. The local exhaust system fans can restart with standby power and can maintain a process bay pressure differential when the process general supply/exhaust HVAC system is not operable (e.g., facility loss of electrical power).

- Maintains local exhaust flow sufficient to dilute potentially hydrogen-rich process gas discharges into the local exhaust duct to preclude flammable mixtures from being generated. Its operation prevents an external hydrogen explosion accident by diluting hydrogen gas from the process vent lines and directing the flow from the process bays through ductwork to HEPA filters prior to discharge from the facility for external and internal hydrogen explosion, thermal runaway, and MCO over pressurization accidents. The 30 lb/in^2 gauge vent line discharge as a result of the MCO over pressurization accident is also adequately diluted by the local exhaust flow. The hood isolation dampers fail closed on loss of power. The local exhaust system can restart with standby power and can reestablish local exhaust flow within 1 minute, sufficient to dilute potentially hydrogen-rich process gas discharges into an exhaust duct and maintain a process bay pressure differential when the process general supply/exhaust HVAC system is not operable (i.e., facility loss of electrical power). The local exhaust provides a process hood low-flow alarm to the control room to preclude cask venting with inadequate dilution flow. The local exhaust also provides the cask venting connection with a flow-restricting orifice, along with a shut-off valve interlocked to a local exhaust low-flow switch for each bay.

2.1.4 Process General Supply/Exhaust HVAC System

2.1.4.1 General Function. The process general supply/exhaust HVAC system exhausts conditioned air from the ,bays, mechanical room, PWC Tank room and transfer corridor areas. The general supply/exhaust HVAC system supplies air to all the above areas except the bays. The system controls exhaust airflow to maintain a minimum negative pressure differential in the process bays and the PWC tank room. The bays are supplied with air from the HVAC recirculation

2.1.4.2 Safety Functions. The process general supply/exhaust HVAC system performs the following safety functions to mitigate safety-significant consequences from the bounding accident scenarios. Only the exhaust portion of the system is credited with mitigation (HEPA filtration) and maintenance of pressure differential to accomplish confinement.

- The process general exhaust system provides confinement of radioactive material within the process bays and process water tank room during processing operations if a release from primary confinement occurs. Its operation mitigates the radioactive release from the CVDF after the gaseous release, liquid release, MCO external hydrogen explosion, MCO internal hydrogen explosion, and MCO over pressurization accidents (identified in the FSAR Table B4-8) by maintaining a negative pressure in the process bays and process water tank room during facility operations, as indicated in Table B4-8, and by HEPA filtering the building air prior to discharge from the facility.

- The process general exhaust isolation dampers at each process bay must fail closed upon facility loss of power to provide confinement and prevent cross contamination. This functional requirement is applicable for the gaseous release, MCO external hydrogen explosion, MCO internal hydrogen explosion, and MCO over pressurization accidents.

2.1.5 Reference Air System

2.1.5.1 General Functions. The role of the reference air system is to provide atmospheric pressure air to each of 18 pressure differential transmitters located in 13 different locations of the CVDF.

2.1.5.2 Safety Functions. The reference air system performs the following safety functions to mitigate safety-significant consequences from the bounding accident scenarios.

- The process bay and process water tank room pressure differential alarms provide a safety-significant function for mitigation of the consequence of gaseous release, liquid release, MCO external hydrogen explosion, MCO internal hydrogen explosion, and MCO over pressurization accidents. The alarm notifies personnel of the loss-of-confinement function, and personnel initiate appropriate action to preclude releases during the abnormal confinement condition. This requirement to demonstrate HVAC confinement function related to location and DBA is summarized in the FSAR Table B4-8.

- The system must provide a reliable reference air signal to the process bay and process water tank room pressure differential indicators with low pressure differential alarms so they can perform their safety-significant function.

2.2 System Classification

2.2.1 Administration Building HVAC System

The administration building HVAC system is classified as general service, Performance Category 1 per DOE Order 1020.

2.2.2 Process Bay Recirculation HVAC System

The process bay recirculation HVAC system is classified as general service. The only portions of the process bay recirculation HVAC system that performs a safety-significant function are the fail-closed inlet isolation dampers. The general service portion must meet the requirements of Performance Category 1, while the safety significant portion must meet the requirements of Performance Category 2.

2.2.3 Process Bay Local Exhaust HVAC and Process Vent System

The Process Bay Local Exhaust HVAC and Process Vent System is classified as safety-significant due to its role in preventing or mitigating safety-significant consequences from bounding accident scenarios described in Section 2.1.3.2. These components meet the criteria of Performance Category 2.

2.2.4 Process General Supply/Exhaust HVAC System

The supply portion of the general supply/exhaust HVAC system is classified as general service. The exhaust portion of the system, from isolation dampers to filter housing, are classified as safety-significant due to its mitigation (HEPA filtration) and maintenance of differential pressure to accomplish confinement. The general service portion must meet the requirements of Performance Category 1, while the safety significant portion must meet the requirements of Performance Category 2.

2.2.5 Reference Air System

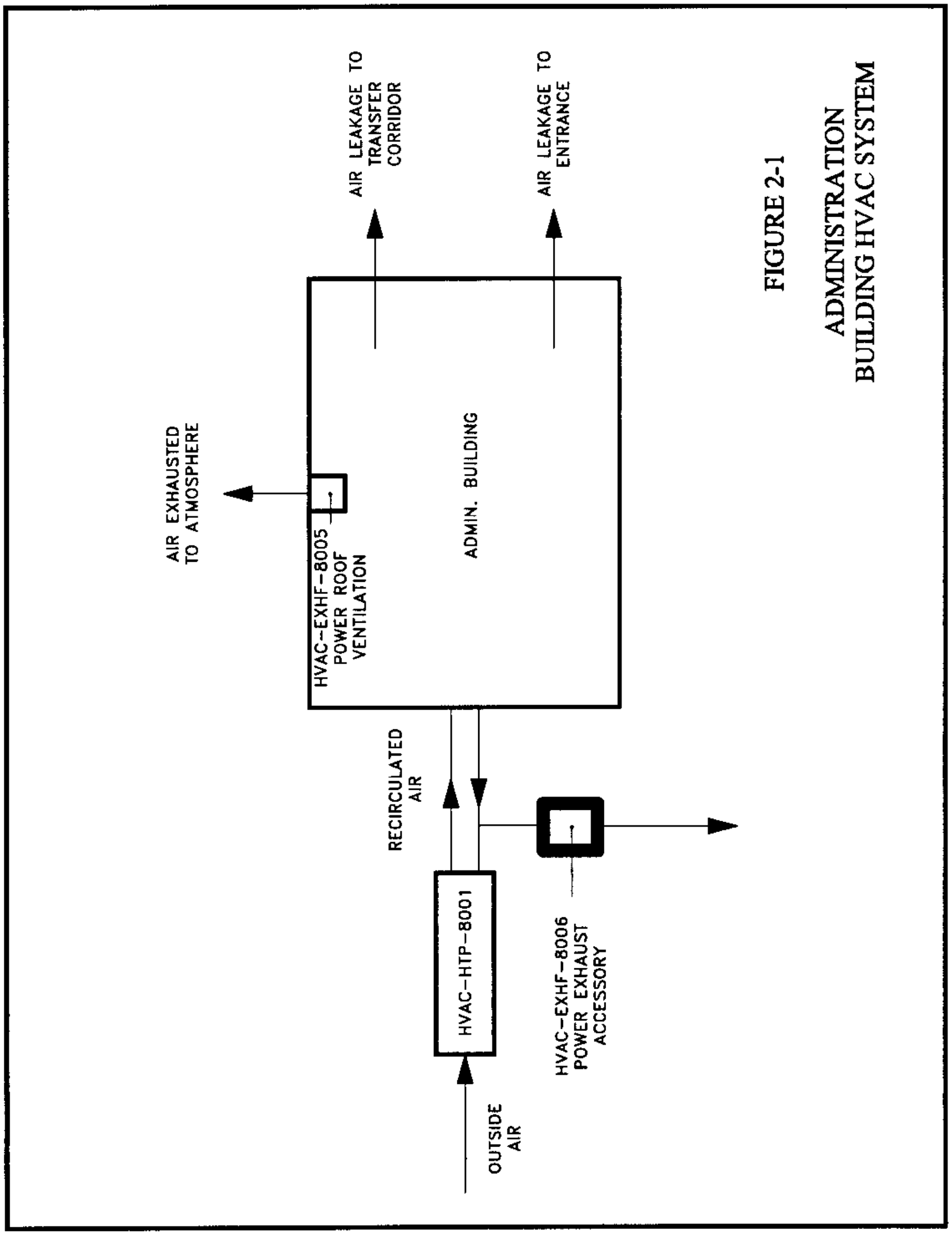
The reference air system is considered safety significant for all function required to provide a reliable reference air signal to the pressure differential alarms. The pressure boundary of the air header and PDITs and the low pressure alarms are safety significant. The indication of the pressure differential for HVAC control is considered general service. Pressure differential indication for HVAC is provided in conjunction with the reference air system and monitored by the automatic temperature control system. Safety-significant PDITs with low pressure differential alarms to the control room are also provided. The alarm will initiate operator action if process or HVAC changes must be initiated based on confinement status.

The general service portion must meet the requirements of Performance Category 1, while the safety significant portion must meet the requirements of Performance Category 2.

2.3 Basic Operational Overview

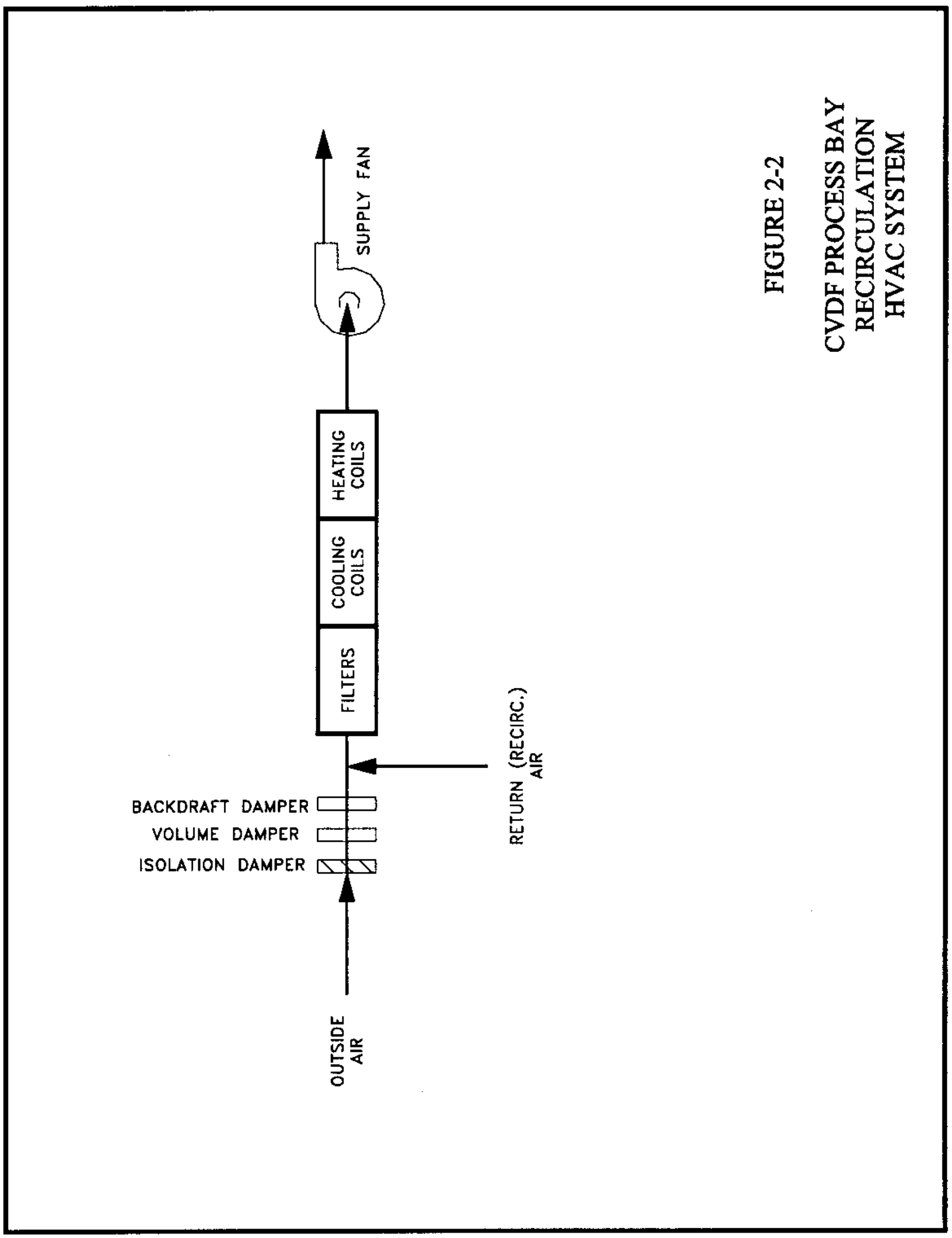
The following sections provide a basic operational overview of each individual system within the CVDF HVAC system. Figures 2-1 through Figure 2-5 provide general overviews of each system.

Figure 2-1. Administration Building HVAC System



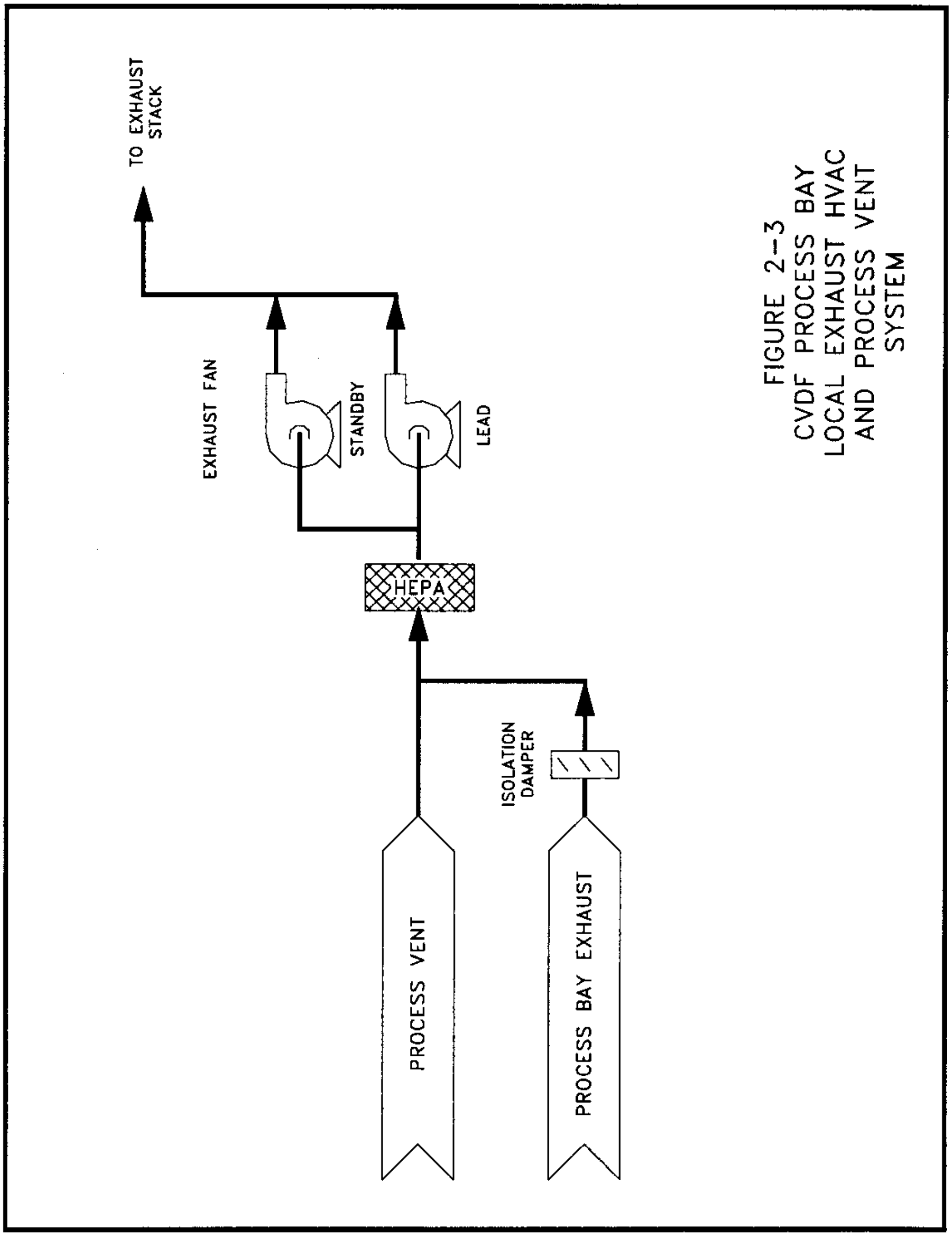
WMF: HVAC_SNF-3081_F2-1 ACAD FILE: ZBAC0012

Figure 2-2. CVDF Process Bay Recirculation HVAC System



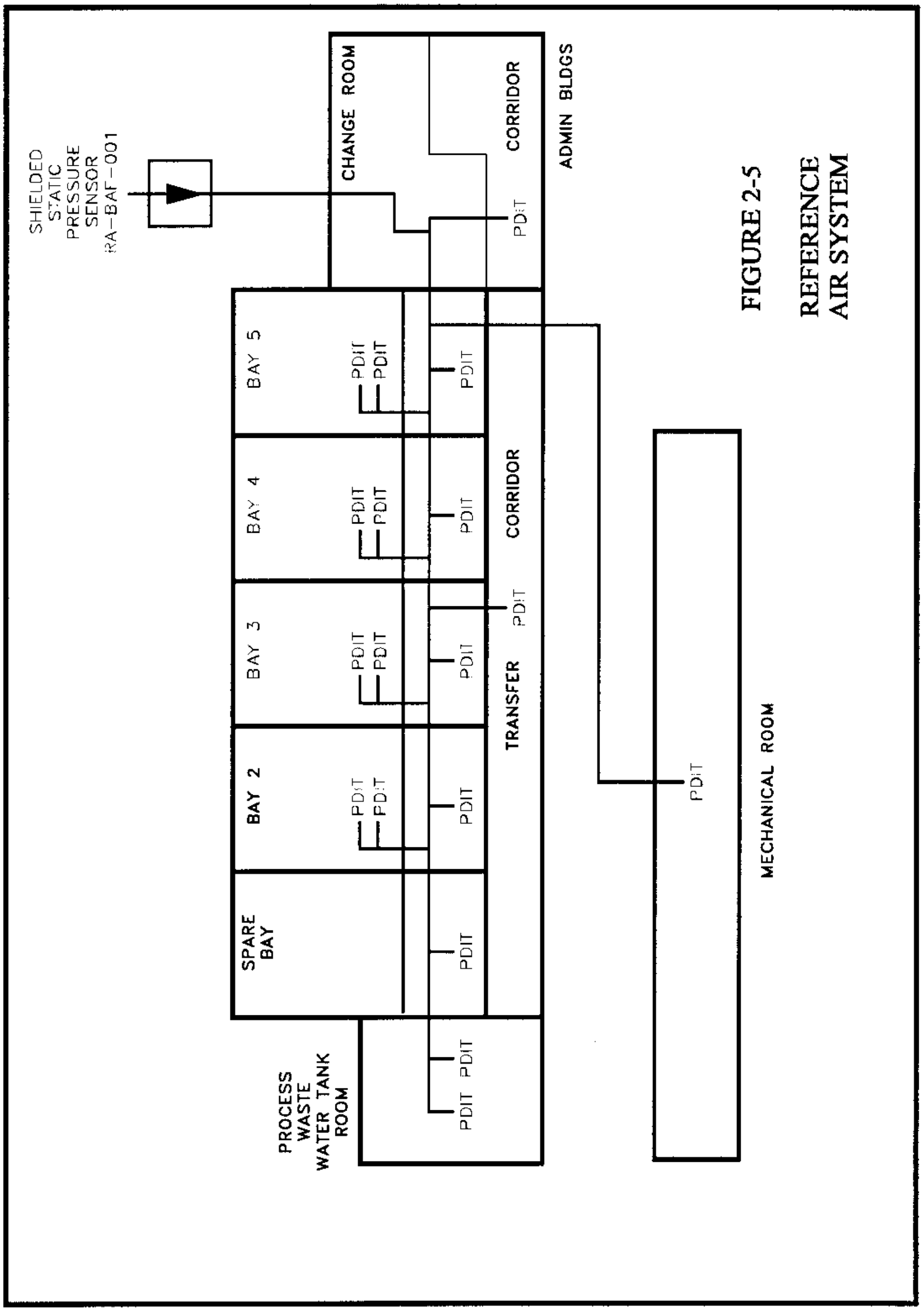
WMF: HVAC_SNF-3081_F2-2 ACAD FILE: ZBAC0013

Figure 2-3. CVDF Process Bay Local Exhaust HVAC and Process Vent System



WMF: HVAC_SNF-3081_F2-3 ACAD FILE: ZTLC0001

Figure 2-4. Reference Air System



WMF: HVAC_SNF-3081_F2-5 ACAD FILE: ZBAC0015

2.3.1 Administration Building HVAC System

The administration building HVAC system supplies a combination of recirculated and outside air to the CVDF administration building. The supply air is cooled or heated as required to maintain the administration building between 72° F and 75° F. The system supplies in excess of six air changes per hour and maintains the administration building at a positive pressure with respect to the CVDF transfer corridor.

2.3.2 Process Bay Recirculation HVAC System

The process bay recirculation HVAC systems supply process bays with fresh air while also recirculating the bay's resident air. The fresh air, drawn from outside the facility, provides make-up air to maintain air quality in the bay. The recirculation of process bay air serves to conserve energy. The fresh and recirculated air streams are mixed, filtered through a HEPA filter train, conditioned by either cooling or heating, and drawn into the supply fan, which discharges the combined air stream back into the process bay at six air changes per hour.

2.3.3 Process Bay Local Exhaust HVAC and Process Vent System

The process bay local exhaust HVAC and process vent system provides exhaust capability to remove contaminated and flammable gases from the process bays. Confinement dampers are provided in hood ducts to prevent cross-contamination between the various areas when the system is not operating. All of the exhaust is drawn through a bank of filters.

2.3.4 Process General Supply/Exhaust HVAC System

The process general supply/exhaust HVAC system supplies 100 percent outside air to the CVDF transfer corridor, mechanical room and PWC tank room. The supply air is filtered and cooled or heated as required to provide tempered air to the zones served.

The process general supply HVAC system consists of the outside air intake louver with isolation damper, the general supply air-handling unit (HVAC-AHU-8002), and the terminal electric heating coils.

The process general exhaust HVAC system provides exhaust capability to remove contamination from each process bay. Confinement dampers are provided at the wall ducts to prevent cross-contamination between the various areas when the system is not operating. All of the exhaust is drawn through a bank of filters

2.3.5 Reference Air System

The reference air system provides atmospheric air to 18pressure differential transmitters/ indicators located 13 places throughout the CVDF. The air is provided as a reliable reference to atmospheric pressure for each applicable room.

3.0 REQUIREMENTS AND BASES

3.1 General Requirements

This section describes the facility functional, safety functional, and functional performance requirements applicable to the HVAC systems; basis for the requirements; and how the requirements are met by the CVDF HVAC systems.

3.1.1 System Functional Requirements

3.1.1.1 Design Requirements

1. **Requirement:** Ventilation design shall comply with DOE Order 6430.1A, Sections 0110-12.4, 1161-4, 1300-7, and 1550. System design shall also comply with the applicable guidelines of the ASHRAE; ACGIH; Sheet Metal and Air Conditioning Contractors National Association; and the latest revisions of the ASME N509 nuclear air handling and filtration system construction, ASME N510 testing criteria, ASME AG-1 nuclear air cleaning system guidebook, and other state and federal regulations.

   Basis: HNF-SD-SNF-DRD-002, Section 6.5.2.

   How the system meets the requirement: The system was designed to the listed codes and standards.

2. **Requirement:** The air streams with potential to have radioactive material within the CVDF shall be filtered prior to release into the environment.

   Basis: HNF-SD-SNF-DRD-002, Section 6.5.2a. Filtering of the air streams with the potential to contain radioactive material is necessary to prevent contamination of the environment.

   How the system meets the requirement: The process bay recirculation HVAC system incorporates two HEPA filter stages to contain airborne radioactive material and particulates. The process bay air is continuously recirculated, even during process upset conditions, to assure filtration of airborne radioactive particles. The process air not recirculated is evacuated through the MCO process hood to the local HVAC exhaust system, which filters the air through two stages of HEPA filters before its release to the environment.

   The process general supply/exhaust HVAC system manages the spread of contamination from accidental release through the use of negative pressures, pressure differentials, and equipment interlocks; these systems provide secondary confinement in the event of an accidental release. Negative pressures with respect to the environment ensure that airflow is always into the CVDF, providing one means of confinement. Pressure differential causes airflow to move from areas of lesser potential contamination to areas of greater potential contamination, providing another means of confinement. Finally, the supply and exhaust fans are interlocked. Should the exhaust fan fail, the supply fan is tripped, preventing pressurization of the process areas, loss of confinement, and release of contamination.

3. **Requirement:** Pursuant to DOE Order 6430.1A, wherever feasible, air shall be filtered and recirculated for energy conservation. Otherwise, 100 percent filtered and conditioned outside air is used for space ventilation.

Basis: HNF-SD-SNF-DRD-002, Section 6.5.2d. Air is to be recirculated, to the maximum extent possible, to conserve energy while maintaining air quality standards.

How the system meets the requirement: The process bay recirculation HVAC system recirculates the majority (approximately 76%) of the process bay air while drawing outside air to meet air quality requirements and provide make-up air (approximately 76%) for air removed from the process bay by the local exhaust HVAC system. Specific flow rates within each process bay are identified on drawing H-1-82192 HVAC-EVP-8003 is solely for room 129 (UPS equipment room) and recirculates room air to provide cooling. (H-1-82197)

4. **Requirement:** Deliverable air quantities shall be provided to all areas sufficient to remove heat, hazardous and radioactive particulate matter and gases, and other contaminants.

Basis: HNF-SD-SNF-DRD-002, Section 6.5.2e. Removal of heat and hazardous, radioactive, and other contaminants is necessary to maintain a safe work place and prevent contamination. Processing activities in the CVDF will produce heat and may produce hazardous and radioactive particulate matter and gases, and other contaminants. The deliverable air quantities required to keep the CVDF airspace clean and comfortable for personnel have been calculated and incorporated into system design. Temperature and air quality ensures personnel comfort and safety as well as protect equipment from temperature extremes that may cause it damage otherwise.

How the system meets the requirement: The HVAC systems are designed to deliver air quantities sufficient to remove radioactive particulates, radioactive gases, and heat generated from processing operations and occupation of the building (Merrick 1996). The process bay recirculation HVAC system is sized to supply a combination of outside air and recirculated air to the process bays at a minimum rate of six air changes per hour. The general supply air handling unit supplies 100 percent outside air to the transfer corridor, tank room, change rooms, and mechanical room of the facility. The general supply air quantities in each room provide a minimum of six air changes per hour, which is adequate to remove heat. The heating and cooling loads are examined and adequate air quantities re-supplied to meet those needs.

5. **Requirement:** Facility air flows shall be from areas of less contamination potential to areas of greater contamination potential.

Basis: HNF-SD-SNF-DRD-002, Section 6.5.2g. Facility airflows should be from areas of less contamination potential to areas of greater contamination potential to minimize the possibility that a low-contamination or non-contaminated area would become more contaminated.

How the system meets the requirement: The process general supply/exhaust HVAC system establishes differential negative pressures within the CVDF by mechanically exhausting more air than is supplied to the system. These differential negative pressures (noted on Drawing H-1-82207) ensure that facility airflow is from areas of lesser potential contamination to areas of greater potential contamination.

6. **Requirement:** Cross contamination paths from one process bay area to another room or bay shall be prevented.

   Basis: HNF-SD-SNF-DRD-002, Section 6.5.2h. Cross-contamination paths within the process bay areas should be prevented to eliminate the possibility of transferring contaminated air from an area of higher contamination potential to an area of lower contamination potential.

   How the system meets the requirement: Cross-contamination paths within the process area are minimized. Paths that do exist between the process bays, mechanical room, and transfer corridor rooms are equipped with back draft dampers to prevent development of cross-contamination paths in the event of process area pressurization

7. **Requirement:** The ventilation system shall meet all minimum deliverable air quantity requirements of ASHRAE Standard 62 and any other specific equipment requirements discussed in DOE Order 6430.1A, Sections 1550-2.5 and 1550-99.0.

   Basis: HNF-SD-SNF-DRD-002, Section 6.5.4a. ASHRAE and DOE 6430.1A establish minimum deliverable air quantities for workplace environments.

   How the system meets the requirement: The HVAC systems are designed to deliver air quantities in accordance with ASHRAE Standard 62 and DOE 6430.1A. A minimum of six air changes per hour is provided for each room or area as identified in Merrick HVAC calculations (Merrick 1996).

8. **Requirement:** The minimum deliverable air quantity of six air changes per hour, pending further hazard analysis, for all ventilation and exhaust air systems serving the confinement areas shall be provided.

   Basis: HNF-SD-SNF-DRD-002, Section 6.5.4b. The process bay recirculation HVAC system is sized to supply air to the process bays at a minimum rate of six air changes per hour.

How the system meets the requirement: This requirement is met by the process bay recirculation HVAC system based on the following calculations:

- Process bay volume = 1,800 ft^2 floor x 30 ft height = 54,000 ft^3
- Process bay recirculation HVAC system minimum airflow = 5,400 ft^3/min.
- Air changes per hour = (5,400 ft^3/min / 54,000 ft^3) x (60 min / 1 h) = 6.0/h

9. **Requirement:** Each process bay (excluding the spare bay) and PWC tank room shall be served by an exhaust system that shall have sufficient capacity and standby functions to ensure an adequate controlled ventilation flow as required to contain contamination in the event of a credible breach (defined in the CVDF safety analysis report) in the primary confinement barrier.

   Basis: HNF-SD-SNF-DRD-002, Section 6.5.4d. The operations in the process bays (excluding the spare bay) and PWC tank room have the potential for a credible breach in the primary confinement barrier. The process general supply/exhaust HVAC system should be designed to contain accidental releases from the primary and/or secondary confinements. This function will be required to prevent releases to the environment that would result in unacceptable dose consequences to onsite workers.

   How the system meets the requirement: The process general supply/exhaust HVAC system provides circulation to each of these areas at the desired air exchange rate. Redundant exhaust fans (HVAC-EXHF-8025, 8027) are provided to ensure continuous circulation in the event of exhaust fan failure.

10. **Requirement:** Air from the process area support rooms shall also be exhausted into a HEPA filter exhaust system.

    Basis: HNF-SD-SNF-DRD-002, Section 6.5.4e. Air is exhausted into the HEPA filter exhaust system in conjunction with the requirement that all air exhausted be HEPA filtered to prevent the release of any contamination.

    How the system meets the requirement: Drawing H-1- 82193 shows the flow diagram for the CVDF HVAC systems. It can be seen that air exhausted from the process area support rooms is exhausted to the process general exhaust HVAC system and HEPA-filtered prior to discharge.

11. **Requirement:** Exhaust air from the facility process area shall pass through a minimum of two HEPA filter stages before exhausting through the stack.

    Basis: HNF-SD-SNF-DRD-002, Section 6.5.4g. Process area exhaust systems have the potential to transport radioactive particulates. The use of two HEPA filter stages ensures that a failure of the first HEPA filter stage does not cause an unfiltered release to occur.

    How the system meets the requirement: Exhaust air from the local exhaust system passes through two HEPA filters in filter housing HVAC-F-8040 prior to release up the stack. Air from the process general exhaust HVAC system is passes through two banks of HEPA filters in filter housing HVAC-F-8020 prior to release through the stack.

12. **Requirement:** Protective coatings shall be applied to the interior of exhaust duct work serving the confinement areas if other than stainless steel duct work is used. These coatings shall meet the requirements of ANSI N512 for light exposure.

    Basis: HNF-SD-SNF-DRD-002, Section 6.5.4.4i. The process bay local exhaust and process vent system and the process general supply/exhaust HVAC system have the potential to transport radioactive particulates. Protective coatings shall be applied if necessary to minimize the potential for radioactive particulate adherence to the duct walls.

    How the system meets the requirement: The exhaust ductwork is fabricated from galvanized steel. The galvanized coating of the ductwork meets the requirement of ANSI N512 for light exposure.

13. **Requirement:** Facility air balance shall be achieved through manually set dampers and variable frequency fans.

    Basis: HNF-SD-SNF-DRD-002, Section 6.5.4.4n. In order to maintain an acceptable air balance within the CVDF, variable frequency fans and manually set dampers should be used.

    How the system meets the requirement: Manual dampers (HVAC-DMP-001, HVAC-DMP-003) and variable frequency fans (HVAC-EXHF-8025, HVAC-EXHF-8027) are incorporated into the system design.

14. **Requirement:** Exhaust fans shall use variable frequency-controlled motors that receive control signals from exhaust flow and/or pressure measurements.

    Basis: HNF-SD-SNF-DRD-002, Section 6.5.4.5a. In order to maintain an acceptable air balance within the CVDF, the exhaust fans should use variable frequency controlled motors that are controlled from the CVDF MCS.

    How the system meets the requirement: Local exhaust fans HVAC-EXHF-8045 and 8047 are controlled by variable frequency drives VFD-8045 and 8047 that receive input from.flow indicating transmitter FIT-8044. General exhaust fans HVAC-EXHF-8025 and 8027 are controlled by variable frequency drives VFD-8025 and 8027 that receive input from flow.flow indicating transmitter FIT-8024

15. **Requirement:** Exhaust fan selection shall be based on the air change rates and pressure head calculated for the serviced areas or process cells.

Basis: HNF-SD-SNF-DRD-002, Section 6.5.4.5b. Selection of exhaust fans for the system should be based on calculations that accommodate required air change rates and pressure heads for the serviced areas and process cells.

How the system meets the requirement: Merrick HVAC calculations (Merrick 1996) indicate that air change rates and pressure head were considered in sizing and selecting exhaust fans.

16. **Requirement:** Fan selection shall consider all anticipated normal operation, upset, off-normal, and faulted conditions of the facility.

    Basis: HNF-SD-SNF-DRD-002, Section 6.5.4.5c. Because the mode of operation of the facility is anticipated to be variable, the fan selection should be based to accommodate any of these modes.

    How the system meets the requirement: The purchase specification calls for two fans. Each fan has been sized per Merrick HVAC calculations (Merrick 1996) to be able to supply 100 percent of the needed airflow for all anticipated normal operation, upset, off-normal, and faulted conditions of the facility without the aid of the other.

3.1.1.1.1 Administration Building HVAC System

1. **Requirement:** The administration area shall be conditioned with air from a dedicated air handling unit for this area.

   Basis: HNF-SD-SNF-DRD-002, Section 6.5.4.7a. A separate, dedicated air-handling unit for the administration area reduces the possibility of a contamination spread to the administration area through operation at a positive pressure to preclude in-leakage from adjacent areas or the outside. The operation and monitoring of the CVDF systems from a control room remote to the processing area within an independent air handling zone provides a safety factor assuring safe operational shutdown and monitoring in the event of a process upset or mishap.

   How the system meets the requirement: Conditioned air is supplied to the CVDF administration building using dedicated heat pump HVAC-HTP-8001 located on the west side of the administration building (Drawing H-1-82199).

2. **Requirement:** Air shall be recirculated with make-up air to maintain indoor air quality per ASHRAE 62 and provide air for the change room and shower area exhaust system. Air from these areas shall be exhausted directly to the outside and is not recirculated.

   Basis: HNF-SD-SNF-DRD-002, Section 6.5.4.7b. Air is to be recirculated, to the maximum extent possible, to conserve energy while maintaining air quality standards. Air exhausted from the change/restrooms is not to be recirculated to the facility due to increased humidity and odor.

How the system meets the requirement: Heat pump HVAC-HTP-8001 supplies ~3,140 ft^3/min of conditioned air to the building.(Drawing H-1-82195) This consists of ~2,110 ft^3/min recirculated air and ~1,030 ft^3/min of outside air. This airflow volume is sufficient to provide in excess of six air changes per hour [Merrick HVAC calculations (Merrick 1996)]. Additionally, 0.5 ft^3/min of air per ft^2 of floor space is provided to each of the change rooms. Air from the restrooms and change rooms is collected and exhausted at approximately 800 ft^3/min using roof exhaust fan HVAC-EXHF-8005, which is provided with a bird screen and back draft damper. Each room is equipped with a separate exhaust register measuring 10 in. by 10 in. (Drawing H-1-82210).

3. **Requirement:** The administration area shall be designed to remain at a positive pressure relative to atmospheric pressure or 12.5 Pa (+0.05 in. w.g.) during normal and atmospheric upset conditions.

   Basis: HNF-SD-SNF-DRD-002, Section 6.5.4.7d. Providing positive pressure in the administration areas adjacent to the process area (which are under partial negative pressure differential), and directional airflow into the process areas from the administration areas, will provide air flow patterns that prevent possible contamination.

   How the system meets the requirement: Drawing H-1-82207 indicates a low pressure alarm setpoint of 0.01 in. w.g. for the administration building air pressure at the hall corridor adjacent to the process area. This indicates that the building is maintained at greater than 0.01 in. w.g.

3.1.1.1.2 Process Bay Recirculation HVAC System

1. **Requirement:** Each process bay shall be served by a supply air system that recirculates a majority of the bay air to conserve energy.

   Basis: HNF-SD-SNF-DRD-002, Section 6.5.4.1b. Air is to be recirculated, to the maximum extent possible, to conserve energy while maintaining air quality standards. The process bay recirculation HVAC system recirculates the majority of the process bay air while drawing outside air to meet air quality requirements and provide make-up air for air removed from the process bay by the process bay local exhaust HVAC and process vent system.

   How the system meets the requirement: The process bay recirculation HVAC system design specifies that 1,300 ft^3 of outside air is combined with 4,100 ft^3 of recirculated air per minute of operation. The recirculated air contributes ~76 percent of the system output to the process bay. Drawing H-1-82192 provides specific flows as balanced at start-up.

2. **Requirement:** Any recirculated air in the process area HVAC system passes through a minimum of two HEPA filter stages to control contamination.

Basis: HNF-SD-SNF-DRD-002, Section 6.5.4.1c. Two stages of HEPA filtration are used to contain the contamination from the process building.

How the system meets the requirement: The process bay recirculation HVAC system incorporates two HEPA filter stages in its design.

3. **Requirement:** Make-up air shall be supplied, as required, to maintain air quality in the bay at six air changes per hour.

Basis: HNF-SD-SNF-DRD-002, Section 6.5.4.1d. The process bay recirculation HVAC system is sized to supply air to the process bays at a minimum rate of six air changes per hour.

How the system meets the requirement: This requirement is met by the process bay recirculation HVAC system based on the following calculations:

- Process bay volume = 1,800 ft^2 floor x 30 ft height = 54,000 ft^3
- Process bay recirculation HVAC system minimum airflow = 5,400 ft^3/min.
- Air changes per hour = (5,400 ft^3/min / 54,000 ft^3) x (60 min / 1 h) = 6.0/h

3.1.1.1.3 Process Bay Local Exhaust HVAC and Process Vent System

1. **Requirement:** The hood shall provide operator protection during connection and removal of the process connectors.

Basis: HNF-SD-SNF-DRD-002, Section 6.5.2b. The area in the vicinity of the top of the MCO is a potential release point for airborne radioactive contamination, especially during connection and removal of the process connectors. In order to protect operations personnel, a process hood should be supplied in the vicinity of the top of the MCO to contain any airborne radioactive contamination and transport it to a HEPA filter bank through a primary exhaust system.

How the system meets the requirement: Primary confinement of releases that may occur at the top of the MCO is accomplished with a hood that draws the air from the area around the top of the MCO into a duct leading to a primary exhaust system. The hood, connected to the local exhaust system by means of a flexible duct, is designed to effectively capture airborne contamination at its source by achieving a capture velocity of 0.64 m/s (125 ft/min) at the control point. The control point is defined as the location most distant from the hood where contamination may be generated.

2. **Requirement:** An exhaust system shall be provided to serve all the process bay areas.

Basis: HNF-SD-SNF-DRD-002, Section 6.5.4.2a. The process bay areas will need to be exhausted to remove potential airborne radioactive contamination and provide air exchange.

How the system meets the requirement: The local exhaust system provides exhaust capabilities to each process bay hood connection and process vent including the PWC tank room tank vents. The process general exhaust HVAC system exhausts additional air.

3. **Requirement:** The hood shall be designed with a minimum inlet face velocity of 0.64 m/sec (125 ft/min) in accordance with the requirements of DOE Order 6430.1A, Chapter 11, and ACGIH Industrial Ventilation Manual hood design. The hood draws air away from the operator breathing space. The hood shall be mocked up and smoke tested to verify its capture capability before fabrication and installation in the facility.

   Basis: HNF-SD-SNF-DRD-002, Section 6.5.4.2b. A process hood will be required to draw potentially contaminated air away from the operator breathing space. In order to ensure that the process hood is capable of performing this function adequately, it needs to be designed in accordance with industry accepted requirements and guidance.

   How the requirement is met: The hood design meets the U.S. Department of Energy (DOE) and American Conference of Governmental Industrial Hygienists requirements based on Merrick HVAC calculations (Merrick 1996). The hood opening is located opposite the MCO from where operators are located during process activities. Smoke testing is performed to verify the hoods capture capability before fabrication and installation in the facility.

4. **Requirement:** The local exhaust system shall be a stand-alone system with 100% exhausted air.

   Basis: HNF-SD-SNF-DRD-002, Section 6.5.4.2c. The process bay local exhaust HVAC and process vent system is likely to contain airborne radioactive particulate contamination and is expected to be the air stream with the highest contamination level in the CVDF. Based on this, the system should not recirculate any portion of its air to the CVDF airspace.

   How the system meets the requirement: The local exhaust system does not recirculate any portion of its air. All air entering the system is routed through two HEPA filter stages located in filter housing HVAC-F-8040 before being exhausted through the stack.

5. **Requirement:** The local exhaust system shall serve all the MCO process hoods and the process system exhaust and vent streams that may normally be contaminated, such as the vacuum pump exhaust, VPS condenser tank vents, PWC, SCHe vents and.

   Basis: HNF-SD-SNF-DRD-002, Section 6.5.4.2d. The local exhaust system process hood is located on top of the MCO during normal operations. The process system exhaust and vent streams that may normally be contaminated are also located at the top of the MCO as well. The proximity of the system exhaust and vent streams to the process hood facilitates the use of the hood as the collection point for these contaminated air streams. The process bay local exhaust HVAC and process vent system serves the process hood for each active process bay.

How the system meets the requirement: The process system exhaust and vent streams that may normally be contaminated, such as the vacuum pump exhaust, VPS condenser tank vents, and PWC tank vents, are vented to the local exhaust system.

6. **Requirement:** Local exhaust system operation shall be designed to maintain or re-establish flow to prevent accumulation of hydrogen.

   Basis: HNF-SD-SNF-DRD-002, Section 6.5.4.i. Continuous operation of the exhaust system during operation is essential to maintain adequate dilution air. In the event of a loss of power it will be necessary to restart the process bay local exhaust system to ensure adequate dilution air is maintained within the system.

   How the system meets the requirement: The system is connected to the standby power system through a restart circuit to allow for the re-establishment of flow after a loss of power incident.

7. **Requirement:** The vent path shall be isolated from the cask vent and MCO vent tools at a loss of power. Provide capability to resume cask and MCO vent operations after a loss of power.

   Basis: HNF-SD-SNF-DRD-002, Section 6.5.4.2i. Isolation of the vent path at loss of power is necessary to prevent backflow or cross contamination of systems.

   How the system meets the requirement: The process bay local exhaust HVAC and process vent system is connected to the standby power system to allow restart of the system after a loss of power. The vent path is isolated by HVAC-DMP-8*03.

8. **Requirement:** For the process bay local exhaust system up to the first HEPA filter, round duct work or pipe shall be used for the confinement exhaust system ventilation unless its installation is impractical. Exhaust ducts shall be sized for the transport velocities needed to convey all particulate without settling.

   Basis: HNF-SD-SNF-DRD-002, Section 6.5.4.4g. The process general supply/exhaust HVAC system has the potential to transport radioactive particulates. Round ductwork or pipe should be employed to transport this potentially contaminated airstream in order to minimize particulates congregating in corners within the ductwork. Exhaust ductwork should be sized so that the airstream velocity is high enough to transport all particulates without settling.

   How the system meets the requirement: Drawing H-1-82198 indicates that the design specifies round ductwork up to the first HEPA filter in-housing HVAC-F-8020.

3.1.1.1.4 Process General Supply/Exhaust HVAC System

1. **Requirement:** Confinement isolation dampers shall be provided on all duct branches connecting to the general exhaust system to prevent back flow in the event of exhaust system shutdown.

   Basis: HNF-SD-SNF-DRD-002, Section 6.5.4f. Confinement isolation dampers prevent backflow in the event of exhaust system shutdown. Prevention of backflow is required to maintain workspace environment.

   How the system meets the requirement: Drawing H-1-83967 specifies that backdraft dampers are used to prevent backflow in the event of exhaust system shutdown. The drawing also shows that dampers are provided on each branch line connecting to the main exhaust duct (HVAC-DMP-8015, 8016, 8018, 8019, 8102, 8202, 8302, 8402, 8502, and 8017).

3.1.1.1.5 Reference Air System

1. **Requirement:** A reference air system shall be provided.

   Basis: HNF-SD-SNF-DRD-002, Section 2.2.9. The reference air system is required to provide continuous monitoring of the air pressure within the designated areas/rooms of the CVDF. The system is an indication that the HVAC confinement systems are operating properly, which has a direct bearing on maintaining the facility in a safe operating condition. As a reliable reference, static atmospheric air is supplied to each pressure differential sensing instrument through non-corrosive piping from a shielded location prov iding a reliable atmospheric pressure reading independent of environmental conditions. Out of tolerance pressure differential conditions are provided by individual alarms in the control room.

   How the system meets the requirement: The reference air system provides continuous monitoring of the static pressure, relative to atmosphere, at 13 locations throughout the CVDF. Static atmospheric air is supplied, as referenced, to each pressure differential indicating transmitter (see Drawing H-1-82207).

2. **Requirement:** The reference air point shall be located in a well designed shielded dampener such that rapid changes in wind speed or direction or sudden atmospheric changes do not affect the reference air system.

   Basis: HNF-SD-SNF-DRD-002, Section 6.6.4.10.

   How the system meets the requirement: The static pressure sensor is shielded and located in a location to preclude upsets to the static pressure reference during adverse environmental conditions. The shielded outside static pressure sensor provides reliable atmospheric pressure via RA-001-CT (Drawing H-1-82207) to bays 2, 3, 4, and 5; mechanical room; PWC tank room; transfer corridor; transfer corridor rooms and administration building corridor. If the pressure differential is ± 0.02in. w.g. of the design pressure for an area, a high-level or low-level alarm will annunciate in the control room. Note the administration building doesn't contain a high pressure setpoint alarm.

3. **Requirement:** Reference air shall be provided for the pressure differential and zone controls for a reliable reference to atmospheric pressure.

   Basis: HNF-SD-SNF-DRD-002, Section 6.6.4.10. The reference air system provides a reference standard of atmospheric air pressure from a shielded, atmospheric, static pressure sensor remote to the process area located below ground level East of the Administration Building. The static atmosphere sensor is located in a shielded enclosure precluding plugging or adverse effects from environmental changes.

   How the system meets the requirement: The reference air system provides a reference standard of atmospheric air pressure from a shielded, atmospheric, static pressure sensor remote to the process area located below ground level East of the Administration Building. Reference air system instrumentation and piping are designed to meet the criteria of performance category 2 construction and ANSI/ASME B31.3.

3.1.1.2 Safety Functional Requirements

3.1.1.2.1 Administration Building HVAC System

There are no safety functional requirements for the Administration Building HVAC System identified in the FSAR.

3.1.1.2.2 Process Bay Recirculation HVAC System

1. **Requirement:** Supply isolation damper. Each inlet isolation damper located at the process bay west wall must fail closed upon loss of electrical power or loss of instrument air to support restart of the local exhaust system on standby power and establish pressure differential in the process bay.

   Basis: HNF-3553, Annex B, Section B4.4.4.3.

   How the system meets the requirement: Each supply inlet isolation damper fails closed upon loss of electricity or loss of instrument air. This supports restart of the local exhaust on standby power to establish pressure differential in the process bay because no HVAC control functions are provided by standby power, and the pressure differential calculations for standby power operation were performed with these dampers closed. HVAC flow rate and pressure differential evaluations for the standby operation of the local exhaust system are documented in SNF-3001 (Calculation MEI.2621.ME.6). The inlet isolation dampers are pneumatically operated nuclear-grade dampers. The nuclear-grade dampers are in accordance with ANSI/ASME N509, Class 1, Construction Class B, to accomplish a "bubbletight" rating.

3.1.1.2.3 Process Bay Local Exhaust HVAC and Process Vent System

1. **Requirement:** Fan operation. The process bay local exhaust system must be operating and accomplish adequate dilution of hydrogen introduced during the cask venting and processing activities, to ensure that the hydrogen lower flammability limit is not reached.

   Basis: HNF-3553, Annex B, Section B4.4.3.3.

   How the system meets the requirement: The process bay local exhaust HVAC and process vent system has a high degree of reliability. Redundant safety-significant exhaust fans are provided for the process bay local exhaust system. Each fan has 100% capacity of the local exhaust system flow to accomplish confinement and dilution flow requirements. The process bay local exhaust HVAC and process vent system has a "hand-off-auto" station located at each exhaust fan. When the fan's hand-off-auto station is in the "auto" position, the automatic temperature control system monitors and controls the exhaust system. The "on" position is used for fan testing only, and the switch is placed in the "auto" position for normal operations. The exhaust fans each have a manual isolation damper that must be placed in the open position for proper operation of the system. Engineering calculations demonstrating the adequacy of the local exhaust fan capacities are compiled in SNF-3001. Backflow dampers downstream of the exhaust fans preclude backflow into the fan that is not operating. The local exhaust fans are provided standby power that will restart the system within 1 minute. Local exhaust system operation on standby power does not require control signals, as all functions operate directly from the standby power system and restart circuit. No accidents are identified in Chapter B3.0 that require performance category 3 seismic qualification of the exhaust fans for the process bay local exhaust HVAC and process vent system.

2. **Requirement:** Flow alarm. A flow switch in process bay branch to the process hood shall be provided with a remote alarm to the control room. It must be demonstrated that the flow in any process bay is adequate, prior to initiating the cask venting operation, and during MCO processing in each process bay.

   Basis: HNF-3553, Annex B, Section B4.4.3.3.

   How the system meets the requirement: Adequate flow in any process bay during MCO processing and prior to initiating the cask venting operation is demonstrated using safety-significant flow switches in each branch. The flow switches provide a low-flow alarm in the control room for each process bay duct branch to inform operators of system functionality. The low flow switches activate at 1,150 ft^3/min (above 1,120 ft^3/min to account for a 10% error band of the flow switches per SNF-4451). A minimum flow of 1,000 ft^3/min is required for dilution of process vent discharge.

3. **Requirement:** HEPA filters. The process bay local exhaust system HEPA filter installation must accomplish a minimum 99.9% filter efficiency as credited in the Chapter B3.0 accident analyses.

   HEPA filter loading shall be administratively controlled to less than 9.4 g of spent fuel while in service. The HEPA filter enclosure shall have the capability to accurately take repeatable measurements for the monitored radiation dose from the prefilters and HEPA filters. Measurements may be performed with portable instruments. Physical access to minimally shielded surveillance locations must be provided.

   Basis: HNF-3553, Annex B, Section B4.4.3.3.

   How the system meets the requirement: A system filter decontamination factor of at least 1.0×10^{-3} is accomplished by either of the two installed stages of HEPA filtration, prior to discharge to the CVDF stack, any time the process bay local exhaust system is operating. The air is filtered with an 85% ASHRAE prefilter and two stages of HEPA filters before discharging the exhaust air via the CVDF exhaust stack. The HEPA filters conform to ANSI/ASME N509, with three test sections located within the filter box to accomplish testing in accordance with ANSI/ASME N510. Pressure differential across each stage of HEPA filters is monitored and alarmed in the control room. Flow indication ahead of the HEPA filters controls the exhaust fan speed to compensate for filter loading by maintaining constant volume flow. Pressure differential instrumentation is provided to demonstrate HEPA filter loading and presence.

   The HEPA filter loading is administratively controlled to less than 9.4 g of spent fuel while in service. The HEPA filter enclosure has the capability to accurately take repeatable measurements for the monitored radiation dose from the prefilters and HEPA filters. Measurements are performed with portable instruments within their calibration period. Physical access to minimally shielded surveillance locations is provided. This is accomplished by not exceeding a contact dose reading in the designated locations on the HEPA filter box of 70 mR/h (SNF-2770, Chapter 6.0).

4. **Requirement:** Ductwork. The process bay local exhaust system ductwork must route discharge air to the HEPA filters from any process bay conducting normal process operations. The process bay local exhaust system must provide a discharge path via the ductwork and HEPA filter for the SCHe pressure venting and the 30 lb/in^2 vent path.

   Basis: HNF-3553, Annex B, Section B4.4.3.3.

   How the system meets the requirement: All ductwork for the process bay local exhaust system is fabricated of round stainless steel duct or pipe and is of welded flange construction. Assurance that a discharge path is available to the HEPA filters is accomplished by the performance category 2 qualification of the process bay local exhaust system ductwork. The performance category 2 local exhaust duct was designed in accordance with ERDA 76-21 schedule methodology. Performance category 2 qualification is sufficient for discharge of the SCHe and 30 lb/in^2 vent path during performance category 3 events because pinching off these process vent lines in order to retain high pressures is not probable. Process bay confinement is not required after a seismic event.

5. **Requirement:** Hood isolation damper. Each isolation damper located near the process hood must fail closed upon loss of electrical power. The dampers shall have the ability to re-open while the general-service instrument air is not operating.

   Basis: HNF-3553, Annex B, Section B4.4.3.3.

   How the system meets the requirement: The hood isolation dampers are pneumatically operated, nuclear- grade dampers. The nuclear-grade dampers are in accordance with ANSI/ASME N509, Class 1, Construction Class B, to accomplish a "bubbletight" rating. Each process hood isolation damper fails closed upon loss of electrical power. The damper actuators are provided a safety-significant, compressed-air reservoir for operation on standby power. The isolation dampers are interlocked to close upon fire alarm signal in each process bay.

6. **Requirement:** Cask venting. A flow restriction orifice and a flow valve interlocked to a low-flow switch in the cask venting connection is incorporated into the ductwork to preclude flammable mixtures in the ductwork and vent lines.

   Basis: HNF-3553, Annex B, Section B4.4.3.3.

   How the system meets the requirement: Dilution of hydrogen introduced during the cask venting activity to ensure that the hydrogen lower flammability limit is not reached is accomplished by the system normal operating capacity of $\geq$1,150 ft^3/min, in conjunction with the cask-venting orifice.(H-1-82192) A minimum flow of 1,000 ft^3/min is required for dilution during cask venting. This is interlocked to the flow valve in the cask vent line to interrupt venting on loss of flow. The flow rate requirement and orifice diameter are documented in SNF-4301.

7. **Requirement:** Standby operation. The process bay local exhaust HVAC and process vent system in the restart mode must be capable of maintaining pressure differential within the process bays under all design basis HEPA filter loading conditions without instrumentation or controls. It must also meet the minimum flow requirement of 1,000 ft^3/min for dilution.

   Basis: HNF-3553, Annex B, Section B4.4.3.3.

   How the system meets the requirement: The process bay local exhaust HVAC and process vent system in the restart mode with standby power is capable of maintaining pressure differential within the process bays under all design basis HEPA filter loading conditions without instrumentation or controls. The motor starter is energized by the standby power system and bypasses the variable speed drive for the fan, operating it at maximum capacity, which is adequate for all HEPA filter loadings. Each process hood isolation damper re-opens using the safety-significant, compressed-air source provided by the compressed-air reservoir in each process bay to restart on standby power. The standby power restart circuit provides the control signal. To accomplish sufficient pressure differential, the isolation dampers on the general exhaust system and the outside air inlet to the process bay recirculation HVAC system must fail closed. These dampers and their safety-significant function are addressed in their appropriate system sections. HVAC flow rate and pressure differential evaluations for the standby operation of the local exhaust system are documented in SNF-3001, Calculation MEI.2621.ME.6.

8. **Requirement:** Local exhaust system operation shall be designed to prevent an over pressure condition in the duct on loss of electrical power, loss of air, or any other anticipated off-normal condition.

   Basis: HNF-SD-SNF-DRD-002, Section 6.5.4.

   How the system meets the requirement: Local exhaust fans HVAC-EXHF-8045 and HVAC-EXHF-8047 will shutdown on loss of electric power. Fan discharge isolation dampers are not provided for these fans, ensuring the exhaust duct is open to the exhaust stack.

9. **Requirement:** The process vent system shall be designed to control the atmosphere in the process vents per the requirements in NFPA 69.

   Basis: HNF-SD-SNF-DRD-002, Section 6.5.4.2g.

   How the system meets the requirement: The process vent system is designed to control the atmosphere in the process vents per the requirements in NFPA 69 as identified in Merrick HVAC calculations (Merrick 1996).

10. **Requirement:** Process vent systems shall be designed to prevent accumulation and transportation of water that could migrate into other vent lines and damage equipment or components.

    Basis: HNF-SD-SNF-DRD-002, Section 6.5.4.2h.

    How the system meets the requirement: Double check valves and normally closed solenoid valve PV-SOV-*312 are provided in process vent line PV-*04-ST-½" to prevent backflow into other process vent lines.

11. **Requirement:** Process bay local exhaust HVAC system branch in each bay shall provide an isolation damper near the process hood to preclude inadvertent backflow of radioactive material in the event of loss of ventilation flow conditions. This precludes backflow from SCHe system operation if local exhaust is not operating.

    Basis: HNF-SD-SNF-DRD-002, Section 6.5.3. The process bay local exhaust HVAC system has the potential to transport radioactive particulates. In the event of an exhaust system shutdown, the potentially contaminated air in the exhaust system should be confined through the use of confinement isolation dampers.

How the system meets the requirement: An isolation damper is provided for each process bay (HVAC-DMP-8203, HVAC-DMP-8303, HVAC-DMP-8403, and HVAC-DMP-8503).

12. **Requirement:** Process bay local exhaust HVAC system shall prevent an external hydrogen explosion in the local exhaust ductwork during cask venting by providing adequate dilution such that the combined streams have a hydrogen concentration less than the lower flammability limit. This is achieved in conjunction with the cask venting orifice that limits the rate of hydrogen release into the operating local exhaust system during cask venting.

    Basis: HNF-SD-SNF-DRD-002, Section 6.5.3. Dilution air to keep the concentration of flammable gases below the lower flammability limit is required to prevent explosions.

    How the system meets the requirement: The HVAC control system provides indication of system functions to the control panel. Flow switches FS-8*07 provide indication that minimum flow rates are available in the local exhaust ducts of each bay. The flow switches are installed in the local exhaust duct prior to HVAC-DMP-8*03 in each bay. The flow control system alarms at flow rates less then 1,150 cfm.

13. **Requirement:** Process bay local exhaust HVAC system shall provide confinement of radioactive material within the process bay during processing operations if a release from primary confinement occurs. Its operation mitigates the radioactive release from the CVDF after the gaseous release accidents by HEPA filtering the building air prior to discharge from the facility.

    Basis: HNF-SD-SNF-DRD-002, Section 6.5.3.

    How the system meets the requirement: Confinement of radioactive material in the process bays (bay 2, 3, 4, and 5) is assured by maintaining a negative building pressure in each area. This is demonstrated by the pressure differential instruments and alarms provided in the control room for each of these areas. Each process bay is individually alarmed for pressure differential by the reference air system.

14. **Requirement:** Process bay local exhaust HVAC system design shall provide a HEPA filtered discharge path for the SCHe venting function under all conditions and accident scenarios.

    Basis: HNF-SD-SNF-DRD-002, Section 6.5.3.

    How the system meets the requirement: Process vent line PV-*01-SS-1" provides a filtered discharge path for the SCHe venting function. The process vent system is connected to the SCHe system downstream of SCHe-PCV-5*75 (PV-*05-ST-¼") and SCHe-PCV-5*55 (PV-*06-ST-¼").

3.1.1.2.4 Process General Supply/Exhaust HVAC System

1. **Requirement:** Ductwork. The process general exhaust system ductwork system must route discharge air to the HEPA filters from any process bay conducting normal process operations and from the process water tank room any time the PWC pumps are operating.

   Basis: HNF-3553, Annex B, Section B.4.4.2.3.

   How the system meets the requirement: Assurance that a filtered discharge path is available is accomplished by the performance category 2 qualification of the process general exhaust system. The performance category 2 general exhaust duct was designed in accordance with ERDA 76-21, *Nuclear Air Cleaning Handbook*, schedule methodology.

2. **Requirement:** HEPA Filters. The process general exhaust system HEPA filter installation must accomplish a minimum99.9% filter efficiency, as credited in the Chapter B3.0 accident analyses, any time the process general exhaust system is operating.

   Basis: HNF-3553, Annex B, Section B4.4.2.3.

   How the system meets the requirement: A system filter decontamination factor of at least 1.0×10^{-3} is accomplished by the two installed stages of testable, HEPA filtration prior to discharge to the CVDF stack. The filters are tested to 99.95% efficiency in accordance with ANSI/ASME N510 upon installation and annually thereafter. The HEPA filters are purchased to a 99.97% efficiency.

3. **Requirement:** Pressure differential. The general exhaust branch at each process bay, or process water tank room conducting process operations, must accomplish confinement of radioactive material for the process bays and the process water tank room by maintaining a negative building pressure and by flowing discharge air through HEPA filters.

   Basis: HNF-3553, Annex B, Section B4.4.2.3.

   How the system meets the requirement: Confinement of radioactive material in the process bays (bay 2, 3, 4, and 5), and the process water tank room is assured by maintaining a negative building pressure in each area. This is demonstrated by the pressure differential instruments and alarms provided in the control room for each of these areas. Each process bay and the process water tank room is individually alarmed for pressure differential by the reference air system. The automatic temperature control system monitors HVAC functions and modulates the volume damper on the process bay recirculation HVAC system outside air inlet to maintain the designated pressure differential.

4. **Requirement:** Bay Isolation. The process general exhaust isolation dampers at each process bay must fail closed upon facility loss of electrical power or loss of instrument air to enable the process bay local exhaust HVAC and process vent system operating on standby power to maintain pressure differential in the process bays and preclude back-flow and communication between process bays.

   Basis: HNF-3553, Annex B, Section B4.4.2.3.

   How the system meets the requirement: The process general exhaust isolation dampers at each process bay fail-closed upon facility loss of electrical power or loss of instrument air, to preclude back-flow and communication between the process bays. The nuclear grade dampers are in accordance with ANSI/ASME N509, Class 1, Construction Class B, to accomplish a "bubbletight" rating.

5. **Requirement:** Process general exhaust system shall provide confinement of radioactive material within the process bay and process water tank room during processing operations if a release from primary confinement occurs. Its operation mitigates the radioactive release from the CVDF after the gaseous release accidents by maintaining a negative pressure in the process bays and process water tank room during processing operations and by HEPA filtering the building air prior to discharge from the facility..

   Basis: HNF-SD-SNF-DRD-002, Section 6.5.3.

   How the system meets the requirement: See discussion for requirement 3 above.

3.1.1.2.5 Reference Air System

1. **Requirement:** Pressure differential instruments. PDITs for each process bay (bays 4, and 5) and the process water tank room shall be provided with low pressure differential alarms in the control room.

   Basis: HNF-3553, Annex B, Section B4.4.5.4.

   How the system meets the requirement: Safety-significant PDITs with low pressure differential alarm set points are provided in the process bays and the process water tank room. These PDITs are in addition and redundant to the PDITs provided for the general-service HVAC control via the automated temperature control system. Drawing H-1-82207 shows this system. The SAR requirement is for bays 4 & 5 but per drawing bays 2,3,4,5 have PDITs installed.

2. **Requirement:** Pressure differential alarms. The low pressure differential alarms must be able to remotely indicate to the control room a loss of negative building pressure relative to atmospheric pressure in the process bays (4 and5), during MCO processing, and in the process water tank room, while the PWC recirculation pump is operating.

   Basis: HNF-3553, Annex B, Section B4.4.5.4.

How the system meets the requirement: Safety-significant pressure differential alarms are provided to the control room to allow timely response to ventilation upset conditions. Engineering calculations demonstrating the adequacy of the performance category 2 reference air low pressure differential alarm system design are listed in SNF-3001. Drawing H-1-82207 shows this system. The SAR requirement is for bays 4 & 5 but per drawing bays 2,3,4,5 have PDITs installed.

3. **Requirement:** Reference air header. The reference air header and static pressure sensor must be available and functional to provide a reliable reference air signal whenever the PDITs and low pressure differential alarms are required to be functional.

   Basis: HNF-3553, Annex B, Section B4.4.5.4.

   How the system meets the requirement: The reference pressure is measured by a static pressure sensor located below ground level East of the administration building. The reference air pipe header is fabricated of noncorrosive material. Piping and instruments that make up the reference air system are supported in accordance with the requirements necessary to meet the criteria of performance category 2 construction. Engineering calculations demonstrating the structural adequacy of the performance category 2 reference air piping and installation design are listed in SNF-3001.

4. **Requirement:** The reference air piping shall be designed and constructed in accordance with ASME B31.9.

   Basis: HNF-SD-SNF-DRD-002, Section 6.6.4.10.

   How the system meets the requirement: The reference air system was designed and constructed according to ASME B31.9. The pipe header and all pressure differential sensor lines are constructed of copper tubing.

3.1.2 Subsystem and Major Components

There are no major subsystems associated with this system, while the major components are described throughout this document.

3.1.3 Boundaries and Interfaces

The HVAC system interfaces with the facility compressed air system, reference air, CHW, instrument air, fire protection systems, the standby power system, and the building structure.

3.1.4 Codes, Standards, and Regulations

- 29 CFR 1910, "Occupational Safety and Health Standards"
- *Industrial Ventilation: Manual of Recommended Practice* (ACGIH 1998)

- *Handbook of Fundamentals* (ASHRAE 1997)
- ANSI N13.1, *Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities*
- ANSI N512, *Protective Coatings (Paints) for the Nuclear Industry*
- ANSI/ASHRAE-52.68, *Method of Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Material*
- ANSI/ASHRAE-62a, *Ventilation for Acceptable Indoor Air Quality*
- ANSI/ASME N509, *Nuclear Power Plant Air Cleaning Units and Components*
- ANSI/ASME AG-1, *Code on Nuclear Air and Gas Treatment.*
- ANSI/ASME N510, *Testing of Nuclear Air Cleaning System*
- ANSI/NFPA 45, *Standard on Fire Protection for Laboratories Using Chemicals*
- ANSI/NFPA 90A, *Standard for the Installation of Air Conditioning and Ventilating Systems*
- ANSI/NFPA 90B, *Standard for the Installation of Warm Air Heating and Air Conditioning Systems*
- ANSI/NFPA 91, *Standard for Exhaust Systems for Air Conveying of Materials*
- ANSI/NFPA 801, *Standard for Facilities Handling Radioactive Materials*
- DOE Order 5480.1A
- DOE Order 6430.1A, *General Design Criteria*, Sections: 0110-12.4, 1161-4, 1300-11.2, 1300-3.6, 1300-7, 1550, 1550-2.5.5, 1550-2.5.6, 1550-99.0, 1589-990.0.1, Chapter 11
- ERDA-76-21, *Nuclear Air Cleaning Handbook*
- GH-CLIM-01, *Design Climate Data for the Hanford Site.*
- *Uniform Building Code* (UBC 1994)
- WAC 246-247, "Radiation Protection-Air Emissions"
- WAC 173-400, "General Regulations for Air Pollution Sources"

- WAC 173-460, "Controls for New Sources of Toxic Air Emissions"

3.1.5 Operability

3.1.5.1 Administration Building HVAC System.

There are no operability requirements for the Administration Building HVAC System.

3.1.5.2 Process Bay Recirculation HVAC System.

There are no operability requirements for the Process Bay Recirculation HVAC System.

3.1.5.3 Process Bay Local Exhaust HVAC and Process Vent System.

Operability requirements for the Process Bay Local Exhaust HVAC and Process Vent System are applicable from the time the process bay doors are closed until successful completion of the final pressure rebound test and both MCO process tube plug valves are closed. Flow switch interlock requirements only apply when cask venting is occurring. Operability requirements for the Process Bay Local Exhaust HVAC and Process Vent System are identified below. A Limiting Condition for Operation (LCO 3.4.2) has been established in HNF-3673 for these operability requirements.

- Process bay local exhaust HVAC and process vent system flow rate instrumentation (FS-8*07) and remote alarms with a flow switch setpoint $\geq$ 1120 standard ft^3/min.
- Two exhaust fans (HVAC-EXHF-8045 and –8047) shall be operable with a system flow rate in the process bays $\geq$ 1120 standard ft^3/min.
- The flow switch interlock (FS-8*52) to the cask venting flow valve shall be operable, with a flow switch setpoint $\geq$ 1120 standard ft^3/min.
- A high-efficiency particulate air (HEPA) filter box with a filtration efficiency of $\geq$ 99.9%.
- The instrument air system piping, tank, and check valve shall be leaktight with a tank pressure $\geq$ 90 lb/in^2 gauge (PI-5*20).

3.1.5.4 Process General Supply/Exhaust HVAC System.

Operability requirements for the Process General Supply/Exhaust HVAC System are applicable when the process general supply/exhaust system fans are operating. Operability requirements for the Process General Supply/Exhaust HVAC System are identified below. A Limiting Condition for Operation (LCO 3.4.1) has been established in HNF-3673 for these operability requirements.

- A high-efficiency particulate air (HEPA) filter box with a filtration efficiency of ≥ 99.9%.

3.1.5.5 Reference Air System.

Operability requirements for the Reference Air System are identified below. Process bay minimum pressure differential requirements, indicator, and alarm apply when a multi-canister overpack is present in the bay and the process bay door is closed. Process water tank room minimum pressure differential requirements, indicator, and alarm apply if the circulation pump is running. A Limiting Condition for Operation (LCO 3.4.3) has been established in HNF-3673 for these operability requirements. Process bays as defined in HNF-3673 are only bays 4 & 5.

- Process bay pressure differential indicator (PDI-8*20B) and remote alarm for each bay with a setpoint < -0.013 in. water gauge.

- Process water tank room pressure differential indicator (PDI-8080B) and remote alarm with a setpoint < -0.013 in. water gauge.

- Pressure in each process bay shall be < 0 in. water gauge relative to the reference air system.

- Pressure in the process water tank room shall be < 0 in. water gauge relative to the reference air system.

3.2 Special Requirements

3.2.1 Radiation and Other Hazards

1. **Requirement:** To prevent possible contamination, air in the rooms connecting the administration area to the process area shall not be exhausted to the outside, but directed towards the process area and the HEPA-filtered exhaust system.

   Basis: HNF-SD-SNF-DRD-002, Section 6.5.4.7c. Personnel protection contamination control measures are to be in place that precludes contamination backflow from the CVDF process areas to adjacent areas in the Administration Building. Therefore, air in the Administration Building areas adjacent to the process areas is not to be exhausted through the Administration Building HVAC system.

   How the system meets the requirement: The administration area of the CVDF has an independent supply and exhaust system that operates at a positive pressure to preclude in-leakage from adjacent areas or the outside.

2. **Requirement:** The CVDF HVAC system shall be demonstrated not to cause adverse harm to facility personnel due to recirculation of CVDF exhaust stack air into the administrative building.

Basis: HNF-SD-SNF-DRD-002, Section 6.5.4.7f. The CVDF stack discharge air is HEPA-filtered to provide airborne radioactive material confinement. The stack will be located and designed to preclude CVDF stack discharge from entering the Administration Building HVAC system and causing adverse harm to personnel.

How the system meets the requirement: Merrick HVAC calculations (Merrick 1996) develop the minimum stack height required to ensure that CVDF exhaust stack air is not recirculated into the administration building HVAC system. A minimum stack height of 44.4 ft was calculated; a stack height of 48.0 ft is used for the design of the CVDF.

3. **Requirement:** Ventilation flows and pressure differentials are detected and monitored throughout the facility as required to prevent the possible spread of hazards, such as radioactive contamination. All confinement ventilation airflows and pressure differentials are alarmed if out of compliance.

   Basis: HNF-SD-SNF-DRD-002, Section 6.5.2f. The CVDF has the potential to contain airborne hazards in its airspace. In order to prevent the possible spread of airborne hazards, ventilation flows and pressure differentials should be detected and monitored throughout the facility. Alarms should be employed if the ventilation air flows and pressure differentials are out of compliance.

   How the system meets the requirement: The CVDF monitors the pressure differentials to ensure that ventilation flows are maintained within design specifications to provide containment of radioactive/hazardous materials. Each process bay is monitored for pressure differential, relative to atmosphere, through a pressure differential indicating transmitter, which is displayed on the pressure differential indicator (see Drawing H-1-82207). If the pressure differential exceeds the specific process bay design pressure (± 0.02 in. w.g.), a low or high alarm will annunciate in the control room. Pressure differential is also monitored across each stage of the HEPA filter bank. Pressure differential across the filter of 3.0 in. w.g. will annunciate a high pressure differential alarm in the control room. A high-high alarm will also annunciate in the control room at 4.0 in. w.g., signifying mandatory change-out of the filter.

   Air measuring stations are included in the process general supply/exhaust HVAC system. Filter pressure differentials are also monitored.

4. **Requirement:** A non-seismic confinement isolation damper is provided on the air intake to prevent backflow of air to the outside in the event of system shutdown.

   Basis: HNF-SD-SNF-DRD-002, Section 6.5.4.1a. Backflow isolation dampers are provided on the outside air inlet to provide for confinement of radioactivity. Seismic qualification of dampers is not required because CVDF negative pressure is not required after the DBA.

   How the system meets the requirement: Isolation dampers in each process bay (HVAC-DMP-8201, HVAC-DMP-8301, HVAC-DMP-8401, HVAC-DMP-8501) are designed to fail in the closed position. A backdraft damper is also provided inline as a redundant component that prevents backflow of air to the outside in the event of a system shutdown. Non-seismic confinement isolation damper HVAC-DMP-8001 performs this function for the general supply system (see Drawing H-1-83967).

5. **Requirement:** Exhaust ventilation systems shall be provided with HEPA filtration to minimize the release of hazardous materials through the exhaust path (DOE Order 6430.1A, Section 1550-2.5.5).

   Basis: HNF-SD-SNF-DRD-002, Section 6.5.2i. In order to protect the environment and operating personnel, HEPA filtration should be employed to minimize the release of hazardous materials through the exhaust path.

   How the system meets the requirement: The process general supply/exhaust HVAC system provides an 85 percent efficient pre-filter and two stages of HEPA filtration prior to discharge through the exhaust stack.

6. **Requirement:** The number of exhaust filtration stages shall be sufficient to limit concentrations of airborne radioactive particulate released to the environment to less than the applicable limits at the point of discharge during all anticipated operating and DBA conditions.

   Basis: HNF-SD-SNF-DRD-002, Section 6.5.4.3b. Airborne concentrations of radioactive particulate must be maintained at less than the applicable limits to achieve compliance with Federal and State regulations.

   How the system meets the requirement: The exhaust system uses two stages of 99.97 percent (purchase specification) efficient HEPA filtration.

3.2.2 ALARA

1. **Requirement:** Sufficient access to and working space around HVAC equipment shall be
2.
3.
4. provided to permit ready and safe operation and maintenance of such equipment. Access and working space shall be in accordance with supplier and International Conference of Building Officials code requirements.

   Basis: HNF-SD-SNF-DRD-002, Section 6.5.2o. To provide for equipment operation and maintenance, worker safety, egress and ingress, and to maintain the policies of as low as reasonably achievable (ALARA), the process bay recirculation HVAC equipment is designed and located to provide adequate space to operate and maintain the process bay recirculation HVAC system equipment.

How the system meets the requirement:

- The process bay recirculation HVAC equipment is located on the mezzanine in the process bay. Drawing H-1-82196 indicates that adequate space is available to operate and maintain the process bay recirculation HVAC equipment.

- The CVDF HVAC systems locate the HEPA filtration as close as possible to any expected airborne contamination sources. The filtration units and fans are located in the CVDF in a location designed to accommodate the equipment footprint and personnel egress and maintenance requirements.

- The general supply/exhaust HVAC and the local exhaust equipment is located in the mechanical room and transfer corridor. Drawings H-1-82197, *Cold Vacuum Drying Facility HVAC Plan Transfer Corridor*, and H-1-82198, *Cold Vacuum Drying Facility HVAC Plan Mechanical Room*, indicate that adequate space is available to operate and maintain the process general supply/exhaust HVAC system equipment.

- The process general supply/exhaust HVAC and the local exhaust systems locates HEPA filters in the mechanical room on the second floor, adjacent to the return register from each of the process bays. Placement within the mechanical room accommodates equipment footprint and allows personnel egress for operations and maintenance (see Drawing H-1-82198).

5. **Requirement:** Air filtration housings shall be designed so that a tier of filters can be completely isolated from the ventilation system during filter element replacement, and they shall be designed and located with appropriate radiation protection to maintain occupational doses ALARA during operations and maintenance.

   Basis: HNF-SD-SNF-DRD-002, Section 6.5.4.3g. The system should be designed for continuous operation during filter element replacement to minimize the affect to processing operations. The location of the filter housings should be in areas not normally occupied by operations personnel, and designed for quick maintenance to maintain occupational doses ALARA during operations and maintenance.

   How the system meets the requirement: The purchase specification calls for a bag-in/bag-out filter housing. This housing is designed so that a tier of filters can be completely isolated from the ventilation system during filter element replacement. The general and local exhaust housing are located in the mechanical room, which is not normally occupied to maintain occupational doses ALARA during normal operations. The recirculation housings are located on the bay mezzanine which also is not normaly occupied. Filter maintenance involves a minimum of exposure time by design, which serves to maintain occupational doses ALARA during maintenance activities.

6. **Requirement:** All filtration units shall be installed as close as practical to the source of contamination to minimize the contaminated ventilation duct work (DOE Order 6430.1A, Sections 1300-11.2, 1550-99.0.2).

   Basis: HNF-SD-SNF-DRD-002, Section 6.5.4.2e.

   How the system meets the requirement: The system design has the filtration units located as close as practical to the source of contamination. Filter housings HVAC-F-8*02 (Process bay recirculation HVAC system) are located in the process bays. Filter housings HVAC-F-8020 (general exhaust) and HVAC-F-8040 (local exhaust) are located in the mechanical room second floor.

7. **Requirement:** The adequacy of the filtration system shall be confirmed by safety analysis to ensure that airborne radioactive particulate concentrations are ALARA and do not exceed DOE Order 5480.1A requirements during abnormal, accident, and DBA conditions.

   Basis: HNF-SD-SNF-DRD-002, Section 6.5.4.3c.

   How the system meets the requirement: The CVDF Final Safety Analysis Report, HNF-3553, has been released.

3.2.3 Nuclear Criticality Safety

No criticality safety requirements are applicable to this system.

3.2.4 Industrial Hazards

There are no unique industrial hazards requirements associated with this system.

3.2.5 Operating Environment and Natural Phenomena

1. **Requirement:** The system must be designed to withstand the operating environment in which it is located.. A summary of conditions at the CVDF site is as follows:

   - Latitude: 46E 34N
   - Longitude: 119E 36O
   - Altitude: 476 ft
   - Prevailing wind: NW
   - Outdoor design temperatures: +9 °F winter; 97 °F db, 67 °F wb summer
   - Indoor design temperatures: 72 °F winter, 75 °F summer.

   Basis: HNF-SD-SNF-DRD-002, Section 6.5.1.1.

How the system meets the requirement: The air handling unit heating coil is designed to accommodate entering air temperatures as low as 9 °F (winter design temperature). The air handling unit cooling coil is designed to accommodate entering air temperatures as high as 97 °F db (summer design temperature). Additionally, the zone terminal heating coils are designed to provide conditioned air to the process areas between 75 °F and 85 °F (indoor design temperatures).

3.2.6 Human Interface Requirements

There are no human interface requirements identified for the CVDF HVAC systems.

3.2.7 Specific Commitments

.Specific commitments defining codeviations are identified in Fluor Handord, Inc (FHI) letter to P.G.Loscoe, DOE, Richland Operation Office (RL), from R.B.Wilkenson, (FH letter 0002595 dated 5-17-00) and DOE-RL response (00-SFO-117 dated 7-17-00 incoming 0003912A) response letter from P.G.Lascoe to R.D.Hanson (FHI). A deviation to DOE 6430.1A design requirement to meet The ASME N509 and N510 was granted applicable to specific components as tabulated in the correspondence

3.3 Engineering Disciplinary Requirements

3.3.1 Civil and Structural

The civil design requirements in HNF-SD-SNF-DRD-002 were reviewed and evaluated for applicability to the CVDF HVAC systems. No pertinent requirements were identified. The structural requirements were also reviewed and the following applicable design requirements identified, and implemented.

All equipment is assigned either to seismic performance category 0 and 1 for general services, performance category 2 for safety-significant functions, or performance category 3 for safety-class functions in accordance with the seismic design requirements in the design requirements document (DRD).

All equipment within the CVDF with the potential, because of seismic-induced failure, of preventing safety-class systems, structures, and components (SSCs) from performing safety-class functions are anchored for the design basis seismic performance category 3 criteria in accordance with WHC-SD-GN-DGS-30006, *Seismic Design Guide for Safety Class 3 and 4 Equipment at the Hanford Site*. Seismic design requirements for all SSCs are assigned and documented in the *Safety Equipment List* (HNF-SD-SNF-SEL-002 1998).

3.3.2 Mechanical and Materials

1. **Requirement:** Office and operational areas shall be maintained at temperatures recommended by the appropriate codes and standards, as required by DOE Order

6430.1A, to ensure personnel comfort and safety and to protect equipment during normal and upset conditions.

Basis: HNF-SD-SNF-DRD-002, Section 6.5.2c. Temperature maintenance ensures personnel comfort and safety as well as protects equipment from temperature extremes that may cause it damage otherwise.

How the system meets the requirement: The HVAC systems maintain occupied rooms at no higher than 75°F; and operational areas no higher than 85°F, meeting DOE Order 6430.1A.

2. **Requirement:** All HEPA filtration design and construction practices shall conform to the guidelines of ERDA-76-21, *Nuclear Air Cleaning Handbook*, Chapter 4; and ASME N509.

   Basis: HNF-SD-SNF-DRD-002, Section 6.5.2i.

   How the system meets the requirement: System was designed to comply with ERDA-76-21, *Nuclear Air Cleaning Handbook*, Chapter 4; and ASME N509. System design utilizes HEPA filtration should be employed to minimize the release of hazardous materials through the exhaust path.

3. **Requirement:** Industrial ventilation design air quantities and transport velocities shall be calculated according to the calculation methods prescribed by the requirements in the ACGIH Industrial Ventilation Manual, ASHRAE Fundamentals, UBC, 29 CFR 1910, NFPA 45, NFPA 90A, and NFPA 801. Design heating and cooling load calculations shall be developed and presented as part of the design packages.

   Basis: HNF-SD-SNF-DRD-002, Section 6.5.4c. Fundamental design requirement driven by the usage of national codes and standards for the system design.

   How the system meets the requirement: Merrick HVAC calculations (Merrick 1996) were performed to the specified calculated methods. The Merrick HVAC calculations (Merrick 1996) provide the design heating and cooling load calculations.

4. **Requirement:** The exhaust air treatment systems shall contain a HEPA filter train with a minimum of two HEPA filter stages or equivalent efficiency filtration, as required pending a safety analysis of accidental exposure criteria. Each HEPA filter stage shall be testable to ASME N510 criteria.

   Basis: HNF-SD-SNF-DRD-002, Section 6.5.4.2f. The process general exhaust and process bay local exhaust HVAC and process vent systems provide confinement of radioactive material within the process bay during processing operations if a release from primary confinement occurs. Based on this function, two HEPA filter stages should be employed to entrap particulate radioactive material before the airstream is released to the environment.

How the system meets the requirement: The exhaust air treatment systems include a HEPA filter train of two HEPA filter stages located in filter housings HVAC-F-8040 and HVAC-F-8020. Filter housings HVAC-F-8040 and HVAC-F-8020 provide test ports upstream and downstream of each individual HEPA filter stage.

5. **Requirement:** HEPA filters and housings shall be fluid-seal, bag-in/bag-out type. The filter housings shall be fabricated from 304-L stainless steel with a 2-B mill finish. All filter housing joints and seams shall be welded and airtight when tested in accordance with ASME N510 at 1.25 times the rated fan capacity per ASME N509, or with ERDA-76-21, Table 5, whichever is more stringent. They shall be equipped with local pressure differential readouts and alarm high interfaces with the MCS to monitor the loading of the filters.

   Basis: HNF-SD-SNF-DRD-002, Section 6.5.4.3a. This requirement is necessary to comply with applicable ASME codes.

   How the system meets the requirement: HVAC system air filtration housings specify the use of a bag-in/bag-out style filter that has provisions for routine, in-place testing of HEPA filter systems. The construction specification (15856) for the CVDF HVAC systems requires that type 304-L stainless steel with a 2-B mill finish be issued for filter housing fabrication. The specification also states that filter housings are to be 100 percent seam-welded, airtight, with no burrs or sharp edges. The joints must be capable of withstanding 10 in. w.g., positive or negative. Each HEPA filter has pressure differential-indicating gauges monitoring the pressure drop through each HEPA filter stage. The HEPA filters have a switch (PDIS) that initiates an alarm when the pressure differential across the filter reaches its high alarm setpoint and again when it reaches its high-high alarm setpoint. The alarms are transmitted, via the ATC, to the control room where they are annunciated on the enunciator panel.

6. **Requirement:** HEPA filters shall have a clean resistance pressure drop not to exceed 250 Pa (1 in. w.g.) with a velocity of the air entering the filter of 1.27 m/sec (250 ft/min).

   Basis: HNF-SD-SNF-DRD-002, Section 6.5.4.3e. System air filtration is accomplished by two installed stages of testable, 99.95% efficient HEPA filter stages. HEPA filters should be tested to ANSI/ASME N510 standards to assure meeting the 99.95% efficiency criterion.

   How the system meets the requirement: HEPA filter design and testing standards are specified in the procurement specification. HEPA filters are tested to ANSI/ASME N510 standards to assure meeting the 99.95 percent efficiency criterion. Filter specifications, testing, and facility air balance/flow adjustments ensure that the requirements will be met.

7. **Requirement:** HEPA filtration systems shall be designed with prefilters installed upstream of HEPA filters to extend the life of the HEPA filters.

Basis: HNF-SD-SNF-DRD-002, Section 6.5.4.3i.

How the system meets the requirement: Prefilters are installed upstream of the HEPA filters in filter housings HVAC-F-8020 and HVAC-F-8040.

8. **Requirement:** All HEPA-filtered systems shall be designed to ensure that proper airflow is maintained across the HEPA filter face and that the HEPA filters shall not operate in atmospheres above 70% relative humidity per ASME N509 section 4.1. Design considerations, supported by extensive calculations, to prevent filter blowout from high water entrainment are required. Pursuant to these considerations and calculations, a moisture sensing and control system shall maintain the filter face below 70% relative humidity or stop the system fans and alarm to the MCS indicating high filter face humidity. Also pending the calculations, HEPA filter housings (with and without deluge spray systems) shall be manually drainable pursuant to ASME N509. If seal pots are used for HEPA filter drains, the seal pots shall be equipped with level control system with low level alarms to the MCS to prevent filter bypass pursuant to ASME N509.

   Basis: HNF-SD-SNF-DRD-002, Section 6.5.4.3n.

   How the system meets the requirement: The design of HEPA filtered systems was performed according to ASME N509. Humidity transmitters are provided in the general exhaust system (XS-8031) and the local exhaust system (XT-8051) upstream of the filter housings. Humidity high alarms are provided on the FCS-OWS. The bay recirculating system doesn't provide humidity transmitters The necessary operator actions will be provided in system operating and alarm response procedures. The HEPA filter system do not provide 70% humidity automatic shut down controls. All the system meet the requirement based on calculation identified in Letter, J.H.Wicks, SNF, to P.G.Loscoe, RL - Spent Nuclear Fuel (SNF) Project Cold Vacuum Drying (CVD) Facility Local and General Exhaust Systems (letter # FH-0003912A R2)

9. **Requirement:** Ducting systems shall be designed to minimize pressure drops through the system while maintaining the required entrainment velocities.

   Basis: HNF-SD-SNF-DRD-002, Section 6.5.4.4b. This is standard design practice to achieve maximum system efficiency.

   How the system meets the requirement: Merrick HVAC calculations (Merrick 1996) were performed to size the HVAC system components, equipment, and systems to specified HVAC design requirements. The duct sizing, pressure drops, airflows, and air velocities are contained in the Merrick HVAC calculations.

10. **Requirement:** Velocities shall be determined in accordance with Section 5 of the ACGIH Industrial Ventilation Manual.

    Basis: HNF-SD-SNF-DRD-002, Section 6.5.4.4d. The system design, sizing, airflow, and velocity calculations for supply and exhaust of air should be performed to industry standards.

    How the system meets the requirement: Merrick HVAC calculations (Merrick 1996) were performed to the HVAC design requirements and provide duct sizing, flow, volume, and velocity data.

11. **Requirement:** Duct thickness shall be determined by Tables 5.1, 5.2, 5.3, and 5.4 of ERDA-76-21. All welded duct work shall have a minimum duct thickness of No. 16 U.S. gauge.

    Basis: HNF-SD-SNF-DRD-002, Section 6.5.4.4e.

    How the system meets the requirement: Process area HVAC system fabrication meets the requirements of ERDA-76-21 as identified in the construction specification (15890). All ductwork is 16 U.S. Standard Gauge.

12. **Requirement:** All ducting systems shall be classified as determined by the criteria in ERDA-76-21, Table 5.5. Each duct system shall comply with the design and construction standards specified in ERDA-76-21 for the levels determined from Table 5.5. Acceptable leakage for each level of classification shall be no greater than the limits specified in Table 5.6 of ERDA-76-21.

    Basis: HNF-SD-SNF-DRD-002, Section 6.5.4.4f. The governing documentation for the project requires use of ERDA and other applicable codes and standards.

    How the system meets the requirement: The Merrick HVAC calculations (Merrick 1996) provide the design calculations for the HVAC ducting. The HVAC construction specification (15890) references ERDA-76-21, Table 5.6, for the determination of maximum leak rates.

13. **Requirement:** Exhaust system duct velocities, upstream of the first stage HEPA filters, shall be maintained at a minimum of 10.2 m/sec (2,000 ft/min) to provide proper entrainment.

    Basis: HNF-SD-SNF-DRD-002, Section 6.5.4.4h.

    How the system meets the requirement: The Merrick HVAC calculations (Merrick 1996) provide the design calculations for the HVAC system.

14. **Requirement:** Dampers shall comply with the requirements determined from Table 5.12 of ERDA-76-21. Duct systems serving the confinement areas of the facility shall not be acoustically treated.

    Basis: HNF-SD-SNF-DRD-002, Section 6.5.4.4m. The process bay recirculation HVAC system fire damper procurement specification requires that fire dampers be rated to Underwriters Laboratories-listed or Factory Mutual-approved specifications according to ASTM E-119. All duct work of the system has a protective coating applied to the interior surface.

    The process general supply/exhaust HVAC system has the potential to transport radioactive particulates. Because of its potential to contain radioactive particulates, dampers in the system should comply with the requirements outlined in ERDA-76-21. Acoustically treated duct systems would entrap particulates prior to their being filtered from the airstream by the HEPA filters

    How the system meets the requirement: The construction specification (15890) requires fabrication and installation in accordance with ANSI/NFPA 90A, SMACNA 1208, and SMACNA 1481. Design of the HVAC system and dampers is included in Merrick HVAC calculations (Merrick 1996).

15. **Requirement:** Radionuclides, nonradioactive air pollutants, and toxic air pollutants shall be emitted through the exhaust stack. Radioactive air emissions and monitoring are governed by U.S. Environmental Protection Agency regulations at 40 CFR 61 and the Washington State regulations listed in WAC 246-247, "Radiation Protection" Air Emissions." Nonradioactive air pollutants are governed by the regulations listed in WAC 173-400, "General Regulations for Air Pollution Sources." Toxic air pollutants are governed by regulations listed in WAC 173-460, "Controls for New Sources of Toxic Air Emissions." All of these regulations specify emission limits, and they require the use of emission control technology, as required.

    Basis: HNF-SD-SNF-DRD-002, Section 6.5.29. The emissions from the CVDF are governed by U.S. Environmental Protection Agency and Washington State regulations that require the use of emission control technology.

    How the system meets the requirement: A stack monitoring system is provided that measures the levels of releases.

16. **Requirement:** Mechanical components for the CVDF are sized and selected according to the appropriate codes and standards.

    Basis: This is requirement is based on good engineering practices.

    How the system meets the requirement: Mechanical components are sized and selected to meet the operational and functional requirements of the system as delineated in Section 3.1.

3.3.3 Chemical and Process

No unique chemical and process requirements are applicable to this system.

3.3.4 Electrical Power

No unique normal operational electrical power requirements are applicable to this system. A standby power supply is provided to power the local exhaust system and reestablish local exhaust flow within 1 minute following a normal power loss.

3.3.5 Instrumentation and Control

1. **Requirement:** Provide a control system for the HVAC control system with interfaces (remote set points and remote indication as necessary) with the facility or process MCS capable of air flow control, fan speed adjustment, and pressure zone maintenance.

   Basis: HNF-SD-SNF-DRD-002, Section 6.5.2k. The CVDF requires that air flow control be employed to create an air flow from areas of lower contamination potential to areas of higher contamination potential

   How the system meets the requirement: The HVAC systems, in the process areas, are controlled by a Automatic Temperature Control (ATC) system that automatically runs the system to maintain design operating limits in the CVDF. The process general supply/exhaust HVAC system provides airflow measuring stations (HVAC-AMS-8007, 8024), variable frequency drives (VFD-8025, 8027), and pressure differential monitors (PDIS 8001, 8021, 8022, 8023). These sensors interface with the ATC to provide airflow control within the CVDF.

2. **Requirement:** An interlocked HVAC control system is provided so that reversed airflow patterns cannot be established.

   Basis: HNF-SD-SNF-DRD-002, Section 6.5.2l. Prevention of reversed airflow patterns is essential for the HVAC system to perform its function and to prevent cross contamination or the release of contaminated air into occupied spaces.

   How the system meets the requirement: The process bay recirculation HVAC system has several interlocks to prevent reversed airflow. If the fire protection system detects smoke in the duct, an interlock cuts power to the supply fan and closes the isolation damper. The anti-backdraft damper, although not interlocked with any system, mechanically eliminates any reversed airflow from the process bay recirculation HVAC system to the outside air.

   The supply fan (HVAC-FAN-8005) is interlocked with the exhaust fans (HVAC-EXHF-8025 and HVAC-EXHF-8027). If the exhaust fans fail, the interlock trips the supply fan, eliminating continued air supply and preventing pressurization of operation areas. This interlock is also triggered by detection of smoke in the HVAC general supply/exhaust system, and by a low temperature sensor designed to protect the CHW cooling coil from freezing.

3. **Requirement:** Pressure differential monitoring and alarms for upset conditions shall be provided between the administration and process areas to ensure the correct direction of airflow.

Basis: HNF-SD-SNF-DRD-002, Section 6.5.4.7e. There are 18 pressure differential transmitters/indicators, including the process transfer corridor and Administration Building hall corridor, 13 interface with the ATC and 5 have separate alarms circuits provided in the control room. Pressure differential in the process transfer corridor is read at PDI 8073 and maintained between -0 .08in. w.g. (high alarm set point) and -0.12 in. w.g. (low alarm set point). Pressure differential in the Administration Building hall corridor is read on PDI 8079 and maintained above +0.01 in. w.g. (low alarm set point). During normal operation, all HVAC systems are operating and confinement is maintained with pressure differential control and correct air flows (area of lowest contamination potential to area of higher potential). During upset conditions, pressure differential cannot be maintained, confinement may be lost, affected pressure differential alarms are given in the control room, but the Administration Building HVAC is not curtailed. The HVAC system remains operational providing positive pressure within the Administration Building and assuring airflow into the process area.

How the system meets the requirement: Pressure differential transmitters/indicators are provided in the process area transfer corridor and in the administration building corridor. These transmitters/indicators monitor air pressure, relative to atmosphere, to ensure that each room's specific design pressure is maintained within design bounds. If the room/area pressure differential exceeds ± 0.02 in. w.g. from the specific room design pressure high or low setting, a high or low pressure differential light will light and an alarm will annunciate at the control room panel. The administration area is maintained above +0.01 in. w.g., and the transfer corridor is maintained between–0.08 and -0.12 in. w.g. (see Drawing H-1-82207).

3.3.6 Computer Hardware and Software

All computer hardware and software for the HVAC system are contained in the ATC system which is detailed in Cold Vacuum Drying Facility Automatic Temperature Control System Process Flow And Operational Description (PFOD), SNF-7032. This system uses commercial Programmable Logic Controllers for process control and IBM® compatible personal computers for supervisory control. All control logic is in the form of standard ladder logic diagrams of discrete control and conventional proportional-integral-differential (PID) algorithms for process loop control. Drawing H-1-84859 sheets 1-74 contain the ATC conduit, wiring and panel layout details.

3.3.7 Fire Protection

1. **Requirement:** The thermal detectors shall be the rate-compensated type connected to the fire alarm control panel and system exhaust fans. The temperature setting for the detector shall be 88 °C (190 °F) within ±4.5 °C (8 °F). Upon detection, the fans shall be stopped and the dampers closed.

   Basis: HNF-SD-SNF-DRD-002, Section 6.5.4.7e. Thermal detectors are required to protect the HEPA filters from exposure to excessive heat.

   How the system meets the requirement: The HVAC system thermal detectors are connected to the fire alarm and control panel. The control panel interlocks stop the fan and close the isolation damper.

2. **Requirement:** Design and installation of duct work and dampers shall comply with DOE Order 6430.1A, Section 1550-2.5.6, which requires compliance with NFPA 90A and Sheet Metal and Air Conditioning Contractors National Association.

   Basis: HNF-SD-SNF-DRD-002, Section 6.5.4.4a. DOE Order 6430.1A is a governing document for the project and compliance with the order is required.

   How the system meets the requirement: The construction specification (15890) requires fabrication and installation in accordance with ANSI/NFPA 90A, SMACNA 1208, and SMACNA 1481. Design of the HVAC system is included in Merrick HVAC calculations (Merrick 1996).

3. **Requirement:** The fire protection provided for the HEPA filter banks shall consist of thermal detectors installed upstream from the banks, fire screens, and dampers in the duct work.

   Basis: HNF-SD-SNF-DRD-002, Section 6.5.4.3j.

   How the system meets the requirement: Thermal detectors XS-8020 and XS-8040 are located upstream of HEPA filter bank housings HVAC-F-8020 and HVAC-F-8040 respectively.

4. **Requirement:** Fire dampers shall be provided in all supply return and exhaust air duct penetrations of fire-rated walls. Provisions shall be included for testing of dampers.

   Basis: HNF-SD-SNF-DRD-002, Section 6.5.4.4c. Fire dampers are installed to isolate and prevent the spread of fire.

   How the system meets the requirement: The only wall in the CVD Facility with a 2 hour fire rating does not contain any dampers.

5. **Requirement:** HVAC shall meet the requirements of NFPA 90A, *Air Conditioning and Ventilating Systems*; and NFPA 90B, *Warm Air Heating and Air Conditioning Systems* as appropriate.

Basis: HNF-SD-SNF-DRD-002, Section 6.5.2m.

How the system meets the requirement: Merrick HVAC calculations (Merrick 1996) were performed to size heating, cooling, and airflow requirements to meet ANSI/NFPA 90A and ANSI/NFPA 90B.

6. **Requirement:** Fire dampers shall be provided only where closure shall not prevent the functioning of safety-class systems in fire-rated separations necessary for confinement. Operation may be by thermal link or automatically from the fire protection system.

   Basis: HNF-SD-SNF-DRD-002, Section 6.5.4h.

   How the system meets the requirement: All isolation dampers are designed and qualified as defined in DOE-STD-1020-94 to allow proper functioning of safety-class systems.

7. **Requirement:** Filter plenums located inside process buildings should be separated from all parts of the building and enclosed by 2-hour, fire-rated construction.

   Basis: HNF-SD-SNF-DRD-002, Section 6.5.2q. This requirement provides containment of radioactive materials in case of fire and is is discussed in WHC-SC-SNF-FHA-003, *CVDF Fire Hazards Analysis.*

   How the system meets the requirement: The filter plenums located in the process bays are will not be contaminated during normal operations. The two-hour, fire-rated construction for the process general supply/exhaust HVAC system filter plenum was not addressed in the procurement of the filter plenums. These issues are being addressed in the FHA.

3.4 Testing And Maintenance Requirements

3.4.1 Testability

1. **Requirement:** The air filtration housing design shall allow for routine in-place testing of HEPA filtration systems (filters, housings, and duct work) as outlined in ASME N510 (DOE Order 6430.1A, Section 1300-3.6).

   Basis: HNF-SD-SNF-DRD-002, Section 6.5.4.3h. Testing is necessary to verify the performance of the HEPA filtration system.

   How the system meets the requirement: HEPA filter housings HVAC-F-8*02 (process bay recirculation HVAC), HVAC-F-8040 (process bay local exhaust and process vent), and HVAC-F-8020 (process general exhaust) all include provisions for in-place testing of HEPA filters as specified in the construction specification. Refer to test specifications SNF-W441-TS-030-2A "Cold Vacuum Drying Facility Process Bay Supply and

Recirculation, Process Bay Local Exhaust and Process Vent, Process General supply and exhaust HVAC".

2. **Requirement:** Duct maintainability and testability shall follow the guidelines outlined in the ERDA-76-21, Section 2.3.8.

   Basis: HNF-SD-SNF-DRD-002, Section 6.5.4.4j. The system must be tested and maintained in order to ensure proper performance.

   How the system meets the requirement: The Merrick HVAC calculations (Merrick 1996) provide the design calculations for the HVAC ducting. The HVAC construction specification (15890) references ERDA-76-21, Table 5.6, for the determination of maximum leak rates.

3.4.2 Technical Safety Requirement-Required Surveillances

Surveillances required by Technical Safety Requirements are detailed in HNF-3673, *Cold Vacuum Drying Facility Technical Safety Requirements.*

3.4.3 Non-Technical Safety Requirement Inspections and Testing

1. **Requirement:** Fire dampers shall be tested in accordance with the requirements of ASTM E-119 and listed by UL or approved by Factory Mutual.

   Basis: HNF-SD-SNF-DRD-002, Section 6.5.2n. This requirement is part of ASTM E-119 and compliance is required.

   How the system meets the requirement: This requirement is part of the procurement specification for fire dampers.

2. **Requirement:** HEPA filters shall have a minimum startup efficiency of 99.95% as evaluated by testing conducted in accordance with ASME N510.

   Basis: HNF-SD-SNF-DRD-002, Section 6.5.4.3d. System air filtration is accomplished by two installed stages of testable, 99.95% efficient HEPA filters.

   How the system meets the requirement: The construction specification (15856, Section 2.4.2) for HVAC systems specifies HEPA filters have 99.97 percent minimum efficiency on removal of particles up to three microns. The 99.97 percent is a purchase specification. HEPA filters are tested to ANSI/ASME N510 standards to assure meeting the 99.95 percent efficiency criterion.

3. **Requirement:** HEPA filters shall be constructed and acceptance-tested in accordance with ASME N509, ASME N510, and ASME AG-1.

Basis: HNF-SD-SNF-DRD-002, Section 6.5.4.3f. The HEPA filters should be in compliance with Nuclear Power Plant Air-Cleaning Units and Components and tested to meet 99.95% efficiency criterion.

How the system meets the requirement: HEPA filter procurement and testing requirements are specified in the HVAC procurement specification. All HEPA filters are constructed and acceptance-tested to ANSI/ASME N509, ANSI/ASME N510, and ANSI/ASME AG-1.

4. **Requirement:** Fans shall be balanced and checked for harmonic vibration in accordance with ASME N509.

   Basis: HNF-SD-SNF-DRD-002, Section 6.5.4.5d. The process bay recirculation HVAC system equipment is designed and procured to facility design life requirements. System fan balancing is required to meet these system design life requirements.

   How the system meets the requirement: The construction specification (15890) requires fabrication and installation in accordance with ANSI/NFPA 90A, SMACNA 1208, and SMACNA 1481. Design of the HVAC system and dampers is included in Merrick HVAC calculations (Merrick 1996).

3.4.4 Maintenance

1. **Requirement:** Duct cleanout provisions shall be included for all confinement duct work.

   Basis: HNF-SD-SNF-DRD-002, Section 6.5.4.4k.

   How the system meets the requirement: Duct access doors for cleaning and inspection are provided upstream and downstream of filters, coils, fans, automatic dampers, and fire dampers as identified in construction specification section 15910, step 3.1.4.

2. **Requirement:** Adequate contamination control features and procedures shall be developed to perform duct cleanout operations.

   Basis: HNF-SD-SNF-DRD-002, Section 6.5.4.4l.

   How the system meets the requirement: Duct cleanout procedures will be developed and included in system operating and maintenance procedures as necessary.

3.5 Other Requirements

3.5.1 Security and Special Nuclear Material Protection

No security and SNM protection requirements are applicable to this system.

3.5.2 Special Installation Requirements

No special installation requirements are applicable to this system.

3.5.3 Reliability, Availability, and Preferred Failure Modes

1. **Requirement:** The system shall provide proper distribution of air flow throughout the facility during process systems normal, upset, emergency and facility maintenance activities excluding loss of electrical power.

   Basis: HNF-SD-SNF-DRD-002, Section 6.5.2j. The CVDF HVAC systems should be designed to protect the environment and operational personnel during all possible system configurations. In the case of a loss of electrical power, this scenario would result in curtailment of normal operations. Therefore, processing operations can cause no releases and the HVAC system does not need to operate during loss of power.

   How the system meets the requirement: The system provides the negative pressure differential required to establish airflow within the facility from areas of lesser potential contamination to areas of higher potential contamination. During loss of power, system dampers fail closed to maintain confinement. The system is not required to function during seismic events.

3.5.4 Quality Assurance

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

3.5.5 Miscellaneous

There are no miscellaneous requirements associated with this system.

4.0 SYSTEM DESCRIPTION

The system operations and configuration descriptions presented in this section discuss HVAC features that satisfy the FSAR safety functions and functional requirements listed in Sections 2 and 3 of this SDD.

4.1 Configuration

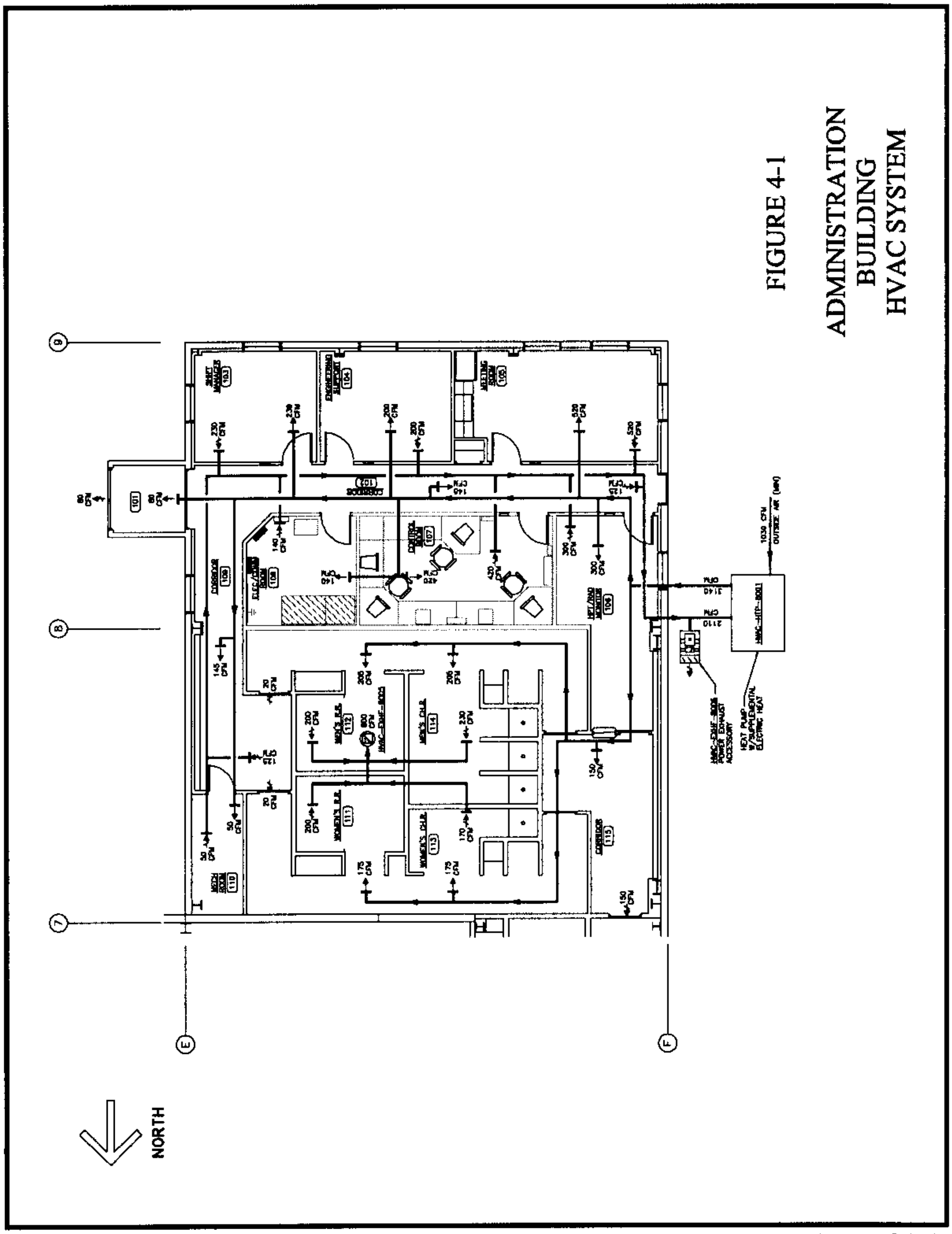
4.1.1 Description of System, Subsystems, and Major Components

4.1.1.1 Administration Building HVAC System. The administration building HVAC system supplies a combination of recirculated and outside air to the CVDF administration building. The system circulates in excess of six air changes per hour, maintains the administration building at a positive pressure with respect to the CVDF transfer corridor, and provides heating and cooling for the administration building. Major components include air-handling unit HVAC-HTP-8001, a power roof ventilator for the restrooms and change rooms, and supply diffusers and return grilles. Drawing H-1-82195, *Cold Vacuum Drying Facility, HVAC Air Flow Diagram, Administration Area*, shows the components of the administration building HVAC system.

4.1.1.2 Process Bay Recirculation HVAC System. The process bay recirculation HVAC systems supply fresh air and maintain temperatures in the process bays. There are four process bay recirculation HVAC systems installed at the CVDF, one for each process bay numbered 2, 3, 4, and 5. Each process bay recirculation HVAC system includes (listed in order) an outside air intake, isolation damper, volume control damper, backdraft damper, return air duct, pre-filter, two stages of HEPA filters, heating coils, cooling coils, supply fan, and ductwork. Figure 4-2, Cold Vacuum Drying Facility HVAC System P&ID, is highlighted to show the process bay recirculation HVAC system and its relationship to the other systems within the CVDF (see Drawings H-1-82196, *Cold Vacuum Drying Facility HVAC Partial Plan Process Bays.*

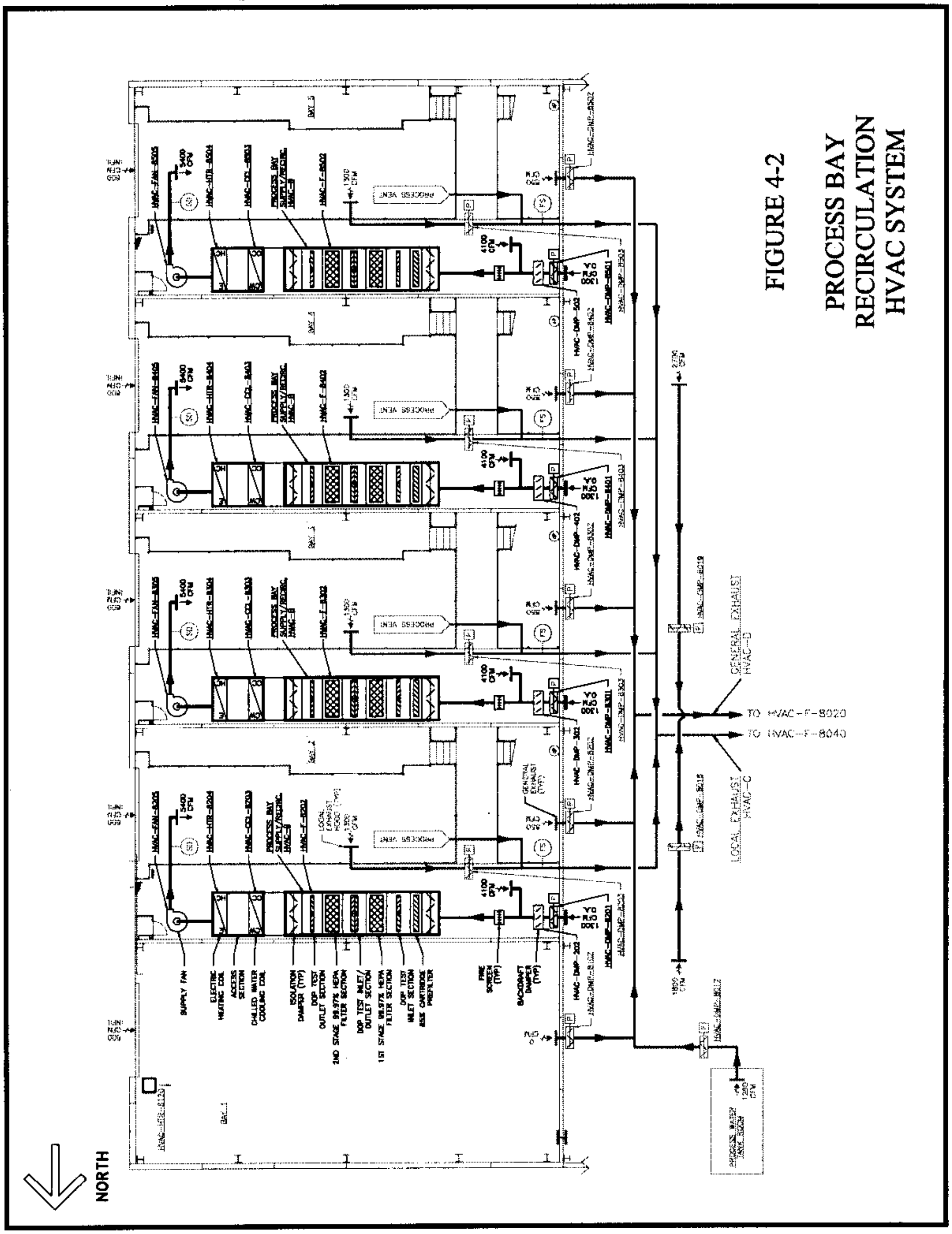
4.1.1.3 Process Bay Local Exhaust HVAC and Process Vent System. The process bay local exhaust HVAC and process vent system provides exhaust capability to remove contaminated gases from process bays numbered 2, 3, 4, and 5 including the process hoods (one per bay, PV-HOOD-1*12) and the process vents. There are four process vents per bay: vacuum piping, interior of the MCO, and two legs of the helium system. Confinement dampers are provided in hood ducts to prevent cross-contamination between the various areas when the system is not operating. All of the exhaust is drawn through a bank of filters. Each filter train includes two isolation dampers, one stage of pre-filters, and two stages of HEPA filters. Three sections are provided for HEPA filter testing. A fire screen/spark arrester and an airflow monitor precede the filter bank. The exhaust gases are drawn through the system by centrifugal exhaust fans (one operating, one standby) and discharged through the facility exhaust stack. Each of the exhaust fans is isolated from the exhaust stream by one manual intake damper and a backdraft damper.

Figure 4-1. Administration Building HVAC System



WMF: HVAC_SNF-3081_F4-1 ACAD FILE: ZBAC0033

Figure 4-2. Process Bay Recirculation HVAC System



WMF: HVAC_SNF-3081_F4-2 ACAD FILE: ZBAC0028

Figure 4-3, Cold Vacuum Drying Facility HVAC System Air Flow Diagram, is highlighted to show the process bay local exhaust HVAC and process vent system and its relationship to the other systems within the CVDF (see Drawings H-1-82192 and H-1-82194).

4.1.1.4 Process General Supply/Exhaust HVAC System. The process general supply HVAC system supplies 100 percent outside air to the CVDF Tank room, Mechanical room, transfer corridor, transfer corridor rooms. The process bays that have separate dedicated supply air handling systems. The general supply air is filtered and cooled or heated as required, to provide tempered air to the zones served. The process general supply HVAC system consists of an outside air intake louver with isolation dampers, general supply air handling unit HVAC-AHU-8002 which includes electric heating coils and chilled water cooling coils. Additionally there are local terminal electric heating coils used for zone heating.
A dedicated 3 ton air conditioning split system cools room 129 to remove the heat dissipation (maximum 30.437 BTU/hr) from the UPS system. HVAC-EVP-8003 circulates room air and rejects the heat to HVAC-CND-8003 located just west of the room on the outside of the building. (H-1-82193 & 82197).

The process general exhaust HVAC system serves both the areas supplied by the process general supply and the process bay.The process general exhaust HVAC system consists of the general exhaust final filter housing, the general exhaust fans, barometric backdraft dampers, and fail-closed fan isolation dampers. The filter housing accommodates 85 percent efficient pre-filters and two stages of HEPA filters. Two general exhaust fans are provided for redundancy. Figure 4-4, *Cold Vacuum Drying Facility HVAC System Air Flow Diagram*, is highlighted to show the process general exhaust HVAC system and its relationship to the other systems within the CVDF facility (see Drawings H-1-82192, H-1-82193, and H-1-82194).

4.1.1.5 Reference Air System. The reference air system provides atmospheric air to 18 pressure differential transmitters/indicators located 13 places throughout the CVDF. The air is provided as a reliable reference to atmospheric pressure for each applicable room. The system is equipped with five valves that act as isolation points. These valves allow isolation of some or all of the pressure differential transmitters

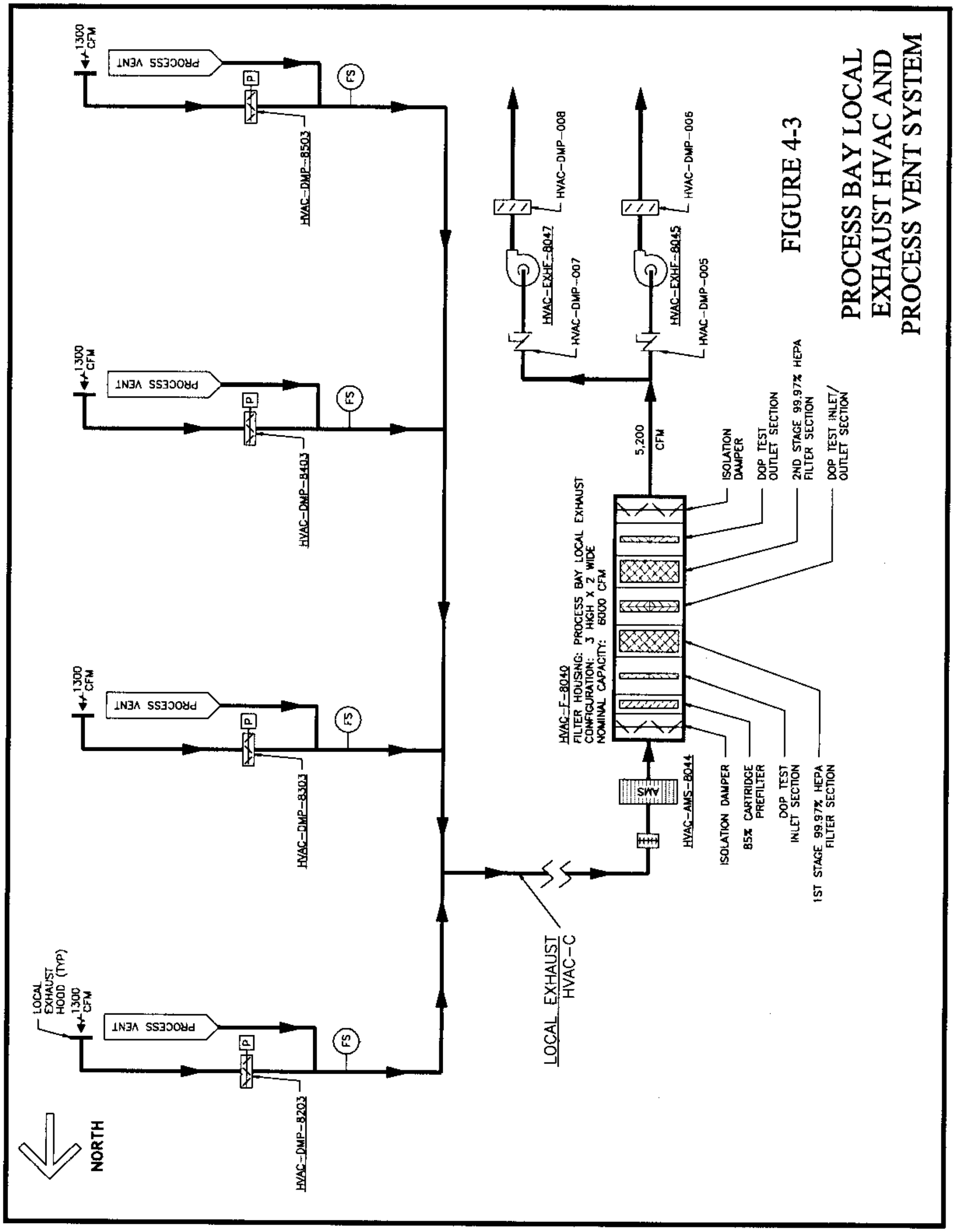
4.1.2 Boundaries and Interfaces

4.1.2.1 Administration Building HVAC System. The administration building HVAC system encompasses the entire administration area complex. The boundary at the west face (F Line) of the facility extends outside to encompass air handling unit HVAC-HTP-8001 and sanitary discharge holding tank TK-9030. The boundary at the east face (E line) of the facility is the outdoors through the entry/exit alcove door. The boundary to the north (Line 7) is the doorway entering the transfer corridor from corridor 115.

Fire Protection System Interface – A smoke detector is provided in the supply duct. If smoke is detected, an indication is provided on the fire alarm panel and an interlock stops the heat pump fan and shuts down the power roof ventilator.

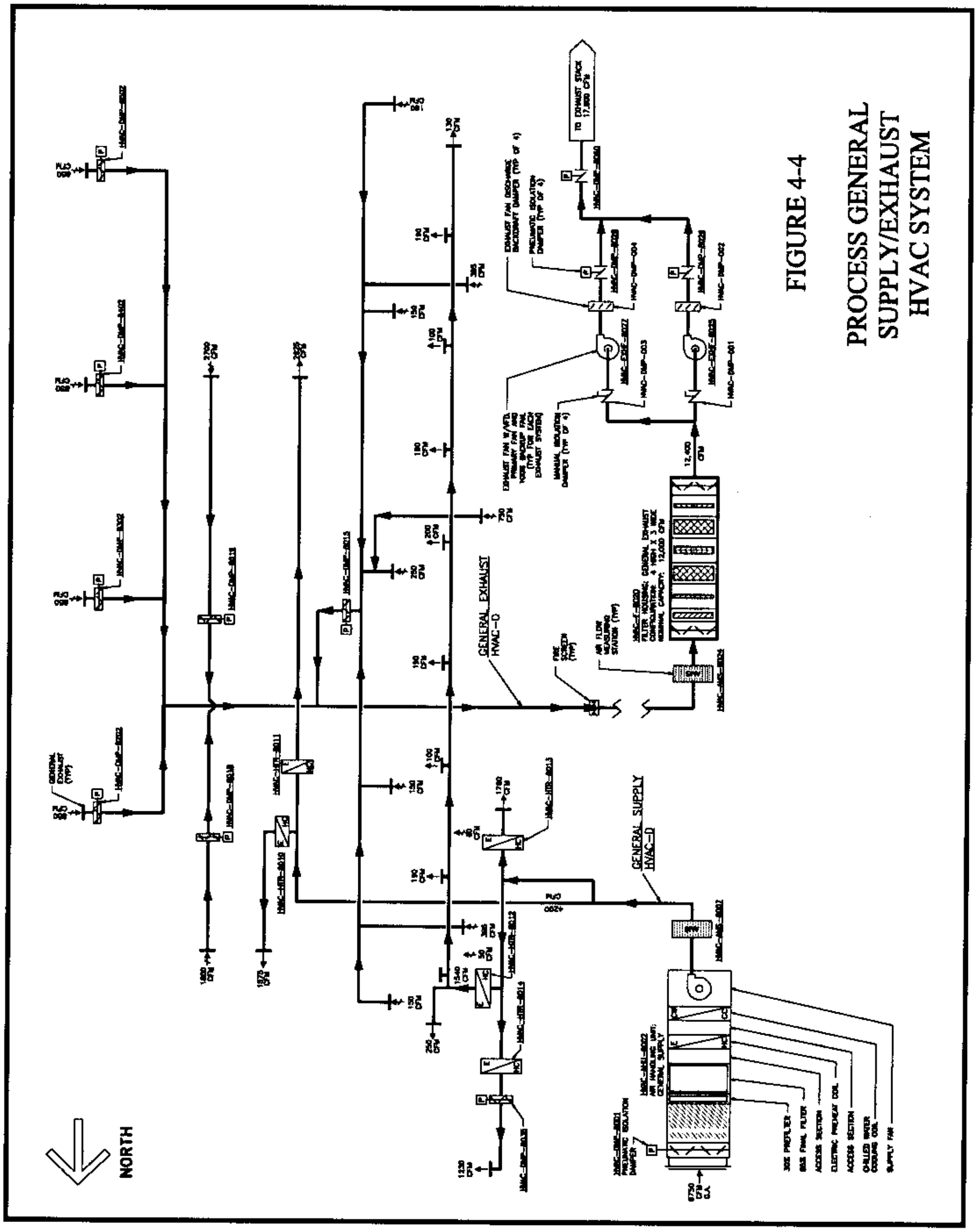
MCS Interface - The administration building HVAC system maintains the control room temperature, where the MCS computer physically resides, within the pre-set temperature ranges to provide correct function for these controls. There is no physical interface with the MCS.

Figure 4-3. Process Bay Local Exhaust HVAC and Process Vent System



WMF: HVAC_SNF-3081_F4-3 ACAD FILE: ZBAC0030

Figure 4-4. Process General Supply and Exhaust HVAC System



WMF: HVAC_SNF-3081_F4-4 ACAD FILE: ZBAC0031

4.1.2.2 Process Bay Recirculation HVAC System. Each process bay recirculation HVAC system has six major interfaces with the CVDF:

Automatic Temperature Control System – The ATC system provides the control devices, operators, sensors, low voltage wiring, software, and programming required to operate the process bay recirculation HVAC systems. The normal operator interface with the ATC system is through the facility control system-operator work station (FCS-OWS) located in the control room (room 107). Details of the ATC system are provided in SNF-7032 Rev. 0

Electrical Power Distribution System - The process bay recirculation HVAC systems are supplied by normal distributed power consisting of single-phase 120V, 60Hz, and three-phase 480V, 60Hz power feeds. The three-phase 480V, 60Hz power feeds the supply fan motor and the electric heating coil module for each process bay recirculation HVAC system. The single-phase 120V, 60Hz feed supplies the remaining power requirements for the process bay recirculation HVAC systems. Details of the electrical power distribution system are provided in SDD-SNF-3075.

Compressed and Instrument Air System - Each process bay recirculation HVAC system interfaces with the compressed and instrument air system. Compressed and instrument air for the process bay recirculation HVAC systems is used to position dampers and to operate CHW cooling coils temperature control flow valves TV-8*03. Compressed and instrument air is supplied to each bay via IA-*02-ST-1/4" and CA-*02-GCS-1/2" lines. (*takes the place of the bay number, example: IA-202-ST-1/4" is located in bay 2). Details of the compressed and instrument air system are provided in SDD-SNF-3066.

CHW System – The CHW system interfaces with the process bay recirculation HVAC system at cooling coil HVAC-CCL-8*03. The CHW system supplies 23.2 gal/min of 7.2 °C (45 °F) chilled water to the cooling coils for each process bay recirculation HVAC system. Chilled water is supplied to process bays 2, 3, 4, and 5 through CHW supply lines CHW-201-CT-2", CHW-301-CT-2", CHW-401-CT-2", and CHW-501-CT-2", respectively. After passing through the cooling coils, the chilled water is transferred out of process bays 2, 3, 4, and 5 through CHW return lines CHW-202-CT-2", CHW-302-CT-2", CHW-402-CT-2", and CHW-502-CT-2" respectively. Details of the CHW system are provided in SDD-SNF-3086.

Fire Protection System – Each process bay recirculation HVAC system interfaces with the fire protection system. Smoke detectors XS-8*05 are provided downstream of each supply fan. If smoke is detected, an indication is provided on the fire alarm and control panel and an interlock stops the supply fan and closes the outside air damper. Details of the fire protection system are provided in SDD-SNF-3077 and in WHC-SD-SNF-FHA-003, *Fire Hazard Analysis for the Cold Vacuum Drying System Facility.*

Condensate collection System - Each process bay recirculation HVAC system interfaces with tank CNDS-TK-410* in the process bays. The tank collects the condensate from the cooling coils. Details of the system are provided in SDD-SNF-3074.

4.1.2.3 Process Bay Local Exhaust HVAC and Process Vent System. The process bay local exhaust HVAC and process vent system, including process hood, has six major interfaces with the CVDF. The local exhaust system includes a process bay isolation damper for process bays numbered 2, 3, 5, and 5; (HVAC-DMP-8*03); a single fire screen downstream of the process bay isolation dampers; an air measuring station (HVAC-AMS-8044); a HEPA filter bank (HVAC-F-8040); two exhaust fans (lead fan HVAC-EXHF-8045 and standby fan HVAC-EXHF-8047), and two backflow dampers (HVAC-DMP-006 and HVAC-DMP-008), one for each exhaust fan.

Electrical Power Distribution System - The process bay local exhaust HVAC system is supplied by normal distributed power comprising single-phase 120V, 60 Hz, and three-phase 480V, 60 Hz power feeds. The three-phase 480V, 60Hz power supplies the exhaust fans for the process local exhaust HVAC system. The single-phase 120V, 60hz supplies the remaining power requirements for the process local exhaust HVAC system. A standby power supply is provided to power the local exhaust system within 1 minute following a of normal power.

Automatic Temperature Control System – The ATC system provides the control devices, operators, sensors, low voltage wiring, software, and programming required to operate the local exhaust and process vent system for the CVDF. The normal operator interface with the ATC system is through the FCS-OWS located in the control room (room 107).

Compressed and Instrument Air System - Compressed and instrument air is supplied to process bay isolation dampers HVAC-DMP-8*03 to control their position (open or closed). Safety-significant, 8.3 gal, compressed air reservoirs are provided for each fail-closed process bay isolation damper. The air reservoirs allow damper operation when standby electrical power is provided following a loss of normal electrical power.

Fire Protection System - The process bay local exhaust HVAC and process vent system interfaces with the fire protection system. A rate-compensated thermal detector upstream of the filter housing monitors temperature rise and will shut down the exhaust fan for high temperature in the filter housing. Process bay exhaust damper HVAC-DMP-8*03 will close when smoke is detected (XS-8*05) in the process bay.

4.1.2.4 Process General Supply/Exhaust HVAC System. The process general supply HVAC system is bounded by the air intake and exhaust locations for the system and includes all components that are required to condition the supply air. The process general exhaust HVAC system is bounded by the air intake and exhaust locations for the system and includes all components that are required to filter and exhaust process air. The process general supply/exhaust HVAC system has six major interfaces with the CVD process.

Automatic Temperature Control System – The ATC system provides the control devices, operators, sensors, low voltage wiring, software, and programming required to operate the general exhaust/supply system. The normal operator interface with the ATC system is through the FCS-OWS located in the control room (room 107).

Electrical Power Distribution System - The process general supply/exhaust HVAC system is supplied by normal distributed power consisting of single-phase 120V, 60 Hz, and three-phase

480V, 60 Hz power feeds. The three-phase 480V, 60Hz power supplies the supply and exhaust fans for the process general supply/exhaust HVAC system. The single-phase 120V, 60hz feed supplies the remaining power requirements for the process general supply/exhaust HVAC system.

Compressed and Instrument Air System - Compressed and instrument air is supplied to process bay isolation dampers HVAC-DMP-8203, HVAC-DMP-8303, HVAC-DMP-8403, and HVAC-DMP-8503 to control their position (open or closed). Compressed and instrument air is supplied to temperature control systems and HVAC airflow balance system, as well as for containment damper alignment. Compressed and instrument air is supplied to the HVAC system at 690 kPa (100 lb/in^2). The air is oil free (contains no hydro-carbons greater than 10 ppm)and dried to -35 °F with a pressure dew point based on 690 kPa (100 lb/in^2) and 100 °F ambient (HNF-SD-SNF-DRD-002). Compressed and instrument air for the process general supply/exhaust HVAC system is used to position dampers and to operate the CHW cooling coil valve at the air handling unit.

CHW System - The CHW system supplies chilled water to cooling coil HVAC-CCL-8004 for the process general supply HVAC system. The CHW system provides partial redundancy for CVD process support by using two split-system, air-cooled water chillers, CHW-CHR-7001, CHW-CCL-7010 with condensing units. Each chiller is sized to accommodate 60 percent of the total facility requirements. Chilled water is supplied to the cooling coils by CHW-015- CT-3". This pipe is fed to CHW-022-CT-3". Discharged water is routed through lines CHW-023-CT-3" to CHW-016-CT-3".

Fire Protection System – The process general supply and exhaust HVAC system interfaces with the fire protection system. Smoke detector XS-8005 is provided downstream of the supply fan. If smoke is detected, an indication is provided on the fire alarm and control panel and an interlock stops supply fan HVAC-FAN-8005 and closes outside air dampers HVAC-DMP-8001 and HVAC-DMP-8001B. Process bay exhaust dampers HVAC-DMP-8*02 will close if smoke detector XS-8*05 detects smoke in the process bay.

Condesate Collection System - For the process general supply HVAC system, condensate is collected from air handling units in the mechanical room and is routed to a tank located in the transfer corridor.

4.1.2.5 Reference Air System. The boundary of the reference air system is between the point of reference and the bay pressure. The point of reference is located in the administration building; the bays and PWC room have pressure indication. This information is fed into the HVAC control system to determine the pressure differential between the bays and tank room.

4.1.3 Physical Location and Layout

4.1.3.1 Administration Building HVAC System. The administration building HVAC system includes a packaged air-to-air heat pump/air handling unit, an economizer exhaust fan, power roof ventilators, ducting, and registers. The heat pump/air handling unit and economizer exhaust fan are located on the west side of the CVDF administration building. The power roof ventilator is located above the men's and women's changerooms and restrooms.

4.1.3.2 Process Bay Recirculation HVAC System. Each process bay recirculation HVAC system is contained completely within its process bay, except for the makeup air birdscreen, which is located outside of the building. The system is located on the second floor mezzanine of the process bay, affording easy access for system maintenance.

4.1.3.3 Process Bay Local Exhaust HVAC and Process Vent System. Each process vent hood and local exhaust intake are located within their respective process bays. The system exhaust fans and filters are located on the second floor-above the transfer corridor in the mechanical room.

4.1.3.4 Process General Supply/Exhaust HVAC System. The components of the general process supply/exhaust HVAC system, with the exception of some ducting and exhaust registers, are located on the second floor above the transfer corridor in the mechanical room.

4.1.3.5 Reference Air System. The reference air system consists of a pipe header connected to an atmospheric static pressure sensor and 18 pressure differential transmitters in 13 various locations throughout the facility. The system is routed from the administration building to the transfer corridor and into each of the process bays and the PWC tank room.

4.1.4 Principles of Operation

4.1.4.1 Administration Building HVAC System. The administration building HVAC system supply fan operates continuously, maintaining a positive pressure between the administration corridor and the transfer corridor. Outside air enters air-handling unit HVAC-HTP-8001 at ~1,030 ft^3/min. and is combined with ~2,110 ft^3/min of recirculated air from the administration building. The air exits the air-handling unit at ~12.8 °C (55 °F) for cooling purposes and ~26.1 °C (79 °F) for heating. The conditioned air is routed to each room in the administration building and discharged though manual balancing dampers and supply diffusers. The supply diffusers are (a) 24 in. by 24 in., lay-in style, louver-faced diffusers, or (b) a 12 in. by 12 in. surface-mounted, louver-faced diffuser equipped with opposed blade dampers.

Recirculation air for the administrative building HVAC is collected from the fire riser mechanical room (room 110), corridor (room 109), shift manager's office (room 103), electrical/communications room (room 108), engineering support room (room 104), meeting room (room 105), and health physics technician room (106) through a return grille or register located in each room. Return grilles are (a) 12 in. by 12 in. or 12 in. by 24 in., lay-in, perforated face grilles, or (b) 12 in. by 12 in. return registers, surface-mounted, perforated-face grilles. Air is pulled from these areas by the heat pump fan and returned to the air-handling unit for mixing with outside air and recirculation through the building. A three-quarter horsepower heat pump fan aids removal of building air during the economizing cycle.

Air from the corridor (room 115) leading to the CVDF transfer corridor, men's and women's change rooms (rooms 114 and 113), and men's and women's restrooms (rooms 112 and 111) is not collected for recirculation. Pressure differentials are used to direct airflow from the corridor toward the CVDF transfer corridor, reducing the potential for spread of contamination from CVDF process areas. A power roof ventilator draws ~ 800 ft^3/min of air from the restrooms and change rooms (rooms 111 through 114). The air is drawn through 10 in. by 10 in., surface-mounted exhaust registers and exhausted to the outside. Exhaust registers are equipped with opposed blade dampers.

An outside Air Sensor is set at ≤ 55 °F to activate the economizer cycle when air-conditioning is required. The power exhaust, HVAC-EXHF-8006 is energized to exit return air outside. Additional outside air enters through the air-handling unit.

4.1.4.2 Process Bay Recirculation HVAC System. The process bay recirculation HVAC systems normally operate continuously in automatic mode. Each recirculation HVAC system draws outside air from a location high on the west exterior of a process bay above the transfer corridor. The air is drawn in through a louver with a birdscreen and an isolation damper (HVAC-DMP-8*01). Position of the isolation damper coincides with the position of the process bay telescoping door. The isolation damper is closed when the bay telescoping door is open; this helps clean the air in the bays prior to closing the doors. The isolation dampers fail-closed upon loss of power to the facility.

After the isolation damper, the air stream passes through a volume damper and a backdraft damper (HVAC-DMP-*02) before blending with return air from the west end of the process bay. A manually controlled volume damper controls the quantity of return air. The combined air streams are mixed through the process bay's filter housing, which contains a pre-filter and two HEPA filter stages (HVAC-F-8*02); a CHW cooling coil (HVAC-CCL-8*03); and an electric heating coil (HVAC-HTR-8*04). A supply fan (HVAC-FAN-8*05) is the last system component before the conditioned air is dispersed at the east end of the bay.

4.1.4.3 Process Bay Local Exhaust HVAC and Process Vent System. The process bay local exhaust HVAC system normally operates continuously in automatic mode. The system exhausts ~4,830 ft^3/min to remove contaminated gases from process bay local exhaust hoods and the process vents. (H-1-82192) Confinement dampers (HVAC-DMP-8*03) are provided in process hood ducts to prevent cross-contamination between the various areas in the event of an exhaust system failure or when the system is not operating. A flow switch is located in each process bay local exhaust duct to monitor flow from each process hood. The switch is monitored by the ATC system and alarms when flow goes below 1,150 cfm. The exhaust is drawn through filter train HVAC-F-8040. The filter train includes two isolation dampers, one stage of pre-filters, two stages of HEPA filters (each stage is greater then 99.9 percent efficient), and three sections for HEPA filter testing. A fire screen/spark arrester and an airflow monitor (HVAC-AMS-8044) precede the filter bank. The exhaust gases are drawn through the system by centrifugal exhaust fans (HVAC-EXHF-8045 or HVAC-EXHF-8047) and discharged through the facility exhaust stack. Each of the exhaust fans can be isolated from the exhaust stream by one manual intake damper (HVAC-DMP-005 and HVAC-DMP-007) and a backdraft damper (HVAC-DMP-006 and HVAC-DMP-008).

4.1.4.4 Process General Supply/Exhaust HVAC System. The process general supply and exhaust systems normally operate continuously in automatic mode. The process general supply HVAC system draws outside air through an intake louver located on the west exterior wall of the second floor mechanical room and an isolation damper (HVAC-DMP-8001 and HVAC-DMP-8001B) into air handling unit HVAC-AHU-8002 at a rate of ~7200 ft^3/min. The air then passes through a 30 percent pre-filter, an 85 percent final filter (HVAC-F-8002), an electric preheat coil HVAC-HTR-8003, and CHW cooling coil HVAC-CCL-8004. The preheat and cooling coils condition the air to the desired exit temperature, between 10 °C (50 °F) to 11.1 °C (55 ° F). The air is then exhausted from the air handling unit at ~ 7200 ft^3/min through supply fan HVAC-FAN-8005. Motor starter MSTR-8005 controls the supply fan. Terminal heaters are provided to heat the air as it is supplied to the PWC tank room, mechanical room, transfer corridor, and transfer corridor rooms.

The process general exhaust HVAC system draws air from the CVDF process areas at a combined rate of ~11460 ft^3/min.(H-1-82194) This air stream is drawn from the PWC tank room, mechanical room, transfer corridor, transfer corridor rooms, and the process bays. Outside air for the system is provided through the intake louver located in the mechanical room and in-leakage due to negative pressure relative to the environment. Approximately 300 ft^3/min of outside air in-leakage occurs through the second floor mechanical room door. In-leakage to each process bay is ~600 ft^3/min and accounts for a portion of the air exhausted from the process bays by the process general exhaust HVAC system. Backdraft dampers located on the wall between the transfer corridor and the process bays allow ~250 ft^3/min of airflow from each transfer corridor room into the process bays. (H-1-82192)

This exhaust airflow rate is sufficient to maintain the desired process area negative pressures ranging from -0.10 in. water to -0.25 in. water. These negative pressures are provided to confine potential contamination. The pressures are such that airflow within the building moves from areas of lower potential contamination toward areas of higher potential contamination. The pressure differential instruments in each bay are interlocked through the ATC system to provide remote alarms.

Exhaust air ducts from the process bays and CVDF rooms are routed to a common exhaust duct. Flow through this duct is monitored by airflow measuring station HVAC-AMS-8024. The duct is routed to general exhaust filter HVAC-F-8020. The filter train includes two isolation dampers, one stage of pre-filters, two stages of HEPA filters (each stage is ≥99.9 percent efficient), and three sections for HEPA filter testing. The filtered air passes through manually operated damper HVAC-DMP-001 and through lead exhaust fan HVAC-EXHF-8025. The exhaust fan is controlled by variable frequency drive VFD-8025. The air then flows across backdraft damper HVAC-DMP-002 and pneumatically operated isolation damper HVAC-DMP-8026. The isolation damper is designed to fail closed, providing confinement of potential contamination. The air is then discharged to the exhaust stack.

In the event that the lead exhaust fan is not operating, a redundant (standby) exhaust train has been provided. The flow sequence and operation mode of the redundant exhaust train are identical to those of the lead train. The standby train includes manual damper HVAC-DMP-003, standby exhaust fan HVAC-EXHF-8027, variable speed drive VFD-8027, backdraft damper HVAC-DMP-004, and isolation damper HVAC-DMP-8028.

Supply fan HVAC-FAN-8005 and exhaust fans HVAC-EXHF-8025 and HVAC-EXHF-8027 are interlocked to prevent the supply fan from operating upon detection of exhaust fan failure. This is done to prevent CVDF process area loss of negative pressure that would occur if air supply continued without adequate air exhaust; the subsequent pressurization would result in loss of confinement. In addition to failure of an exhaust air fan, a signal from smoke detector XS-8005 downstream of air handling unit HVAC-AHU-8002 and a low temperature signal from temperature sensor TS-8005 on CHW cooling coil HVAC-CCL-8004 will trip the exhaust fan and activate the interlock.

A dedicated 3 ton air conditioning cools room 129 to remove the heat dissipation (maximum 30.437 BTU/hr) from the UPS system. HVAC-EVP-8003 circulates room air and rejects the heat to HVAC-CND-8003 located outside the building. (H-1-82193 & 82197).

4.1.4.5 Reference Air System. The reference air system allows atmospheric reference pressure to enter through RA-BAF-001. The reference air system consists of a main pipe header, eight branch reference air lines and 18 pressure differential transmitters. The atmospheric reference enters line RA-001-CT-2". In room 117, this line branches into RA-002-CT-½" and RA-003-CT-1". Line RA-003-CT-1" directs atmospheric reference to PDIT-8070 in the mechanical room (room 207). Line RA-002-CT-½" directs atmospheric reference to six additional pressure differential transmitters: PDIT-8074 (transfer corridor room 130), PDIT-8075 (transfer corridor room 127), PDIT-8076 (transfer corridor room 124), PDIT-8077 (transfer corridor room 121), PDIT-8078 (transfer corridor room 118), and PDIT-8079 (transfer corridor room 116). Additionally, RA-002-CT-½" directs air atmospheric reference to five other reference air lines: RA-001-CT-1", RA-201-CT-1", RA-301-CT-1", RA-401-CT-1", and RA-501-CT-1". Line RA-001-CT-1" directs atmospheric reference to PDIT-8080, which is located in the PWC tank room (room 132). Line RA-201-CT-1" directs reference air into PDIT-8220 in process bay 2 (room 128), line RA-301-CT-1" directs reference air into PDIT-8320 in process bay 3 (room 125), line RA-401-CT-1" directs reference air into PDIT-8420 in process bay 4 (room 122), and lastly, line RA-501-CT-1" directs reference air into process bay 5 (room 119).

4.1.5 System Reliability

The system reliability features for each of the HVAC and reference air systems are outlined below.

4.1.5.1 Administration Building HVAC System. The administration building HVAC system does not contain any redundant systems or components. The system is designed to accommodate 100 percent of the building heating/cooling requirements. The fail-safe operation of the system is to shut down.

4.1.5.2 Process Bay Recirculation HVAC System. The individual process bay recirculation HVAC systems do not contain any redundant components. At system shutdown from an operational accident or seismic event, outside isolation dampers HVAC-DMP-8*01 close and supply fans HVAC-FAN-8*05 stop.

4.1.5.3 Process Bay Local Exhaust HVAC and Process Vent System. The process bay local exhaust HVAC and process vent system contains redundant lead exhaust fan HVAC-EXHF-8045 and standby exhaust fan HVAC-EXHF-8047. In the event one fan goes down, the system will start the second fan and provide the operator with the information.

Standby power is provided to the process bay local exhaust HVAC and process vent system to allow re-establishing flow in the local exhaust system after a facility power loss. The local exhaust system restarts automatically on standby power on loss of normal power to the facility. Local exhaust bay isolation dampers that fail closed upon a loss of electrical power are each equipped with a safety-significant, 8.3 gal, compressed air reservoir to operate the damper during standby power operation.

4.1.5.4 Process General Supply/Exhaust HVAC System. The process general supply/exhaust HVAC system contains redundant lead exhaust fan HVAC-EXHF-8025 and standby exhaust fan HVAC-EXHF-8027. In the event one fan goes down, the system will start the second fan and provide the operator with the information. The exhaust fans and supply fan are interlocked to prevent the supply fan from operating upon detection of an exhaust air fan failure. The fan interlock prevents CVDF process area loss of negative pressure, which would occur if air supply continued without adequate air exhaust.

4.1.5.5 Reference Air System. The reference air system does not contain any redundant equipment.

4.1.6 System Control Features

4.1.6.1 System Monitoring. The ATC monitors the operating parameters and provides remote alarming in the control room for each system.

4.1.6.2 Control Capability and Locations

4.1.6.2.1 Administration Building HVAC System. The administration building HVAC system is locally controlled by a programmable thermostat. The thermostat is wall-mounted on the southern end of corridor 102, on the north wall.

4.1.6.2.2 Process Bay Recirculation HVAC System. The process bay recirculation HVAC systems are normally operated from the FCS-OWS located in the control room. Each process bay recirculation HVAC system has a "Hand-Off-Auto" (HOA) station located at each supply fan. The switch is placed in the "Auto" position for normal operations. When the supply fan HOA station is in the "Auto" position, the ATC system controls operation of the cooling water and electric heating coils to maintain temperatures within the bay. The "Hand" position is used for fan testing only. Temperature transmitter setpoints are listed in table 4-2.

4.1.6.2.3 Process Bay Local Exhaust HVAC and Process Vent System. The process bay local exhaust HVAC and process vent system has a HOA station located at each exhaust fan. The "Auto" position is used for normal operations. When the fan's HOA station is in the "Auto" position, the ATC system monitors and controls the exhaust system. The "Hand" position is used for fan testing only. The exhaust fans each have manual isolation dampers (HVAC-DMP-005 and HVAC-DMP-007) that must be open for proper operation of the system. Temperature transmitter setpoints are listed in table 4-2.

4.1.6.2.4 Process General Supply/Exhaust System. The process general supply/exhaust system has a HOA station located at each fan (supply and two exhaust fans) within the system. When the fan's HOA station is in the "Auto" position, the ATC system monitors and controls all parameters of the supply/exhaust system. The "Hand" position is used for fan testing only. The "Auto" position is used for normal operations. The exhaust fans have manual isolation dampers (HVAC-DMP-001 and HVAC-DMP-003) that must be open for proper operation of the system. Temperature transmitter setpoints are listed in table 4-2.

4.1.6.2.5 Reference Air System. The reference air system contains manual controls to place the system in operation. Each process bay contains a manual isolation valve for the reference air system. The valve must be open to allow atmospheric reference to pressure differential monitor in the process bay.

4.1.6.3 Automatic and Manual Actions. The ATC system provides automatic start and stop sequences to operate the HVAC systems without an operator controlling each individual fan motor and damper. This is the preferred method of operating the HVAC systems. The HVAC systems may also be operated manually. Manual control can be performed locally from Hand-Off-Auto switches or from the FCS-OWS. Software interlocks are bypassed by manual control. Hardwire interlocks are available during manual control.

4.1.6.3.1 Administration Building HVAC System. No operator actions are required for normal operations of the administration building HVAC system. The system is under automatic control for the building's heating and cooling needs. The control system automatically controls operation of the administration building HVAC system heat pump, economizer exhaust fan, and roof ventilators.

4.1.6.3.2 Process Bay Recirculation HVAC System. The operator activates the process bay recirculation HVAC systems from the FCS-OWS. System activation initiates an automatic start sequence that is controlled by the ATC system. Additional operator actions are not required for normal operation of the system. During normal system operation, the ATC system performs the following control functions automatically:

- The ATC system controls heating coil HVAC-HTR-8*04. The ATC system determines a leaving air temperature setpoint based on process bay temperature and modulates heat output from the heating coils to achieve the temperature setpoint.
- The ATC system controls cooling coil HVAC-CCL-8*03. The ATC system determines a leaving air temperature setpoint based on process bay temperature and controls the flow of

chilled water to the cooling coils by providing a signal to the temperature control valve TV-8*03.

- The ATC system modulates the outside air volume damper to maintain process bay negative pressure at the setpoint.

- The ATC system closes outside air damper HVAC-DMP-8*01 when the telescoping door is open. The damper is opened when the telescoping door is subsequently closed.

4.1.6.3.3 Process Bay Local Exhaust HVAC and Process Vent System. The operator activates the process bay local exhaust HVAC and process vent system from the FCS-OWS. System activation initiates an automatic start sequence that is controlled by the ATC system. Additional operator actions are not required for normal operation of the system. During normal system operation, the ATC system performs the following control functions automatically:

- The ATC system controls exhaust fan (HVAC-EXHF-8045 or HVAC-EXHF-8047) speed. During fan start, fan speed will slowly ramp-up to satisfy the control signal from the VFD. During fan operation, the control signal to the VFD will vary fan speed as necessary to maintain constant design airflow.

4.1.6.3.4 Process General Supply/Exhaust HVAC System. The operator activates the process general supply and exhaust HVAC system from the FCS-OWS. System activation initiates an automatic start sequence that is controlled by the ATC system. Additional operator actions are not required for normal operation of the system. During normal system operation, the ATC system performs the following control functions automatically:

- The ATC system controls exhaust fan (HVAC-EXHF-8025 or HVAC-EXHF-8027) speed. During fan start, fan speed will slowly ramp-up to satisfy the control signal from the VFD. During fan operation, the control signal to the VFD will vary fan speed as necessary to maintain constant design airflow.

- Preheat coil HVAC-HTR-8003 in the general supply air-handling unit AHU HVAC-AHU-8002 is controlled by the ATC system. Heat output is modulated to maintain outlet temperature above the specified minimum temperature identified in Section 4.1.6.4.

- The ATC system controls supply duct heaters HVAC-HTR-8010, HVAC-HTR-8011, HVAC-HTR-8012, HVAC-HTR-8013, and HVAC-HTR-8014 to maintain temperatures in the mechanical room, PWC tank room, transfer corridor, and transfer corridor rooms above the specified minimum temperatures identified in Section 4.1.6.4.

- Cooling coil HVAC-CCL-8004 in the general supply air-handling unit HVAC-AHU-8002 is controlled by the ATC system. Temperature control valve TV-8004 modulates to control the flow of chilled water to the cooling coils to maintain design temperature in the transfer corridor and temperatures in the mechanical room, PWC tank room, and transfer corridor rooms below the specified maximum temperatures identified in Section 4.1.6.4.

4.1.6.3.5 Reference Air System. No operator actions are required for normal operation of the reference air system.

4.1.6.4 Setpoints and Ranges

4.1.6.4.1 Administration Building HVAC System

Heat pump approximately 3,140 ft^3/min

HVAC-HTP-8001 1.25 in w.g external static pressure at sea level
3.0 HP, 480 V/3-ph /60 Hz motor
Cooling Capacity:
Entering air temperature: 27.9 °C (82.2 °F) db, 16.9 °C
(62.5 °F) wb
Leaving air temperature: 12.8 °C (55.0 °F) db, 11.1 °C
(52.0 °F) wb
Heating Capacity:
Entering air temperature: 10.8 °C (51.4 °F) db
Leaving air temperature: 18.9 °C (66.1 °F) db

Exhaust fan 3/4 HP, 480V/1-ph /60Hz motor

HVAC-EXHF-8006

Power roof ventilator approximately 800 ft^3/min

HVAC-EXHF-8005 0.75 in w.g.
3/4 HP, 480V/3-ph /60Hz motor

Building setpoints:

Temperature setpoint	23.9 °C (75 °F) cooling
General building areas	22.2 °C (72 °F) heating
Temperature setpoint	23.9 °C (75 °F) cooling
Restrooms/change rooms	23.9 °C (75 °F) heating
Pressure setpoint	Low: +0.01 in. w.g.
PDI 8079	

4.1.6.4.2 Process Bay Recirculation HVAC System. The following system parameters and setpoints apply to each process bay recirculation system.

Supply fan: approximately 5,400 ft^3/min see H-1-82192 for start-up values
8.0 in. w.g. static pressure
15 HP, 480V/3-ph /60 Hz motor

Cooling coil: approximately 5,400 ft^3/min see H-1-82192 for start-up values
116,000 Btu/h

Entering air temperature: 26.7 °C (80.1 °F) db, 16.4 ° C (61.6 °F) wb
Leaving air temperature: 15.7 °C (60.2 °F) db, 12.3 ° C (54.1 °F) wb

Heating coil: approximately 5,400 ft^3/min see H-1-82192 for start-up values
161,700 Btu/h
47.4 kW, 480V/3-ph/60 Hz
Entering air temperature: 13.8 °C (56.8 °F)
Leaving air temperature: 29.4 °C (85.0 °F)

Bay temperature setpoint: 23.9 °C (75 °F) cooling
22.2 °C (72 °F) heating

Filter alarms:

Pre-filter	High: 1.0 in. water gage High-high: 1.5 in water gage
First HEPA	High: 3.0 in. water gage High-high: 4.0 in water gage
Second HEPA	High: 2.0 in. water gage High-high: 3.0 in water gage

4.1.6.4.3 Process Bay Local Exhaust HVAC and Process Vent System. Normal flow rate through the filter bank is approximately 4830 ft^3/min, see H-1-82194 for start-up values. Filters are changed when a contact radiation level of 70 mrem/h is reached on the filter housing.

Filter alarms:

Pre-filter	High: 1.0 in. water gage High-high: 1.5 in water gage
First HEPA	High: 3.0 in. water gage High-high: 4.0 in water gage
Second HEPA	High: 2.0 in. water gage High-high: 3.0 in water gage

4.1.6.4.4 Process General Supply/Exhaust HVAC System. Air handling unit HVAC-AHU-8002.

Supply fan: approximately 8750 ft^3/min see H-1-82194 for start-up values
4.0 in. w.g. static pressure
10.0 HP, 480V/3-ph/60 Hz motor

Cooling coil:	376 MBH (113kW) Entering air temperature: 36.1 °C (97 °F) db, 19.4 °C (67 °F) wb Leaving air temperature: 15 °C (59 °F) db, 11.1 °C (52 °F) wb
Heating coil:	385 MBH (113 kw) Entering air temperature: -12.8 °C (9 °F) Leaving air temperature: 10 °C (50 °F)

Zone Terminal Heating Coils

HVAC-HTR-8010 Mechanical room North	approximately 1,575 ft^3/min 58.5 MBH (17.2 kW) 480V/3-ph /60 Hz Setpoint 29.4 °C (85 °F)
HVAC-HTR-8011 Mechanical room SOUTH	approximately 2,625 ft^3/min 97.5 MBH (28.6 kw) 480V/3-ph/60 Hz Setpoint 29.4 °C (85 °F)
HVAC-HTR-8012 Transfer corridor ROOMS	approximately 1,540 ft^3/min 65.8 MBH (17.9 kw) 480V/3-ph/60 Hz Setpoint 31.5 °C (88.8 °F)
HVAC-HTR-8013 Transfer corridor	1,780 ft^3/min 61.3 MBH (19.4 kw) 480V/3-ph/60 Hz Setpoint 29.4 °C (85 °F)
HVAC-HTR-8014 PWC room	1,230 ft^3/min 45.7 MBH (13.4 kw) 480V/3-ph/60 Hz Setpoint 29.4 °C (85 °F)

Room 129 Air conditioner (H-1-82197)

HVAC-EVP-8003	1250 CFM @ 0.3 inch wg Ceiling mount 208V 1 ph/60 Hz
HVAC-CND-8003	Nominal 3 Tons 208V 1 ph/60 Hz

General Exhaust Fans

HVAC-EXHF-8025 approximately 12,400 ft^3/min ea. see H-1-82194 for start-up values

12.0 in. w.g. static pressure
30 HP, 480V/3-ph/60 Hz
Class II

HVAC-EXHF-8027 approximately 12,400 ft^3/min ea. see H-1-82194 for start-up values

12.0 in. w.g. static pressure
30 HP, 480V/3-ph/60 Hz
Class II

Filter alarms:

Supply pre-filter	High: 1.0 in. water gage
Supply final filter	High: 1.5 in. water gage
Exhaust Pre-filter	High: 1.0 in. water gage High-high: 1.5 in water gage
Exhaust First HEPA	High: 3.0 in. water gage High-high: 4.0 in water gage
Exhaust Second HEPA	High: 2.0 in. water gage High-high: 3.0 in water gage

4.1.6.4.5 Reference Air System. The reference air pressure differential transmitter setpoints are listed in Table 4-1.

Table 4-1. Pressure Differential Transmitter Setpoints

Pressure differential Indicating Transmitter	Room Number	Room Design Space Pressure Relative to Atmosphere (inch w.g.)	Alarm points: High and Low (inch w.g.)
PDIT-8070	Mechanical room (Room 207)	-0.10	High: -0.05 Low: -0.15
PDIT-8073	Room 116	-0.10	High: -0.05 Low: -0.15
PDIT-8074	Room 130	-0.15	High: -0.10 Low: -0.20
PDIT-8075	Room 127	-0.15	High: -0.10 Low: -0.20
PDIT-8076	Room 124	-0.15	High: -0.10 Low: -0.20
PDIT-8077	Room 121	-0.15	High: -0.10 Low: -0.20
PDIT-8078	Room 118	-0.15	High: -0.10 Low: -0.20
PDIT-8079	Room 115	+0.01	High: ------- Low: +0.01
PDIT-8080	PWC tank room (room 132)	-0.25	High: -0.20 Low: -0.30
PDIT-8220	Process bay 2 (room 128)	-0.20	High: -0.15 Low: -0.25
PDIT-8320	Process bay 3 (room 125)	-0.20	High: -0.15 Low: -0.25
PDIT-8420	Process bay 4 (room 122)	-0.20	High: -0.15 Low: -0.25
PDIT-8520	Process bay 5 (room 119)	-0.20	High: -0.15 Low: -0.25

Table 4-2. Temperature Transmitter Setpoints

Temperature Transmitter	Exhaust System Interface	Room	Alarm Points: High and Low (°F)
TT-8010	General supply	Mechanical room (room 207)	High: 85 Low: 72
TT-8011	General supply	Mechanical room (room 207)	High: 85 Low: 72
TT-8012	General supply	room 121	High: 75 Low: 72
TT-8013	General supply	Transfer corridor (room 116)	High: 75 Low: 72
TT-8014	General supply	PWC tank room (room 132)	High: 75 Low: 72
TT-8204	Process bay local	Process bay 2 (room 128)	High: 75 Low: 72
TT-8304	Process bay local	Process bay 3 (room 125)	High: 75 Low: 72
TT-8404	Process bay local	Process bay 4 (room 122)	High: 75 Low: 72
TT-8504	Process bay local	Process bay 5 (room 119)	High: 75 Low: 72

4.1.6.5 Interlocks, Bypasses, and Permissives.

All interlocks summarized in this section are implemented by the ATC system unless specifically identified as hardwire interlock. Manual operation of systems, either from the FCS-OWS or from the local HOA stations, bypasses ATC interlocks. Hardwire interlocks are implemented regardless of the mode of operation.

4.1.6.5.1 Administration Building HVAC System. Interlocks for the administrative building HVAC system are summarized below:

- The heat pump (HVAC-HTP-8001) supply fan is interlocked with roof exhauster HVAC-EXHF-8005 such that exhauster operates when the supply fan is operating. This is a hardwire interlock between the exhauster and flow switch HVAC-FS-8005 in the supply duct.

- Heat pump HVAC-HTP-8001 and roof exhauster HVAC-EXHF-8005 are hardwire interlocked to shutdown when smoke is detected in the supply duct.

4.1.6.5.2 Process Bay Recirculation HVAC System. Interlocks for the process bay recirculation HVAC systems are summarized below. Permissives are discussed in Section 4.2.2.2.

- Process bay outside air damper HVAC-DMP-8*01 is hardwire interlocked to supply fan pressure differential switch PDIS-8*05. The damper will close when fan pressure differential is less than the setpoint of the pressure differential switch.

- Process bay outside air damper HVAC-DMP-8*01 will close when the process bay roll-up door is open. The damper will reopen when the roll-up door is subsequently closed.

- Process bay outside air damper HVAC-DMP-8*01 will close when general exhaust fan HVAC-EXHF-8025 or HVAC-EXHF-8027 pressure differential is less than the setpoint of the exhaust fan pressure differential switch.

- Process bay outside air damper HVAC-DMP-8*01 will close when local exhaust fan HVAC-EXHF-8045 or HVAC-EXHF-8047 pressure differential is less than the setpoint of the exhaust fan pressure differential switch.

- Process bay outside air damper HVAC-DMP-8*01 will close when local exhaust isolation damper HVAC-DMP-8*03 is not fully open.

- Process bay outside air damper HVAC-DMP-8*01 will close when general exhaust isolation damper HVAC-DMP-8*02 is not fully open.

- Process bay outside air damper HVAC-DMP-8*01 will close and supply fan HVAC-FAN-8*05 will stop when smoke detector XS-8*05 detects smoke in the process bay. The supply fan motor starter is hardwire interlocked to the fire alarm and control panel.

- Process bay supply fan HVAC-FAN-8*05 will stop when a high-high pressure differential condition exists across the pre-filter or HEPA filters in filter housing HVAC-F-8*02.

4.1.6.5.3 Process Bay Local Exhaust HVAC and Process Vent System. Interlocks for the process bay local exhaust HVAC and process vent system are summarized below. Permissives are discussed in Section 4.2.2.3.

- An automatic start sequence after electric power (standby) is restored following a loss of normal electric power. A local exhaust fan will restart and the process bay isolation damper will reopen, re-establishing flow in the local exhaust system within 1 minute of the loss of normal electric power.

- Standby local exhaust fan HVAC-EXHF-8047 will start upon failure of lead local exhaust fan HVAC-EXHF-8045.

- Process bay isolation dampers HVAC-DMP-8*03 will close when smoke detector XS-8*05 detects smoke in the process bay.

- Process bay isolation dampers HVAC-DMP-8*03 will close when the operating exhaust fan (HVAC-EXHF-8045 or HVAC-EXHF-8047) pressure differential is less than the setpoint of the fan pressure differential switch (PDIS-8045 or PDIS-8047).

- The operating local exhaust fan (HVAC-EXHF-8045 or HVAC-EXHF-8047) will stop if fan suction pressure is greater (more negative) than the setpoint (-10 inches w.g.) of pressure switch PSL-8049.

- The operating local exhaust fan (HVAC-EXHF-8045 or HVAC-EXHF-8047) will stop if the temperature or the rate of temperature increase in the exhaust duct exceeds the setpoint (190 °F or 30 °F increase within 10 seconds) of heat detector XS-8040.

- The operating local exhaust fan (HVAC-EXHF-8045 or HVAC-EXHF-8047) will stop when a high-high pressure differential condition exists across the pre-filter or HEPA filters in filter housing HVAC-F-8040.

4.1.6.5.4 Process General Supply/Exhaust HVAC System. Interlocks for the process general supply and exhaust HVAC systems are summarized below. Permissive are discussed in Section 4.2.2.4.

- General supply fan HVAC-FAN-8005 will shutdown if general exhaust system flow rate is less than or equal to the low flow setpoint as measured by air monitoring station AMS-~~8007~~.

- General supply fan HVAC-FAN-8005 will shutdown if general exhaust fan HVAC-EXHF-8025 or HVAC-EXHF-8027 pressure differential is less than or equal to the setpoint for the fan pressure differential switch (PDIS-8025 or PDIS-8027 respectively). This interlock is hardwired from the supply fan motor starter and the exhaust fan pressure differential switches.

- General supply fan HVAC-FAN-8005 is hardwire interlocked with temperature switch TS-8005. The supply fan will shutdown if cooling coil HVAC-CCL-8004 inlet temperature is less than or equal to the setpoint (40 °F) of temperature switch TS-8005.

- General supply fan HVAC-FAN-8005 will shutdown if smoke detector XS-8005 detects smoke in the supply duct downstream of the supply fan. This is a hardwire interlock between the fire alarm and control panel and the supply fan motor starter.

- General supply fan HVAC-FAN-8005 will shutdown if outside air isolation dampers HVAC-DMP-8001 and HVAC-DMP-8001B are not fully open. This is a hardwire interlock between the dampers and the supply fan.

- Outside air isolation dampers HVAC-DMP-8001 and HVAC-DMP-8001B are hardwire interlocked to general supply fan HVAC-FAN-8005. The dampers will open when the fan is energized and close when the fan is not energized.

- Outside air isolation dampers HVAC-DMP-8001 and HVAC-DMP-8001B will close if cooling coil HVAC-CCL-8004 inlet temperature is less than or equal to the setpoint (40 °F) of temperature switch TS-8005.

- Outside air isolation dampers HVAC-DMP-8001 and HVAC-DMP-8001B will close if smoke detector XS-8005 detects smoke in the supply duct downstream of the supply fan.

- The operating general exhaust fan (HVAC-EXHF-8025 or HVAC-EXHF-8027) will shutdown if its respective fan isolation damper (HVAC-DMP-8026 or HVAC-DMP-8028) is not fully open. This is a hardwire interlock between the damper and the fan VFD.

- The operating general exhaust fan (HVAC-EXHF-8025 or HVAC-EXHF-8027) will shutdown if fan suction pressure is greater (more negative) than the setpoint (-10 inches w.g.) of pressure switch PSL-8029.

- The operating general exhaust fan (HVAC-EXHF-8025 or HVAC-EXHF-8027) will shutdown if the temperature or the rate of temperature increase in the exhaust duct exceeds the setpoint (190 °F or 30 °F increase within 10 seconds) of heat detector XS-8020.

- The operating general exhaust fan (HVAC-EXHF-8025 or HVAC-EXHF-8027) will stop when a high-high pressure differential condition exists across the pre-filter or HEPA filters in filter housing HVAC-F-8020.

- Standby general exhaust fan HVAC-EXHF-8027 will start if lead general exhaust fan HVAC-EXHF-8025 pressure differential is less than or equal to the setpoint of pressure differential switch PDIS-8025 or general exhaust system flow rate is less than or equal to the low flow setpoint as measured by air monitoring station AMS-8024.

- Process bay isolation dampers HVAC-DMP-8*02 will close when smoke detector XS-8*05 detects smoke in the process bay.

- Process bay isolation dampers HVAC-DMP-8*02 will close when the operating exhaust fan (HVAC-EXHF-8025 or HVAC-EXHF-8027) pressure differential is less than the setpoint of the fan pressure differential switch (PDIS-8025 or PDIS-8027).

- Isolation dampers HVAC-DMP-8015, HVAC-DMP-8016, HVAC-DMP-8017, HVAC-DMP-8018, and HVAC-DMP-8019 will close when the operating exhaust fan (HVAC-EXHF-8025 or HVAC-EXHF-8027) pressure differential is less than the setpoint of the fan pressure differential switch (PDIS-8025 or PDIS-8027).

4.1.6.5.5 Reference Air System. Not applicable.

4.2 Operations

4.2.1 Initial Configurations

4.2.1.1 Administration Building HVAC System. There are no initial configurations identified for the administration building HVAC system.

4.2.1.2 Process Bay Recirculation HVAC System. The process bay recirculation HVAC systems have been manually balanced to achieve a fixed supply airflow rate of a minimum of 5,400 cfm; a maximum of 1300 cfm of outside air and a fixed return rate of ~4,100 cfm. (H-1-82192)

The initial configuration for the process bay recirculation HVAC system includes outside air isolation damper HVAC-DMP-8*01 in its fail-closed position and supply fan HVAC-FAN-8*01 is off. Normal electrical power is available. The CHW and compressed and instrument air systems are operating normally. There is adequate capacity in condensate collection tank CNDS-TK-410*. The process bay local exhaust HVAC and process vent system and the process general supply/exhaust system are operating prior to staring the process bay recirculation HVAC system. Additional initial conditions will be identified in system operating procedures.

4.2.1.3 Process Bay Local Exhaust HVAC and Process Vent System. The process bay local exhaust HVAC and process vent system and exhaust fans HVAC-EXHF-8045 and HVAC-EXHF-8047 have been manually balanced to achieve the design airflow rate of ~4805 cfm.(H-1-82194)

The initial configuration for the process bay local exhaust HVAC and process vent system includes the following conditions: process bay isolation dampers HVAC-DMP-8*03 in fail-closed positions, exhaust fans HVAC-EXHF-8045 and HVAC-EXHF-8047 are off, fan suction dampers HVAC-DMP-005 and HVAC-DMP-007 are open, and process vent isolation valves PV-SOV-*312 are closed. Normal and standby electrical power is available. The compressed and instrument air system is operating normally. Additional initial conditions will be identified in system operating procedures.

4.2.1.4 Process General Supply/Exhaust HVAC System. General supply fan HVAC-FAN-8005 and the supply air distribution system has been balanced to achieve the design airflow rate of ~7205 cfm.(H-1-82194) The general exhaust air system has been manually balance to achieve the design airflow rate from each area, totaling ~11,640 cfm.(H-1-82194)

The initial configuration for the process general exhaust system includes the following conditions: isolation dampers HVAC-DMP-8*02 and HVAC-DMP- 8015 through 8019 dampers in fail-closed positions, exhaust fans HVAC-EXHF-8025 and HVAC-EXHF-8027 are off, fan isolation dampers HVAC-DMP-001 and HVAC-DMP-003 are open, and fan isolation dampers HVAC-DMP-8026 and HVAC-DMP-8028 in fail-closed position. The initial configuration for the process general supply HVAC system includes the following conditions: outside air dampers HVAC-DMP-8001 and HVAC-DMP-8001B in fail-closed positions, PWC tank room isolation damper HVAC-DMP-8035 in the fail-closed position, supply fan HVAC-FAN-8005 is off, and the process general exhaust system is operating. Normal electrical power is available. The compressed and instrument air system is operating normally. Additional initial conditions will be identified in system operating procedures.

4.2.1.5 Reference Air System. The initial configuration for the reference air system include isolation valves RA-V-005, RA-V-201, RA-V-301, RA-V-401, and RA-V-501 are open; drain valve RA-V-001 is closed, and the calibration ball valves at each pressure differential transmitter are open. Normal electrical power is available. Additional initial conditions will be identified in system operating procedures.

4.2.2 System Startup

The CVDF process area HVAC systems are started individually from the FCS-OWS. The HVAC systems should be started in the following sequence during a normal startup: the process bay local exhaust HVAC system, process general exhaust system, process general supply system, and then each process bay recirculation HVAC system. This sequence will ensure that airflow within the CVDF is from areas with lower contamination potential to areas of higher contamination potential. The administration building HVAC system maintains the administration building at a positive pressure with respect to the process areas and may be started without regard for the sequence of starting the process HVAC systems.

4.2.2.1 Administration Building HVAC System. The administration building HVAC system is started from the control panel mounted on the heat pump/air-handling unit. The ATC system does not monitor or control the administration building HVAC system.

4.2.2.2 Process Bay Recirculation HVAC System. Each process bay recirculation HVAC system is started automatically by the ATC system when the operator issues a start command for that particular system. When a start command is received, the ATC system will verify permissive conditions are satisfied and then start supply fan HVAC-FAN-8*05 and open outside air isolation damper HVAC-DMP-8*01. Permissive conditions for the process bay recirculation HVAC system are identified in Table 4-3.

Table 4-3. Process Bay Recirculation HVAC Permissive Conditions

Process Bay Outside Air Damper HVAC-DMP-8*01	
Open Permissives	
• Process bay smoke detector XS-8*05 not activated	
• Process bay personnel door closed	
• Process bay roll-up door closed	
• Process bay supply fan operating (PDIS-8*05 closed contacts)	
• General exhaust fan operating (PDIS-8025 or PDIS-8027 contacts closed)	
• Local exhaust fan operating (PDIS-8045 or PDIS-8047 contacts closed)	
• Process bay general exhaust damper HVAC-DMP-8*02 open	
• Process bay local exhaust damper HVAC-DMP-8*03 open	
Process Bay Supply Fan HVAC-FAN-8*05	
Start Permissives	**Run Permissives**
• HOA switch in Auto	• HOA Switch in Auto
• Smoke detector XS-8*05 not activated (hardwire interlock)	• Smoke detector XS-8*05 not activated (hardwire interlock)
• Operator initiated Start command	• Filter (HVAC-F-8*02) high-high pressure differential alarm not activated.
	• No operated initiated Stop command

4.2.2.3 Process Bay Local Exhaust HVAC and Process Vent System. The local exhaust system is started automatically by the ATC system when the operator issues a start command. When a start command is received, the ATC system will verify permissive conditions are satisfied and then open exhaust dampers HVAC-DMP-8*03 start lead exhaust fan HVAC-EXHF-8045. Permissive conditions for the process bay local exhaust HVAC and process vent system are identified in Table 4-4. If the lead fan fails to start, standby exhaust fan HVAC-EXHF-8047 will start when permissive conditions are satisfied.

An adjustable time delay is provided to bypass the damper HVAC-DMP-8*03 open permissive that requires exhaust fan pressure differential to be greater than or equal to the PDIS-8045/8047 setpoint. This time delay allows starting the exhaust fan with the dampers open. The time delay will be adjusted based on field tests. After the time delay has expired, dampers HVAC-DMP-8*03 will close if exhaust fan pressure differential is less than the PDIS-8045/8047 setpoint.

Table 4-4. Local Exhaust HVAC and Process Vent System Permissive Conditions

Lead Local Exhaust Fan HVAC-FAN-8045	
Start Permissives	**Run Permissives**
• HOA switch in Auto	• HOA Switch in Auto
• No VFD faults	• No VFD faults
• Exhaust fan suction pressure low alarm PAL-8049 not activated.	• Exhaust fan suction pressure low alarm PAL-8049 not activated.
• Temperature alarm high TAH-8040 not activated	• Temperature alarm high TAH-8040 not activated

• Operator initiated Start command	• Filter (HVAC-F-8040) high-high pressure differential alarm not activated.
	• No operated initiated Stop command
Standby Local Exhaust Fan HVAC-FAN-8047	
Start Permissives	**Run Permissives**
• HOA switch in Auto	• HOA Switch in Auto
• No VFD faults	• No VFD faults
• Exhaust fan suction pressure low alarm PAL-8049 not activated.	• Exhaust fan suction pressure low alarm PAL-8029 not activated.
• Temperature alarm high TAH-8040 not activated.	• Temperature alarm high TAH-8040 not activated.
• Operator initiated Start command.	• Filter (HVAC-F-8040) high-high pressure differential alarm not activated.
• Lead local exhaust fan Fail-to-Start alarm activated.	• No operated initiated Stop command.
Process Bay Exhaust Dampers HVAC-DMP-8*03	
Open Permissives	
• Local exhaust fan operating (PDIS-8045 or PDIS-8047 contacts closed). An adjustable time delay bypasses this permisssive to allow starting the exhaust fan with the damper open.	
• Process bay smoke detector XS-8*05 not activated	

4.2.2.4 Process General Supply/Exhaust HVAC System. The general supply and exhaust systems are started automatically by the ATC system when the operator issues a start command. When a start command is received, the ATC system will verify permissive conditions are satisfied and then open exhaust isolation dampers HVAC-DMP-8*02, HVAC-DMP-8015, HVAC-DMP-8016, HVAC-DMP-8017, HVAC-DMP-8018, and HVAC-DMP-8019; open fan isolation damper HVAC-DMP-8026; and start lead exhaust fan HVAC-EXHF-8025. Permissive conditions for the process general supply and exhaust system are identified in Tables 4-5 and 4-6. If the lead exhaust fan fails to start, standby exhaust fan HVAC-EXHF-8027 will start and damper HVAC-DMP-8028 will open when permissive conditions are satisfied.

An adjustable time delay is provided to bypass the open permissive for the exhaust isolation dampers that requires exhaust fan pressure differential to be greater than or equal to the PDIS-8025/8027 setpoint. This time delay allows starting the exhaust fan with the dampers open. The time delay will be adjusted based on field tests. After the time delay has expired, the dampers will close if exhaust fan pressure differential is less than the PDIS-8025/8027 setpoint.

The ATC system will check general supply fan start permissive conditions 10 minutes after starting the general exhaust fan. If the start conditions are satisfied, the ATC system will open supply fan dampers HVAC-DMP-8001 and HVAC-DMP-8001B and start general supply fan HVAC-FAN-8005. Tank room supply damper HVAC-DMP-8035 will open when open permissive conditions are satisfied.

A normal startup of the process general supply HVAC system is performed automatically after startup of the process general exhaust system. However, a process general supply HVAC system restart would be necessary if a fault or failure causes the system to stop operating while the process general exhaust system is operating. This may occur if one or more of the run permissive conditions for supply fan HVAC-FAN-8005 are not satisfied. The operator may activate the automatic restart sequence for the general supply system by depressing a video pushbutton at the operator workstation. This pushbutton is only available if the process general supply is not operating while the process general exhaust system is operating.

Table 4-5. General Exhaust System Permissive Conditions

Lead General Exhaust Fan HVAC-EXHF-8025	
Start Permissives	**Run Permissives**
• HOA switch in Auto	• HOA Switch in Auto
• No VFD faults	• No VFD faults
• Exhaust fan suction pressure switch PSL-8029 contacts closed.	• Exhaust fan suction pressure switch PSL-8029 contacts closed.
• Heat detector XS-8020 contacts closed.	• Heat detector XS-8020 contacts closed.
• Operator initiated Start command	• No operated initiated Stop command
• Damper HVAC-DMP-8026 open	• Damper HVAC-DMP-8026 open
	• Filter (HVAC-F-8020) high-high pressure differential alarm not activated.
Standby General Exhaust Fan HVAC-EXHF-8027	
Start Permissives	**Run Permissives**
• HOA switch in Auto	• HOA Switch in Auto
• No VFD faults	• No VFD faults
• Exhaust fan suction pressure switch PSL-8029 contacts closed.	• Exhaust fan suction pressure switch PSL-8029 contacts closed.
• Heat detector XS-8020 contacts closed.	• Heat detector XS-8020 contacts closed.
• Operator initiated Start command	• No operated initiated Stop command
• Lead general exhaust fan Fail-to-Start alarm activated	• Damper HVAC-DMP-8028 open
• Damper HVAC-DMP-8028 open	• Filter (HVAC-F-8020) high-high pressure differential alarm not activated.
General Exhaust Dampers HVAC-DMP-801*	
Open Permissive	
• General exhaust fan operating (PDIS-8025 or PDIS-8027 contacts closed). An adjustable time delay bypasses this permisssive to allow starting the exhaust fan with the damper open.	
General Exhaust Dampers HVAC-DMP-8*02 (Process Bays)	
Open Permissives	
• General exhaust fan operating (PDIS-8025 or PDIS-8027 contacts closed). An adjustable time delay bypasses this permisssive to allow starting the exhaust fan with the damper open.	
• Process bay smoke detector XS-8*05 not activated	

Table 4-6. General Supply HVAC System Permissive Conditions

General Supply Fan HVAC-FAN-8005	
Start Permissives	**Run Permissives**
• HOA switch in Auto	• HOA Switch in Auto

• Motor overload relay not tripped	• Motor overload relay not tripped
• General exhaust fan operating (PDIS-8025 or PDIS-8027 contacts closed; hardwire interlock)	• General exhaust fan operating (PDIS-8025 or PDIS-8027 contacts closed; hardwire interlock)
• General exhaust low flow alarm FAL-8024 not activated.	• General Exhaust Low Flow Alarm FAL-8024 not activated.
• Dampers HVAC-DMP-8*02 open.	• Inlet supply dampers HVAC-DMP-8001 and HVAC-DMP-8001B open.
• Dampers HVAC-DMP-8015, HVAC-DMP-8016, HVAC-DMP-8017, HVAC-DMP-8018, and HVAC-DMP-8019 are open.	• Dampers HVAC-DMP-8015, HVAC-DMP-8016, HVAC-DMP-8018, and HVAC-DMP-8019 are open.
• General supply smoke detector XS-8005 not activated (hardwire interlock)	• General supply smoke detector XS-8005 not activated (hardwire interlock)
• Cooling coil low temperature switch TS-8005 not tripped (hardwire interlock)	• Cooling coil low temperature switch TS-8005 not tripped (hardwire interlock)
• 10 minute time delay satisfied (from exhaust fan run confirmation)	• No operated initiated Stop command.
• Operator initiated Start command for General Exhaust/Supply System or Restart command for General Supply System	
Tank Room Supply Damper HVAC-DMP-8035	
Open Permissives	
• General Supply HVAC-FAN-8005 started.	
• General Supply Low Flow Alarm FAL-8007 is not activated.	
• Tank Room Exhaust Damper HVAC-DMP-8017 is open.	

4.2.2.5 Reference Air System. The reference air system is ready to support operations when the initial configuration conditions have been established.

4.2.3 Normal Operations

During normal operations, each of the CVDF HVAC systems is operating. The ATC system provides automatic start and stop sequences to operate the HVAC systems without an operator controlling each individual fan motor and damper. This is the preferred method of operating the HVAC systems. The operator interface with the ATC system is through an operator workstation.

The primary operator workstation is personal computer located in the control room (room 107). A portable personal computer can be connected to one of the ATC system PLCs and used as a temporary workstation. The portable workstation is used primarily for maintenance activities.

4.2.4 Off-Normal Operations

4.2.4.1 Administration Building HVAC System. The administration building HVAC system will shutdown on a loss of normal electric power. The administration building HVAC system will not restart on standby power.

4.2.4.2 Process Bay Recirculation HVAC System. A loss of normal electric power will cause the process bay recirculation HVAC systems to shutdown. Outside air dampers HVAC-DMP-8*01 will reposition to their fail-closed positions. Supply fan HVAC-FAN-8*05 will stop. The process bay recirculation HVAC system will not restart on standby power.

4.2.4.3 Process Bay Local Exhaust HVAC and Process Vent System. Initially, a loss of normal electric power will cause the process bay local exhaust HVAC and process vent system to shutdown. The operating local exhaust fan (HVAC-EXHF-8045 or HVAC-EXHF-8047) will stop. Process bay isolation dampers HVAC-DMP-8*03 will reposition to its fail-closed positions. Process vent isolation valves PV-SOV-*312 will reposition to their fail-closed positions.

The process bay local exhaust HVAC and process vent system will automatically restart within one minute on standby electric power to restore process bay pressure differential. The standby power system provides restart circuits and hardwire connections to the local exhaust HVAC system. Process bay isolation dampers HVAC-DMP-8*03 will open when standby power is available to the solenoid-operating valves (SOV-8*03) that supply compressed air to the damper actuators. A compressed air reservoir is provided for each damper to ensure compressed air is available to operate the dampers. Lead local exhaust fan HVAC-EXHF-8045 will automatically restart when standby power is available. Standby local exhaust fan HVAC-EXHF-8047 will automatically restart on standby power if the lead fan fails to start.

4.2.4.4 Process General Supply/Exhaust HVAC System. A loss of normal electric power will cause the process general supply and exhaust HVAC systems to shutdown. General supply fan HVAC-FAN-8005 will stop. Outside air dampers HVAC-DMP-8001 and HVAC-DMP-8001B will reposition to their fail-closed positions. Tank room supply damper HVAC-DMP-8035 will reposition to its fail-closed position. The operating general exhaust fan (HVAC-EXHF-8025 or HVAC-EXHF-8027) will stop and the associated fan isolation damper (HVAC-DMP-8026 or HVAC-DMP-8028) will reposition to its fail-closed position. Exhaust isolation dampers HVAC-DMP-8*02, HVAC-DMP-8015, HVAC-DMP-8016, HVAC-DMP-8017, HVAC-DMP-8018, and HVAC-DMP-8019 will reposition to their fail-closed positions. The process general supply and exhaust HVAC systems do not restart on standby power.

4.2.4.5 Reference Air System. A loss of normal electric power will cause the reference air system pressure differential transmitters to deenergize.

4.2.5 System Shutdown

The CVDF HVAC systems are shutdown individually from the FCS-OWS. The HVAC systems should be shutdown in the following sequence during a normal shutdown: each process bay recirculation HVAC system, process general supply system, process general exhaust system, and then the process bay local exhaust HVAC system. This sequence will ensure that airflow within the CVDF is from areas with lower contamination potential to areas of higher contamination potential. Although the administration building HVAC is expected to be operating continuously, the system may be shutdown without regard for the sequence of stopping the process HVAC systems.

4.2.5.1 Administration Building HVAC System. The administration building HVAC system may be shutdown from the control panel mounted on the heat pump/air-handling unit.

4.2.5.2 Process Bay Recirculation HVAC System. Each process bay recirculation HVAC system is shutdown automatically by the ATC system when the operator issues a stop command for that particular system. When a stop command is received, the ATC system will stop supply fan HVAC-FAN-8*05. Outside air isolation damper HVAC-DMP-8*01 will close when the open permissive conditions (fan pressure differential is below the PDIT-8*05 setpoint) are not satisfied.

4.2.5.3 Process Bay Local Exhaust HVAC and Process Vent System. The local exhaust system is shutdown automatically by the ATC system when the operator issues a stop command. When a stop command is received, the ATC system will stop the operating local exhaust fan (HVAC-EXHF-8045 or HVAC-EXHF-8047). Process bay local exhaust dampers HVAC-DMP-8*03 will then close when exhaust fan pressure differential is below the setpoint of the fan pressure differential switch (PDIT-8045 or PDIT-8047).

4.2.5.4 Process General Supply/Exhaust HVAC System. The general supply and exhaust systems are shutdown automatically by the ATC system when the operator issues a stop command. When a stop command is received, the ATC system will stop general supply fan HVAC-FAN-8005 and close outside air dampers HVAC-DMP-8001 and HVAC-DMP-8001B and tank room supply damper HVAC-DMP-8035 after an adjustable time delay. The operating general exhaust fan (HVAC-EXHF-8025 or HVAC-EXHF-8027) will stop and the fan isolation damper (HVAC-DMP-8026 or HVAC-DMP-8028) will close after an adjustable time delay. Isolation dampers HVAC-DMP-8*02, HVAC-DMP-8015, HVAC-DMP-8016, HVAC-DMP-8017, HVAC-DMP-8018, and HVAC-DMP-8019 will close when exhaust fan pressure differential is below the setpoint of the fan pressure differential switch (PDIT-8025 or PDIT-8027).

4.2.5.5 Reference Air System. The reference air system is not shutdown. Sections of the system may be isolated manually if necessary for maintenance activities.

4.2.6 Safety Management Programs and Administrative Controls

The safety management programs and administrative controls for this SDD will be integrated into the SNF Project Integrated Safety Management System.

4.3 Testing And Maintenance

4.3.1 Temporary Configurations

There are no temporary configurations for any of the CVDF HVAC and reference air systems.

4.3.2 Technical Safety Requirement-Required Surveillances

Routine radiation monitoring of the facility includes monitoring the radiation levels of the system pre-filters and HEPA filters. These filters are changed out if their radiation level reaches 70 mrem/h. Filters are changed out to protect the TSR value of no more than 82 mrem/h.

4.3.3 Non-Technical Safety Requirement Inspections and Testing

Non-technical safety requirement inspections and testing are identified in HNF-2356.

4.3.4 Maintenance

4.3.4.1 Administration Building HVAC System A brief summary of maintenance activities required for the administration building HVAC system is provided in this section. Additional detail is provided in HNF-2356. General maintenance is conducted according to equipment manufacturer's recommendations.

- Filters on heat pump HVAC-HTP-8001 must be changed every six months or more frequently if heavy dust loading occurs.

- The heat pump manufacturer's recommendations are followed for equipment maintenance.

4.3.4.2 Process Bay Recirculation HVAC System. A brief summary of maintenance activities required for the process bay recirculation HVAC systems is provided in this section. Additional detail is provided in HNF-2356.

- Filters are changed based on particulate loading as indicated by the filter pressure differential gauges or the filter radiation level.

- The exhaust fan and motors are maintained (lubricated and belts tightened) per manufacturer's instructions.

4.3.4.3 Process Bay Local Exhaust HVAC and Process Vent System. A brief summary of maintenance activities required for the process bay local exhaust HVAC and process vent system is provided in this section. Additional detail is provided in HNF-2356.

- All filters are changed based on particulate loading as indicated by the filter pressure differential gauges or the filter radiation level.

- The exhaust fan and motors are maintained (lubricated and belts tightened) per manufacturer's instructions.

4.3.4.4 Process General Supply/Exhaust HVAC System. A brief summary of maintenance activities required for the process general supply/exhaust HVAC system is provided below. Additional detail is provided in HNF-2356.

- Pre-filters and HEPA filters are changed based on particulate loading as indicated by filter pressure differential gauges.

- The fan manufacturer's lubrication instructions as indicated on the fan housing are to be followed.

4.3.4.5 Reference Air System. A brief summary of maintenance activities required for the process general supply/exhaust HVAC system is provided below. Additional detail is provided in HNF-2356.

- Dampers and valves are maintained per vendor information.

- The atmospheric referenced pipe header is drained of any moisture that may be due to condensation. A drain is installed for this purpose.

- The reference air system pressure transmitters/indicators are calibrated and/or functionally checked on a periodic basis as defined in applicable vendor information.

Appendix A

Source Documents

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

29 CFR 1910, "Occupational Safety and Health Standards," Section 1910.120, "Hazardous Waste Operations and Emergency Response," *Code of Federal Regulations*, as amended.

40 CFR 61,"National Emission Standard for Hazardous Air Pollutants," *Code of Federal Regulations*, as amended.

ACGIH, 1998, *Industrial Ventilation: Manual of Recommended Practice*, 23rd Edition, American Conference of Governmental Industrial Hygienists, Cincinnati, Ohio.

ANSI N13.1, 1993, *Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities*, American National Standards Institute, New York, New York.

ANSI N512, 1974 (withdrawn/never replaced per ANSI, March 1988), *Protective Coatings (Paints) for the Nuclear Industry*, American National Standards Institute, New York, New York.

ANSI/ARI 550, 1992, *Centrifugal or Rotary Screw Water Chilling Packages*, Air Conditioning and Refrigeration Institute, Arlington, Virginia.

ANSI/ARI 590, 1992, *Reciprocating Water Chilling Packages*, Air Conditioning and Refrigeration Institute, Arlington, Virginia.

ANSI/ASHRAE-52.68, 1995, *Method of Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Material*, American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Atlanta, Georgia.

ANSI/ASHRAE-62a, 1991, *Ventilation for Acceptable Indoor Air Quality*, American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Atlanta, Georgia.

ANSI/ASME AG-1, 1994, *Code on Nuclear Air and Gas Treatment*, American Society of Mechanical Engineers, New York, New York.

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

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

ANSI/ASME B31.5, 1995, *Refrigerant Piping Code*, American Society of Mechanical Engineers, New York, New York.

ANSI/ASME B31.9, 1996, *General Services Piping Code*, American Society of Mechanical Engineers, New York, New York.

ANSI/ASME N509, 1996, *Nuclear Power Plant Air Cleaning Units and Components*, American Society of Mechanical Engineers, New York, New York.

ANSI/ASME N510, 1996, *Testing of Nuclear Air Cleaning System*, American Society of Mechanical Engineers, New York, New York.

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

ANSI/AWWA-D100a, 1989, *Welded Steel Tanks for Water Storage*, American Water Works Association, Denver, Colorado.

ANSI/NFPA 45, 1996, *Standard on Fire Protection for Laboratories Using Chemicals*, National Fire Protection Association, Quincy, Massachusetts.

ANSI/NFPA 90A, 1996, *Standard for the Installation of Air Conditioning and Ventilating Systems*, National Fire Protection Association, Quincy, Massachusetts.

ANSI/NFPA 90B, 1996, *Standard for the Installation of Warm Air Heating and Air Conditioning Systems*, National Fire Protection Association, Quincy, Massachusetts.

ANSI/NFPA 91, 1995, *Standard for Exhaust Systems for Air Conveying of Materials*, National Fire Protection Association, Quincy, Massachusetts.

ANSI/NFPA 801, 1995, *Standard for Facilities Handling Radioactive Materials*, National Fire Protection Association, Quincy, Massachusetts.

ASHRAE, 1997, *Handbook of Fundamentals*, American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Atlanta, Georgia.

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

ASTM E119, 1995, *Fire Tests of Building Construction and Materials*, American Society for Testing and Materials, West Conshohocken, Pennsylvania.

ERDA-76-21, 1976, *Nuclear Air Cleaning Handbook*, Energy Research and Development Administration, Washington, D.C.

SMACNA 1208, *HVAC Systems Duct Design*, Sheet Metal and Air Conditioning Contractors National Association, Vienna, Virginia.

SMACNA 1481, *HVAC Duct Construction Standards* - Metal and Flexible, Sheet Metal and Air Conditioning Contractors National Association, Vienna, Virginia.

UBC, 1994, *Uniform Building Code*, International Conference of Building Officials, Whittier, California.

WAC 173-400, "General Regulations for Air Pollution Sources," Washington Administrative Code, as amended.

WAC 173-460, "Controls for New Sources of Toxic Air Emissions," Washington Administrative Code, as amended.

WAC 246-247, "Radiation Protection-Air Emissions," Washington Administrative Code, as amended.

DOE Order 5480.1A, "Environmental Protection, Safety, and Health Protection Information Reporting Requirements," U.S. Department of Energy, Washington, D.C.

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

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

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

GH-CLIM-01, 1996, *Design Climate Data for the Hanford Site*, ICF Kaiser Hanford, Richland, Washington.

HNF-2356, 1999, *Spent Nuclear Fuel Project Cold Vacuum Drying Facility Operations Manual*, Rev. 1, DE&S Hanford, Inc., Richland, Washington.

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

HNF-SD-SNF-DRD-002, 1999, *Cold Vacuum Drying Facility Design Requirements*, Rev. 4, Fluor Daniel Hanford, Inc., Richland, Washington.

HNF-SD-SNF-HIE-004, 1998, *Cold Vacuum Drying Facility Hazard Analysis Report*, Rev. 5, Fluor Daniel Hanford, Inc., Richland, Washington.

HNF-3553, Annex B, 2000,rev 1, Safety Analysis Report for the Cold Vacuum Drying Facility, Fluor Daniel Hanford, Inc., Richland, Washington.

HNF-SD-SNF-SEL-002, 2000 rev 8, *Spent Nuclear Fuel Project Cold Vacuum Drying Facility Safety Equipment List*, Rev. 6, Fluor Daniel Hanford, Inc., Richland, Washington.

HNF-SD-SNF-TM-004, 1997, *Cold Vacuum Drying Process Technical Manual*, Rev. 0, Fluor Daniel Hanford, Inc., Richland, Washington.

Merrick, 1996, *HVAC Calculations for Project W-441-C1 - Cold Vacuum Drying Facility*, Merrick Engineers & Architects, Los Alamos, New Mexico.

WHC-SD-GN-DGS-30006, 1993, *Seismic Design Guide for Safety Class 3 and 4 Equipment at the Hanford Site*, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

WHC-SD-SNF-FHA-003, 1996, *Preliminary Fire Hazard Analysis for the Cold Vacuum Drying System Facility*, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

WHC-SD-SNF-SD-005, 1996, *Spent Nuclear Fuel Project Technical Baseline Description*, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

TEM, 2000, *Cold Vacuum Drying Facility Automatic Temperature Control System Process Flow and Operational Description*, Rev. D Draft dated April 5, 2000, Total Energy Management, Richland, Washington.

FHI Letter to P. G Loscoe, DOE, Richland Operation Office (RL) From R. B. Wilkenson, (FH Letter 0002595 dated 05/17/00) and DOE-RL Response (00-SFO-117 dated 07/17/00 incoming 0003912A response letter from P. G Lascoe to R. D. Hanson (FHI)

Appendix B

System Drawings

DRAWING LIST

Piping and instrumentation diagrams, flow diagrams, and other drawings applicable to the HVAC systems are listed in Table B-1. The table is provided as a reference for locating drawings. The primary drawing title of all drawings is Cold Vacuum Drying Facility. The secondary title, drawing numbers, and numbers of applicable sheets with each sub-package are as listed in Table B-1. Complete sets of drawings are located with the Spent Nuclear Fuel Project files for the CVD project.

Table B-1. Drawings. (2 sheets)

Drawing Number	Revision Number	Title	Sheet Number
H-1-82191	2	HVAC Abbreviations, Symbols and General Notes	1
H-1-82192	2	HVAC Air Flow Diagram Process Bays	1
H-1-82193	1	HVAC Air Flow Diagram Transfer Corridor	1
H-1-82194	2	HVAC Air Flow Diagram Mechanical Room	1
H-1-82195	2	HVAC Air Flow Diagram Administration Area	1
H-1-82196	2	HVAC Air Partial Plan Process Bays	1
H-1-82196	2	HVAC Air Partial Plan Process Bays	2
H-1-82196	0	HVAC Ductwork Support Details	3
H-1-82197	2	HVAC Plan Transfer Corridor	1
H-1-82198	2	HVAC Plan Mechanical Room	1
H-1-82199	2	HVAC Plan Administration Area	1
H-1-82200	2	Chilled Water Piping Plan Mechanical Room	1
H-1-82202	2	HVAC Sections	1
H-1-82203	2	HVAC Sections	1
H-1-82204	2	HVAC P&ID Process Bay Supply (Typ)	1
H-1-82205	3	HVAC P&ID General Supply	1
H-1-82206	3	HVAC P&ID Exhaust System	1
H-1-82207	2	HVAC P&ID Facility Instrumentation	1
H-1-82209	2	HVAC P&ID Stack Monitoring System	1
H-1-82210	2	HVAC Equipment Schedule	1
H-1-82210	2	HVAC Equipment Schedule	2
H-1-82211	2	Exhaust Stack Plan, El., Details and Sections	1
H-1-82212	2	Exhaust Stack Details and Sections	1

Drawing Number	Revision Number	Title	Sheet Number
H-1-82213	2	Exhaust Stack Details and Sections	1
H-1-82214	0	Stack Monitoring Exhaust Spool Piece Details	1
H-1-82214	0	Stack Monitoring Shrouded Probe Locations	2
H-1-82214	0	Stack Monitoring Air Flow/Temperature Loc.	3
H-1-82214	0	Stack Monitoring Probe Mounting Details	4
H-1-82215	0	Stack Monitoring Equipment Location	1
H-1-82215	0	Stack Monitoring Equipment Shelf Details	2
H-1-82216	2	Stack Monitoring Piping Layout	1
H-1-82216	2	Stack Monitoring Piping Layout	2
H-1-82216	2	Stack Monitoring Piping Layout	3
H-1-82221	0	Mechanical Utilities Legend, Schedule, Notes	1
H-1-82222	0	Mechanical Utilities Wtr. & Compressed Gases P&ID	1
H-1-82222	0	Mechanical Utilities Compressed & Instr. Air P&ID	2
H-1-82223	0	Mechanical Utilities Drainage Systems P&ID	1
H-1-82225	0	Mechanical Utilities 1st Floor Drainage Systems	1
H-1-82226	0	Mechanical Utilities 1st Floor Compressed Gases	1
H-1-82227	0	Mechanical Utilities 1st Floor Water Systems	1
H-1-82228	0	Mechanical Utilities 2nd Floor Process Chld. Water	1
H-1-82229	0	Mechanical Utilities Sections & Details	1
H-1-82230	0	Mechanical Utilities Sections & Details	1
H-1-82231	0	Mechanical Utilities Hanger Details	1
H-1-84859	0	Automatic Temperature Control System	1-74

SPECIFICATION LIST

This SDD refers to two sections of the construction specification. These sections are Section 15856, which addresses the HEPA filter housings, and Section 15890, which addresses the ductwork. This information is listed in Table B-2.

Table B-2. Specification List.

Specification Number	Title
SNF-6209 Rev 0 Section 15856 Section 15890	Cold Vacuum Drying Facility Construction Specification HEPA Filter Housing Ductwork

Appendix C

System Procedures

MP-CVD-016	Change Out Process Bay HEPA Filters
MP-CVD-017	Inspect General Supply HVAC Equipment
MP-CVD-018	Clean and Inspect General Exhaust HVAC Equipment
MP-CVD-019	Clean and Inspect Local Exhaust HVAC Equipment
MP-CVD-020	Clean and Inspect Process Bay HVAC Equipment
MP-CVD-021	Clean and Inspect Administration Building HVAC Equipment
MP-CVD-035	Inspect and Test Hood Seals
OP-CVD-028	Startup/Shutdown CVD HVAC Systems
SP-CVD-009	Calibrate HVAC Instrumentation

Operation, maintenance and alarm response procedures will be developed.

Appendix D

Miscellaneous Information

Table D-1. Transmitters in the Process Bay Local Air Supply Temperature Control Loop.

Temperature Transmitter	Room
TT-8204	Process bay 2 (room 128)
TT-8304	Process bay 3 (room 125)
TT-8404	Process bay 4 (room 122)
TT-8504	Process bay 5 (room 119)

Table D-2. Instrumentation Supplied Power by the Electrical Distribution System.

Instrument	Location
TT-8010	Mechanical room (room 207)
TT-8011	Mechanical room (room 207)
TT-8012	Room 121 (Transfer corridor)
TT-8013	Transfer corridor (room 116)
TT-8014	Process waste water tank room (room 132)
PDIT-8070	Mechanical room (room 207)
PDIT-8073	Room 116
PDIT-8074	Room 130
PDIT-8075	Room 127
PDIT-8076	Room 124
PDIT-8077	Room 121
PDIT-8078	Room 118
PDIT-8079	Room 115
PDIT-8080	Process waste water tank room (room 132)
PDIT-8220	Process bay 2 (room 128)
PDIT-8320	Process bay 3 (room 125)
PDIT-8420	Process bay 4 (room 122)
PDIT-8520	Process bay 5 (room 119)

PDIT = pressure differential indicating transmitter.

Table D-3. Transmitters in the General Air Supply Temperature Control Loop.

Temperature Transmitter	Room
TT-8010	Mechanical room (room 207)
TT-8011	Mechanical room (room 207)
TT-8012	Room 121
TT-8013	Transfer corridor (room 116)
TT-8014	Process waste water tank room (room 132)

Table D-4. Codes, Standards, and Source Documents that Apply to CVDF Piped System

Category/Application	General Service SSCs	Safety-Significant SSCs	Safety-Class SSCs
Chilled/cooling water systems piping, valves, and pumps	ANSI/ARI 550, 590 ANSI/ASME B31.3, B31.5 ASME VIII ANSI/ASME B16 series	Same as general service	ASME III*
Condensate, floor drain, and tanks	ANSI/ASME B31.3, ANSI/AWWA-D100a	Same as general service	ASME III*
Compressed air system piping, valves and tanks	CGA ANSI/ASME B31.3 ASME VIII ANSI/ASME B16 series	Same as general service	ASME III*
Reference air system	ANSI/ASME B31.3	Same as general service	ASME III*

Note: See Section 8.0 for a list of the references cited in this table.

*ASME, 1995, *Boiler and Pressure Vessel Code*, American Society of Mechanical Engineers, New York, New York, Section III, or comparable safety-related codes and standards that are appropriate for the system being designed.

CGA = Compressed Gas Association.
SSC = structure, system, and component.

Appendix E

GENERATOR BUILDING 142KA
HVAC

GENERATOR BUILDING

The generator building is a separate preengineered metal building to the north of the main facility. The primary function of the building is to house the stand by power system diesel generator.

Facility Functional HVAC Requirements

Requirement: The room temperature shall be maintained within the operating requirements of the stand by power generator.

Basis: HNF-SD-SNF-DRD-002, Section 6.5.2c. Office and operational areas shall be maintained at temperatures recommended by the appropriate codes and standards, as required by DOE Order 6430.1A, to ensure personnel comfort and safety and to protect equipment during normal and upset conditions.

How the system meets the requirement: The exhaust fans and electric unit heaters maintain the stand by power diesel generator inside ambient temperature requirement as described in SNF-6423, Page 3-10, Paragraph 3.1.8.2. The building can be maintained above 40 degree F while the generator is not running per ECN 662320. However, when the generator is running the ambient inside room temperature will stabilize at slightly above the outside ambient temperature.

The exhaust fans control the high temperature to below the 122 degree F generator requirement, in both the normal (generator not running) and off normal condition (generator running) by ventilating heat buildup to the exterior of the building.

The electric unit heater controls the normal building temperature to above 40 degree F. The off normal (generator running) room temperature meets the 5 degree F minimum design temperature for PC-2, SSCs as calculations in SNF-6988 indicate.

The HVAC provided for building 142KA is the following equipment: (H-1-83974, H-1-83977)

GENERATOR ROOM 1

Unit Electric Heater
HVAC-HTR-8024 5 KW

Exhaust fan (wall mounted)
HVAC-EXHF-8010 325 CFM
Local thermostat (initial set point 90 degree F)

Exhaust fan (wall mounted)
HVAC-EXHF-8008 290 CFM
Variable speed drive

GENERATOR ROOM 2

Unit Electric Heater
HVAC-HTR-8024 5 KW

Exhaust fan (wall mounted)
HVAC-EXHF-8010 4000 CFM
Local thermostat (initial set point 90 degree F)

Exhaust fan (wall mounted)
HVAC-EXHF-8008 290 CFM
Variable speed drive