S

ENGINEERING CHANGE NOTICE

Page 1 of 2

1. ECN 663701

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 []	A. Artzer, CVDF, X3-78, 372-2785	[X] Yes [] No	10/09/00
	6. Project Title/No./Work Order No. SNF/W-441, Spent Nuclear Fuel Cold Vacuum Drying	7. Bldg./Sys./Fac. No. CVDF 142K	8. Approval Designator S^NQ
	9. Document Numbers Changed by this ECN (includes sheet no. and rev.) SNF-3077, Rev. 1	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? [] Yes [X] No

FIRE PROTECTION

GS

Changed performance categories for the Fire Protection System to be consistent with the SAR (HNF-3553, Annex B).

USQ Approval: 1539 Rev. 1 mm 10/12/00 CVD-OD-~~2002~~

14a. Justification (mark one)	14b. Justification Details
Criteria Change [] Design Improvement [X] Environmental [] Facility Deactivation [] As-Found [] Facilitate Const [] Const. Error/Omission [] Design Error/Omission []	Implemented SAR requirements. The design verification method for ~~SC/SS~~ GS are 10/10/00 components is by ~~independent~~ Informal are 10/10/00 review in accordance with EN-6-027-01. Documentation of this review is accomplished by the independent review approval signature provided on page 2 of this ECN.

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

See distribution sheet.

RELEASE STAMP

OCT 17 2000

DATE:

STA: #19

HANFORD RELEASE

ID: 15

A-7900-013-2 (10/97)

ENGINEERING CHANGE NOTICE

1. ECN (use no. from pg. 1): 663701

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

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

SDD/DD	[]	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	[]	N/A	[X]
Environmental Permit	[]	Inventory Adjustment Request	[]		[]

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

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

21. Approvals

	Signature	Date
Design Authority G. Singh		10/9/00
Cog. Eng N/A		~~10/9~~
Cog. Mgr. * C. Haller	John Dearing for C.H.	10/10/00
QA R. K. Ramsgate		10/10/00
Safety J. R. Brehm for		10/12/00
Environ. N/A		
Other N/A		
Independent Review SC WALLACE		10/9/00

	Signature	Date
Design Agent		
PE		
QA		
Safety		
Design		
Environ.		
Other		

~~*Approval Authorizes Parallel Preparation of USQ Screen with Implementation of ECN Per NS-4-001.~~ DEK 10-13-00

DEPARTMENT OF ENERGY

Signature or a Control Number that tracks the Approval Signature

ADDITIONAL

DISTRIBUTION SHEET

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Distribution	SNF-CVD	
Project Title/Work Order		Date
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		ECN No. 663701

Name	MSIN	Text With All Attach.	Text Only	Attach./ Appendix Only	EDT/ECN Only
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SNF-3077
Revision 2

Cold Vacuum Drying Facility Fire Protection System Design Description System 24

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-3077
Revision 2

ECN 663701

Cold Vacuum Drying Facility Fire Protection System Design Description System 24

Project No: W-441 Division: SNF-441

G. Singh
Fluor Hanford, Inc.

Date Published
October 2000

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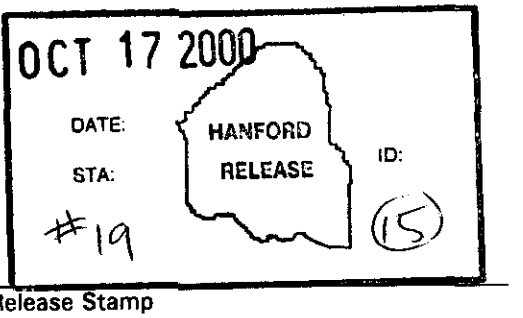

Janis Braden 10/17/00
Release Approval Date

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SNF-3077
Rev2

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RECORD OF REVISION

(1) Document Number: SNF-3077

(2) Title

COLD VACUUM DRYING FACILITY
FIRE PROTECTION SYSTEM DESIGN DESCRIPTION, SYSTEM 24

Change Control Record

(3) Revision	(4) Description of Change - Replace, Add, and Delete Pages	Authorized for Release	
		(5) Cog. Engr.	(6) Cog. Mgr. Date
0	(7) EDT 626308, INITIAL RELEASE	G. SINGH	C. HALLER
1	ECN 660512, UPDATE TO REFLECT CURRENT SYSTEM DESIGN	G. SINGH	C. HALLER
2 RS	ECN 663701, UPDATE TO REFLECT THE CURRENT SAR (HNF-3553, ANNEX B)	10/9/00	John J. Dearing for C. Haller 10/10/00

A-7320-005 (10/97)

COLD VACUUM DRYING FACILITY FIRE PROTECTION SYSTEM DESIGN DESCRIPTION SYSTEM 24

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1.0 INTRODUCTION

1.1 System Identification

This system design description (SDD) addresses the Cold Vacuum Drying (CVD) Facility fire protection system (FPS). The primary features of the FPS for the CVD are a fire alarm and detection system, automatic sprinklers, and fire hydrants. The FPS also includes fire extinguishers located throughout the facility and fire hydrants to assist in manual firefighting efforts. In addition, a fire barrier separates the operations support (administrative) area from the process bays and process bay support areas. Administrative controls to limit combustible materials have been established and are a part of the overall fire protection program. The FPS is augmented by assistance from the Hanford Fire Department (HFD) and by interface systems including service water, electrical power, drains, instrumentation and controls. This SDD, when used in conjunction with the other elements of the definitive design package, provides a complete picture of the FPS for the CVD Facility.

1.2 Limitations of the SDD

This SDD has been prepared using information taken from reviewed and approved CVD design documents and drawings including the CVD Design Requirements Document, HNF-SD-SNF-DRD-002, Rev. 4. The facility Fire Hazards Analysis (FHA), SNF-4268, Rev. 0 was also used in developing this SDD. Inherent to all facilities are design changes and modifications that are needed to upgrade the systems to improve safety and performance. Periodic review of this SDD is recommended to ensure that changes made to the FPS are appropriately incorporated into this SDD.

1.3 Ownership of the SDD

The CVD Facility Design Authority assigned to the FPS 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

AHJ	Authority Having Jurisdiction
ALARA	As Low As Reasonably Achievable
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWS	American Welding Society
CAT	Construction Acceptance Test
CFR	Code of Federal Regulations
CSDD	Computer Safety Design Description
CVD	Cold Vacuum Drying
DBA	Design Basis Accident
DOE	U.S. Department of Energy
DRD	Design Requirements Document
FACP	Fire alarm control panel
FAT	Factory Acceptance Test
FHA	Fire Hazard Analysis
FM	Factory Mutual
FPS	Fire Protection System
FSAR	Final Safety Analysis Report
fpm	Feet per minute
gal	Gallon
gpm	Gallons per Minute
HEPA	High-Efficiency Particulate Air
HFD	Hanford Fire Department
HVAC	Heating, Ventilation, and Air Conditioning
LED	Light Emitting Diode
MCS	Monitoring and Control System
MPFL	Maximum Possible Fire Loss
NEMA	National Equipment Manufacturers Association
NFPA	National Fire Protection Association
PC	Performance Category
PIV	Post Indicator Valve
psig	Pounds per square inch gauge
RFAR	Radio fire alarm reporter
RL	U.S. Department of Energy, Richland Operations Office
RLID	RL Implementing Directive
SAR	Safety Analysis Report
SDD	System design document
SNF	Spent Nuclear Fuel
SSC	Structures, Systems, and Components
TSR	Technical Safety Requirement
UBC	Uniform Building Code
UL	Underwriters Laboratory
UPS	Uninterruptible Power Supply

2.0 GENERAL OVERVIEW

2.1 System Functions

The FPS provides suppression, alarm and detection, life safety provisions and property loss limitations for the CVD Facility and personnel. The FPS accomplishes this by using various supporting interfacing systems, in addition to systems specific to fire protection. Administrative controls are also used to limit the types and quantities of combustible materials in order to reduce fire loading to within the limits prescribed in the facility FHA.

2.2 Interfaces and Boundaries

The FPS interfaces with the electrical distribution system, service water system, heating, ventilation, and air conditioning (HVAC) system, process bay drain system, instrumentation and control system and the radio fire alarm reporter (RFAR) system, which transmits trouble and fire alarm signals to the HFD.

The FPS alarm and detection system is powered by a 120V dedicated supply from the building electrical distribution system. Building electrical power to the fire alarm control panel (FACP) is required for normal operation of the fire alarm and detection system. Should the power supply fail, a battery will supply backup power for a limited amount of time to the FACP.

Water for building fire suppression is supplied by three electric service water pumps located in the 190 KE building. The pumps draw water from the KE clearwell and supply the water to the existing service water distribution system. Fire protection water to the CVD is provided from the existing service water system via an 8-inch connection to the service water header in building 165 KW.

Primary FPS components in the building HVAC system are fire screens and smoke detectors. Heat detectors are located on the local and general exhaust system ducts upstream of the high-efficiency particulate air (HEPA) filters, however these detectors are not considered components of the FPS.

The process bay drains interface with the fire alarm system in order to ensure that water released from activation of the automatic sprinkler system is removed from the facility. Floor drains are installed in each process bay for the purpose of routing drainage to the respective bay sump and then to a containment basin located outside the facility.

The instrumentation and control system incorporates the wiring and logic necessary to permit the actions previously described in this section to occur.

The RFAR transmits trouble and alarm signals directly to the HFD. The RFAR is located outside the building and receives signals from the FACP.

2.3 Safety System Classification

All FPS equipment, valves, piping, instrumentation, and controls required to perform primary fire detection and suppression functions are designated as general service. The component installation is designed and qualified for performance category 1 as defined in DOE-STD-1020, *Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities*. Anchorage and piping for those portions of the system that, upon failure, could impact the performance and function of safety-significant or safety class equipment are designed and qualified for performance category 2 as defined in DOE-STD-1020. There are no nuclear safety functional requirements for fire protection. The functions of the FPS are to provide protection of government property and notify the building occupants in the event of a fire or related emergency. The FPS performs these functions by providing automatic fire suppression, detecting the existence of an impending or actual fire, alerting personnel of the need to evacuate and notifying the HFD for assistance.

2.4 Basic Operational Overview

The FPS consists primarily of a wet-pipe sprinkler system, a fire detection and alarm system and external fire hydrants. Portable fire extinguishers, fire barriers and combustible material administrative controls are included as part of the FPS.

A single automatic wet pipe sprinkler system has been provided for the entire facility. The sprinkler system is designed and installed in accordance with NFPA 13, *Installation of Sprinkler Systems.* The CVD Facility is divided into three fire areas. The operations support area is considered a single fire area. The sprinkler system is designed as Ordinary Group 1 occupancy. The process bays and the process bay support area are each a fire area and the sprinkler system for each area is designed as an Ordinary group 2 occupancy.

The fire alarm system was designed and installed in accordance with National Fire Protection Agency (NFPA) 72, *National Fire Alarm Code.* The fire alarm system consists of a Pyrotronics System 3, CP-35 FACP with adequate zoning capacity to satisfy the requirements for monitoring, annunciation and notification in the CVF Facility.

Two fire hydrants, one located to the Northwest of the CVD Facility and the second located to the Southeast of the CVD Facility provide manual firefighting capability.

Portable fire extinguishers are strategically located throughout the facility in accordance with the requirements of NFPA 10, *Portable Fire Extinguishers.*

A two hour fire barrier separates the operations support area from both the process bay area and the process bay support area in accordance with the requirements of Chapter 5 of the Uniform Building Code (UBC), Section 504.6, *Area Separation Walls.* The operations support (administrative) area is classified as business occupancy per NFPA 101 and the UBC. The process bay and process bay support area are classified as a special purpose industrial occupancy per NFPA 101 and as Group H, division 7 (H-7) occupancy per the UBC.

A performance-based approach to control combustible material loading has been implemented at the CVD Facility. The CVD FHA provides specific requirements with regard to combustible loading that must be complied with to reduce the potential fire hazards to an acceptable level. These requirements have been implemented through the Spent Nuclear Fuel (SNF) fire protection administrative procedure and facility operating procedure.

3.0 REQUIREMENTS AND BASES

3.1 General Design Criteria Requirements

3.1.1 DOE 6430.1A, *General Design Criteria,* Design Criteria

Facilities shall comply with the following:

- DOE 5480.4 Attachment 2, Section 2C
- DOE 5480.7 (replaced with DOE 5480.7A)
- Section 1530, Fire Protection

Requirement: The fire protection design shall comply with the requirements of the U.S. Department of Energy (DOE) Order 6430.1A, *General Design Criteria*, DOE 5480.7A, *Fire Protection*, and DOE 5480.4, *Environmental Protection, Safety and Health Protection Standards*, Attachment 2, Section 2C.

Basis: DOE fire protection requirements are derived from the Code of Federal Regulations (CFR) 29, Part 1910 and Part 1926, NFPA codes and standards Facilities as defined in section 0101-1 shall comply with the following:

3.1.2 Specific Cold Vacuum Drying Facility Design Criteria Requirements

The design criteria from the documents listed in section 3.1.1 above and the design criteria in documents referenced therein that are applicable to the CVD are described below. The applicable requirements are identified in and taken from HNF-SD-SNF-DRD-002, *Cold Vacuum Drying Facility Design Requirements* and from the CVD Fire Hazards Analysis, HNF-4268, Rev. 0. Applicable design criteria that are not being met are specifically addressed in the facility FHA. Exemptions, equivalencies and/or waivers to all applicable DOE requirements not being met have been submitted to and approved by the U.S. Department of Energy, Richland Operations Office (RL) and are identified in the applicable sections below.

3.1.3 General Design Requirements

3.1.2.1 Safety Requirements

Requirement: A graded FHA that reflects the risks from fire in a facility shall be performed for new facilities as directed by DOE 6430.1A for nuclear facilities where safety analyses are required by DOE 5480.23.

Basis: Fire scenarios relative to the facility fire hazards require evaluation in the FHA document and a subsequent evaluation of the bounding FHA scenario(s) are required in the facility authorization bases documents to ensure that the potential consequences of accidents involving these hazards do not result in onsite or offsite dose consequences that exceed DOE criteria or impact safety class or safety significant structures, systems, and components (SSCs). If the authorization bases analyses conclude that there is a potential for an onsite or offsite does consequence or that safety class or safety significant SSCs will be impacted, administrative and/or engineered controls are required to mitigate the accident(s).

Requirement Compliance: An FHA, (HNF-4268, Rev. 0) documenting compliance to the appropriate codes and standards and evaluation of facility fire hazards as mandated by DOE and CFR requirements, has been completed for the CVD Facility. The FHA and facility authorization bases documents have been integrated as required per RLID 5480.7 and WHC-SD-GN-FHA-30001, Rev. 0.

3.1.2.2 Seismic Requirements

Requirement: Earthquake load design of Performance Category (PC) 1 and 2 SSCs shall comply with the UBC, seismic zone 2B for essential facilities.

Basis: Procedure HNF-PRO-097, *Engineering Design and Evaluation*, provides the minimum requirements for seismic design.

Requirement Compliance: The CVD Facility sprinkler system design and installation meets the NFPA 13 requirements for seismic restraint. These requirements are equivalent to the requirements in HNF-PRO-097.

3.1.2.3 Environmental Requirements.

There are no environmental requirements for the FPS.

3.1.2.4 Mission-Critical Requirements

There are no mission-critical requirements for the system.

3.1.2.5 Other Overall System Requirements

3.1.2.5.1 Codes, Standards, and Regulations

Code of Federal Regulations (CFR)

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

American Society of Mechanical Engineers (ASME)

B16.5, Pipe Flanges and Flanged Fittings (American National Standards Institute (ANSI)-approved)
B16.10, Face to Face and End to End Dimensions of Valves
B16.11, Forged Steel Fittings, Socket-Welding and Threaded (ANSI-approved)
B16.21, Nonmetallic Flat Gaskets for Pipe Flanges
B16.25, Buttwelding Ends
B16.34, Valves Flanged, Threaded, and Welding End
B16.39, Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300 (ANSI- approved)
B31.3, Process Piping Code, Category M

American Society of Nondestructive Testing (ASND)

SNT-TC-1A, Recommended Practice

American Society for Testing and Materials (ASTM)

A36, Standard Specification for Structural Steel
A105, Standard Specification for Forgings, Carbon Steel, for Piping Components
A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service
A276, Standard Specification for Stainless and Heat-Resisting Steel Bars and Shapes
A312/312M, Standard Specification for Seamless and Welded Austenitic Stainless Steel Pipes
A354, Standard Specification for Quenched and Tempered Alloy Steel Bolts, Studs and Other Externally Threaded Fasteners
A403, Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings
A480, Standard Specification for General Requirements for Flat-Rolled Stainless Heat-Resisting Steel Plate, Sheet, and Strip
A500, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
A563, Standard Specification for Carbon and Alloy Steel Nuts

American Welding Society (AWS)

D1.1, Structural Welding Code – Steel

National Equipment Manufacturers Association (NEMA)

250, Enclosures for Electrical Equipment

National Fire Protection Association (NFPA)

NFPA 13, *Standard for the Installation of Sprinkler Systems*
NFPA 70, *National Electrical Code*
NFPA 72, *National Fire Alarm Code*

NFPA 90A, *Standard for the Installation of Air Conditioning and Ventilating Systems*
NFPA 101, *Code for Safety to Life from Fire in Buildings and Structures*
NFPA 1221, *Installation Maintenance and Use of Public Fire Service Communication Systems*
NFPA 1963, *Standard for Screw Threads and Gaskets for Fire Hose Connections*
UL, *Electrical Appliance and Utilization Equipment Directory*
UL, *Electrical Construction Materials Directory*
UL, *Fire Protection Equipment Directory*
UL, *Fire Resistance Directory*
WAC 246-290, "Public Water Supplies."

Factory Mutual (FM) System Approval Guide

A-A-1922A, *Shield, Expansion (Caulking Anchors, Single Lead)*
A-A-1923A, *Shield, Expansion (Lag, Machine and Externally Threaded Wedge Bolt Anchors)*
A-A-1924A, *Shield, Expansion (Self Drilling Tubular Expansion Shell Bolt Anchors)*
A-A-1925A, *Shield, Expansion (Nail Anchors)*
A-A-1556A, *Sealing Compound (Elastomeric Joint Sealant)*
A-A-55614, *Shield, Expansion (Non-Drilling Expansion Anchors)*
A-A-55615, *Shield, Expansion (Wood Screw and Lag Bolt Self Threading Anchors)*

American Society for Testing and Materials (ASTM)

ASTM A135, *Standard Specification for Electric-Resistance-Welded Steel Pipe*
ASTM A536, *Standard Specification for Ductile Iron Castings*
ASTM A568, *General Requirements for Standard Specification for Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled, and Cold Rolled*

3.1.2.5.2 Operability

There are no operating procedures or Technical Safety Requirements (TSRs) required for the operation of the FPS.

3.1.2.5.3 Radiation and Other Hazards

This section does not apply to this SDD.

3.1.2.5.4 As Low As Reasonably Achievable (ALARA)

There are no specific ALARA requirements imposed on the FPS. The following requirements are stated in HNF-SD-SNF-DRD-002, Rev. 4 and are included to prevent the spread of potentially radiologically contaminated fire water.

a. **Requirement:** Each process bay and the building shall be equipped with floor drains for the purposes of collecting firewater should the sprinkler system activate. The drains and drain piping shall be sized to accommodate drainage at the designed sprinkler system flowrate.

Basis: The basis is to collect the water in sumps and/or retention basins where the water can be sampled prior to disposal and to prevent runoff of potentially contaminated firewater into normally occupied clean areas.

Requirement Compliance: The process bays are a potentially contaminated area at the CVD Facility, and are equipped with floor drains that are routed to a collection sump for each respective bay. The sumps are routed to a retention basin and the water sampled prior to disposal. The drainage piping is 8-inch diameter piping.

b. **Requirement:** The facility floors in the process bays shall have dikes and slopes to contain spills and a discharge of firewater.

Basis: Slopes and dikes will contain the water within desired areas while it is being drained by the drainage system.

Requirement Compliance: The floors in the process bays are sloped.

3.1.2.5.5 Criticality Safety

Criticality is not a concern at the CVF Facility. Therefore, the use of water or any other fire suppression method to combat a fire at the CVD is not restricted.

3.1.2.5.6 Industrial Hazards Requirements

There are no unique industrial hazards that would be created by the FPS or that would be impact the operation of the FPS.

3.1.2.5.7 Operating Environment and Natural Phenomenon Requirements

All FPS components are designed to function under worst case internal and external environmental conditions (excluding seismic conditions). The FPS sprinkler piping is seismically qualified for performance category 1. The fire protection system is protected from high winds by the CVD Facility structure. Flooding protection is provided by the location of the CVD Facility. The facility incorporates lightning protection and is protected from snow loads by compliance with structural design criteria.

3.1.2.5.8 Human Interface Requirements

Under normal operating conditions no human interface is required for proper operation of the FPS. In the event of a fire or emergency, personnel may operate a manual pull station or use a portable fire extinguisher (Note: Fire extinguisher operation by building occupants in the event of a fire is not a requirement.). NFPA 72 and NFPA 10 respectively provide location requirements for the installation of this equipment to ensure convenient and safe access to the equipment.

3.1.2.5.9 Specific Commitment Requirements

There are no specific commitments made regarding the FPS at the CVD Facility.

3.1.2.5.10 Engineering Discipline Requirements

There are no unique engineering requirements associated with the design, installation and operation of the FPS at the CVD Facility.

3.2 Subsystem and Major Component Requirements

3.2.1 Firewater Supply

General Requirements

a. **Requirement:** The underground firewater system shall be designed and installed in accordance with the requirements of NFPA 24 and applicable Authority Having Jurisdiction (AHJ) (DOE) requirements.

   Basis: To provide a reasonable degree of protection for life and property from fire through installation requirements for underground fire water supply systems based on sound engineering principles, test data and field experience.

   Requirement Compliance: The distribution system is designed and installed in accordance with NFPA 24, with guidance from the (AHJ), DOE-RL.

b. **Requirement:** Underground fire water mains including valves, hydrants and fittings shall be flushed and tested in accordance with the requirements of NFPA 24.

   Basis: Flushing ensures that any debris remaining in the piping from the construction phase is removed thereby eliminating the possibility of flow blockages in downstream equipment. Testing verifies the integrity of the piping system and ensures it is capable of performing as designed.

   Requirement Compliance: The firewater mains, valves, hydrants, and fittings are installed, flushed, sterilized, and tested prior to operation of the CVD Facility. (Reference construction specification, Section 15300.).

Specific Requirements

a. **Requirement:** Water supplies for fire protection shall be of the looped grid type, providing two independent points of supply and two-way flow with sectional valving arranged to provide alternate water flowpaths from the source to any point in the distribution system, where MPFL exceeds $1 million.

Basis: The DOE 6430.1A, Section 1530-99.0 requirement for a minimum of two reliable water sources for firefighting and RLID 5480.7 requirement (also stated in the new fire protection RLID 420.1, section 8.4.c) will reduce property loss potential by increasing water supply reliability and availability.

Requirement Compliance: The CVD project does not comply with this requirement, however, the project has received a waiver to DOE 6430.1A, section 1530-99.0 and an exemption to RLID 5480.7A, section 8.1.c for this requirement (reference DOE Letter No. 98-SFD-181, dated October 8, 1998).

b. **Requirement**: Underground piping mains shall be sized for the largest fire flows anticipated but in no case shall be less than 8-inch diameter.

Basis: DOE 5480.7A section 9.b (9). Establishment of a minimum firewater supply pipe size requirement ensures that the system can supply the required quantity of water at the required pressure to the sprinkler system plus hose streams to effectively combat a fire. Water supply requirements are documented in calculation MEI-2288-FP-02.

Requirement Compliance: This requirement is complied with. The firewater supply to the CVD is 8 inches.

c. **Requirement:** The design of the water supply system shall include a post-indicating valve (PIV).

Basis: To permit isolation of the facility wet pipe sprinkler system a safe distance from the facility following activation of the sprinkler system.

Requirement Compliance: A PIV has been incorporated into the design and has been installed in accordance with NFPA 24.

d. **Requirement:** Sprinkler risers shall be located at exterior walls.

Basis: Location of the sprinkler riser at the exterior wall reduces the length of supply piping that must be run underneath the building. This reduces the potential impact to the facility in the event that maintenance or replacement of the piping becomes necessary.

Requirement Compliance: The sprinkler riser at the CVD is located in room 110. The east wall of room 110 is an exterior wall. (Reference drawing H-1-82237.)

e. **Requirement:** Sprinkler supply lead-ins should run under buildings the minimum distance possible.

Basis: DOE 6430.1A limits the piping runs underneath buildings to minimize the interference and potential cost impact to repair or replace the piping.

Requirement Compliance: The sprinkler system lead-in is located at the east wall of room 110 thereby minimizing the sprinkler supply piping run underneath the CVD.

f. **Requirement:** Outside control valves shall be located, if possible, a minimum distance of 40 feet from the building.

Basis: Control valves (including the PIV) should be located at least 40 feet from the building to allow safe access during a fire.

Requirement Compliance: The outside control valves are located approximately 40 feet from the facility. Alarm valves are located as close as possible to the building entry point in room 110. (Reference drawings H-1-82237, -82092.)

g. **Requirement:** A minimum of two operational fire hydrants shall be provided for each building. Parts of the exterior of the building shall be reached with hose lays that do not exceed 350 feet. For new construction, at least one hydrant shall be located within 150 feet of the fire department connection. Hydrants should not be closer than 40 feet to the facility. Reference RLID 420.1, Fire Protection)

Basis: The hose lay requirements ensure that the distance to a firefighting water supply is minimized to aid in response time and ensure adequate equipment is available to effectively combat the fire.

Requirement Compliance: The required hose lays to any portion of the CVD Facility are less than 300 feet and are within 75 feet of the fire department connection (Reference drawing H-1-82092).

h. **Requirement:** Fire hydrants should not be located closer than 40 feet from the facility.

Basis: NFPA 24, Section 4.2.2 requires a distance of 40 feet for average conditions to provide an adequate safe distance for firefighters to access the hydrant during a building fire. DOE 6430.1A requires that hydrants be located at least 50 feet from buildings.

Requirement Compliance: The CVD is provided with two fire hydrants. Fire hydrant FH1 is located approximately 50 feet to the northwest of the facility and hydrant FH2 is located approximately 50 feet to the southeast of the facility and the fire department connection.

3.2.2 Automatic Sprinkler System

a. **Requirement:** The sprinkler system at CVD (142-K) shall be an automatic wet pipe system, hydraulically designed and installed in accordance with NFPA 13, *Installation of Sprinkler Systems*.

Basis: Complete automatic fire suppression designed in accordance with applicable NFPA standards is required per DOE 5480.7A, Section 9.b (3)(b) in all structures having an MPFL excess of $1 million. DOE 6430.1A requires that sprinkler systems comply with NFPA 13. NFPA 13 is the applicable NFPA code used to design and install automatic wet pipe sprinkler systems.

Requirement Compliance: The sprinkler system in the CVD Facility is an automatic wet pipe sprinkler system, hydraulically designed and installed in accordance with NFPA 13.

b. **Requirement:** NFPA 13 shall be used to determine the occupancy classification for the facility as it relates to sprinkler installations and their water supplies only.

Basis: Occupancy classification in accordance with NFPA13 shall be determined according to the quantity and combustibility of contents, the expected rates of heat release, the total potential for energy release, the heights of stockpiles and the presence of flammable and combustible liquids. Determination of the occupancy classification dictates the water density to be used (reference Figure 5-2.3) over a chosen area of operation and, therefore the required total flowrate to meet the sprinkler system requirements.

Requirement Compliance: Hydraulic designs are developed based on calculations MEI-2288-FP-01 and MEI-2288-FP-03 (see SNF-3001). These designs have been implemented via the design media.

c. **Requirement:** A 500 gpm hose stream requirement shall be added to the required total sprinkler system flowrate for the most remote area in order to determine the total water supply requirement.

Basis: The basis for this requirement is to ensure that a single water supply is capable of supplying the total sprinkler system demand requirement plus an adequate supply of water for manual fire fighting.

Requirement Compliance: Determination of the adequacy of water supplies was made based on actual flow test measurements gathered using methods in NFPA 13, Appendix B. A water flow test conducted on February 6, 1999 had a static pressure 112 psig, a flow of 1,110 gpm, and a residual pressure of 92 psig.

3.2.3 Fire Alarm System

Equipment

a. **Requirement**: All fire detection and alarm device equipment shall be listed or approved by a nationally recognized testing agency for its intended purpose (as defined in Occupational Safety and Health 29 CFR 1910.7) and comply with the requirements of NFPA 72.

Basis: HNF-PRO-349 requires fire protection equipment to be listed or approved to ensure that fire protection equipment used on the Hanford site is reliable and has been verified to perform as required in the installed system. NFPA 72 also requires that the equipment be listed for its intended use. DOE Order 6430.1A, Section 1530-8.1 requires that fire detection and alarm device equipment comply with NFPA 72 to ensure that standards for required level of performance, and functionality are consistent with the accepted standard.

Requirement Compliance: Device qualifications are indicated in Construction Specification SNF-6209, Rev. 0, Section 15300 and in Submittals 0130 and 0137. The qualifications meet NFPA 72 requirements.

b. **Requirement:** All fire alarm and detection equipment shall be similar to and compatible with a "Pyrotronics System 3" or equal.

Basis: Standardization to a specific equipment type reduces costs by minimizing the stock of spare parts required and reducing training and maintenance and costs.

Requirement Compliance: A "Pyrotronics System 3" is installed at the CVD Facility.

c. **Requirement**: The FACP shall have the ability to interface with the Hanford Site RFAR boxes.

Basis: DOE Order 6430.1A requires that fire alarm systems be able to transmit signals to a DOE facility fire department alarm center (HFD) in accordance with the appropriate NFPA Signaling Systems Standard. The FACP must have the capability to interface with the Hanford Site RFAR boxes in order to send alarm signals to the HFD.

Requirement Compliance: The FACP is interfaced with the Hanford Site RFAR boxes as shown on Drawing H-1-82244, sheet 4.

d. **Requirement:** Automatic fire detectors and their spacing and location shall comply with the requirements of NFPA 72. Spacing shall be based on threshold fire size, growth rate, and ceiling height as described in the standard.

Basis: DOE 6430.1A, Section 1530-8.3.4 requires that NFPA 72 be used as the system design standard to ensure the design and installation methods are consistent with established standards.

Requirement Compliance: Fire detector requirements are outlined in Specification Section 16720, Paragraph 1.4.3, and meets NFPA 72. Detector spacing is in accordance with NFPA 72 and is shown on Drawing H-1-82244.

e. **Requirement:** Smoke detectors shall be installed in all areas. Smoke detectors shall be photoelectric type or comparable as described in NFPA 72.

Basis: The CVD is classified as both a business and special purpose industrial occupancy per NFPA 101. NFPA 101 requires that business and industrial occupancies be equipped with a fire alarm system that is initiated manually. There are two exceptions. One exception states that initiation shall be permitted by an approved automatic fire detection system installed throughout the building and the second exception is that initiation shall be permitted by an automatic sprinkler system installed throughout the building. Installation of automatic sprinkler protection throughout the building is required by DOE Order 5480.7A in all buildings where the MPFL exceeds $1 million. DOE requires redundant fire protection capabilities when the MPFL exceeds $50 million. The MPFL for the CVD does not exceed $50 million per the CVD FHA. The second exception identified above has been implemented therefore an automatic fire detection system is not required.

Requirement Compliance: Although not required by DOE or NFPA, a complete automatic fire detection system has been installed throughout the CVD in accordance with NFPA 72.

System Features

a. **Requirement:** A manual fire alarm system shall be installed throughout the CVD Facility as required by NFPA 101.

Basis: DOE Order 6430.1A, Section 1530-8.2.2 requires a means to manually notify the fire department in the event of a fire or other emergency. The CVD Facility is classified as both a special purpose industrial occupancy and business occupancy per NFPA 101. NFPA 101 requires that a fire alarm system with a manual means of initiation be provided throughout the building for these occupancy classifications.

Requirement Compliance: Manual pull boxes are installed as required by NFPA 101 per NFPA 72.

b. **Requirement:** The fire alarm system shall have the following basic features: 1) Transmission of signals to the 200 Area HFD, 2) Local alarms for the building or zone in alarm, 3) Transmission of trouble signals, 4) Appropriately sized, emergency 60-hour battery for backup system operation, 5) Electronic supervision of all circuits as required by the appropriate NFPA standard, 6) Contain supervisory devices for all critical functions as applicable such as valve position water level, temperature, etc.).

Basis: DOE 6430.1A, Section 1530-8.2.1 requires that the installed fire alarm system include the features listed above. These features are also required by the applicable NFPA codes such as NFPA 13 and NFPA 72. The features are in place to notify building occupants and appropriate emergency response personnel in an emergency and to ensure that the integrity of the fire protection systems is maintained.

Requirement Compliance: The fire alarm system at the CVD Facility has the following basic features: 1) transmission of fire alarm signals to the 200 Area fire department, 2) local sounding of fire alarms for the building or zone in the building and at the building FACP, 3) transmission of trouble signals to the 200 Area fire department and a local alarm at the

FACP, 4) an appropriately sized, emergency 60-hour battery backup for system operation, 5) supervision of all circuits for the detection of faults, and 6) supervision of post indicator and backflow preventer valve position. The CVD Facility firewater supply valve located in the 190 KW basement is not provided with a tamper switch. The valve is chained and locked in the open position. This is acceptable per NFPA 25, *Inspection, Testing and Maintenance of Water-Based Fire Protection Systems,* section 9-3.3.1.

c. **Requirement:** The FACP and RFAR must have the capability for annunciating the following three separate conditions: 1) fire alarm, 2) trouble alarm and 3) supervisory signal. Each condition must have a separate and distinct sound at the FACP.

   Basis: DOE 6430.1A, Section 1530-8.2.1 and NFPA 72 require that audible alarm notification appliances for a fire alarm system produce signals that are distinctive from other similar appliances used for other purposes in the same area. An exception to this in NFPA 72 permits a supervisory signal sound to be used to indicate a trouble condition provided that the distinction between signals is provided by other appropriate means such as visible annunciation. DOE 6430.1A invokes NFPA 72 in the design of fire alarm systems, therefore complying with the exception implies compliance with DOE 6430.1A.

   Requirement Compliance: The FACP and the RFAR have the capability of annunciating three separate conditions: (1) fire alarm, (2) trouble signal and 3) supervisory signal. The FACP complies with the exception described above. Details of the components used are found in Submittal 0238.

d. **Requirement:** A FACP must be provided that has the ability to transmit subsequent soundings of fire alarm panel supervisory signals.

   Basis: Personnel are to be notified when fire response related actions are in process.

   Requirement Compliance: A FACP that has the ability to transmit subsequent soundings of fire alarm panel supervisory signals is provided. The interface between the FACP and the RFAR is detailed in Drawing H-1-82244 and Specification Section 16720, Part 2.

e. **Requirement:** Alarms that respond to the flow of water shall be provided for each sprinkler system and shall comply with the requirements of the NFPA standard for the type of signaling system used.

   Basis: DOE Order 6430.1A, Section 1530-8.2.2 and NFPA 13 require that flow alarms be provided wherever sprinkler systems are installed to provide notification of sprinkler system activation and an immediate response by the fire department.

   Requirement Compliance: Sprinkler system flow alarms are installed at the CVD in accordance with NFPA 13 and NFPA 72 requirements.

3.2.4 Fire Barriers

a. **Requirement**. The CVD Facility shall be divided into three fire areas by a two-hour, fire-rated wall(s) in accordance with the Section 504.6 of the UBC.

Basis: The operations support area is classified as business occupancy per NFPA 101 and the UBC. The process bay and process bay support areas are classified as a special purpose industrial occupancy per NFPA 101 and a Group H, Division 7 (H-7) occupancy per the UBC. The construction is classified as Type II (000) per NFPA 220 and Type II-N per the UBC. A one-hour occupancy separation between the operations support area and the process bay support area and the process bay is required in accordance with the UBC, Table 3-B. Section 504.6 of the UBC states, "When an area separation wall also separates occupancies that are required to be separated by an occupancy separation, the most restrictive requirements of each separation shall apply." Section 504.6.2 requires that area separation wall be two-hour fire-rated construction for Type II-N construction.

Requirement Compliance: The CVD complies with this requirement. The pre-cast concrete panels that form the wall separating the process bays from the change rooms on the first floor have been upgraded to an equivalent fire resistance rating of two hours by the addition of gypsum wallboard (Reference Equivalency Request in Correspondence No. FDH-9956370 and DOE-RL concurrence in letter 99-SFD-185). Fire rated dampers have been installed between each process bay and the associated change room. In addition, gypsum has been added to the ceilings of the change rooms to provide an equivalent two-hour fire resistance (see above identified equivalency request).

The wall that separates the operations support area from process bay #5 and the process bay support area has two qualifications. The portion of the wall that separates process bay #5 from the operations support area has been increased to a two hour equivalent fire resistance rating by the addition of gypsum wallboard per above equivalency request documentation. The remaining portion of the wall that separates the process bay support area from the operations support area is a two-hour rated wall assembly in accordance with UL Design No. U419 (UL Fire Resistance Directory, 1999 Edition). Note: The deficiencies identified in Section 4.6.2 of the facility FHA, SNF-4268, Rev. 0, have also been corrected.

b. **Requirement:** Walls separating the process bays shall be made from pre-cast concrete panels, steel framing, and noncombustible materials in a fire-rated configuration.

Basis: This requirement is taken from HNF-SD-SNF-DRD-002, Rev. 4.

Requirement Compliance: Walls separating the process bays are made from pre-cast concrete panels, steel framing, and noncombustible materials as stipulated in the above design requirements document, however the walls are not fire rated nor are they required to be.

c. **Requirement:** All closable openings in firewalls and ventilation systems penetrating rated fire separations shall be provided with fire doors or fire dampers of the appropriate ratings in accordance with NFPA 801, *Fire Protection for Facilities Handling Radioactive Materials.*

   Basis: Openings in fire barriers shall be consistent with the designated fire resistance rating of the barrier per NFPA 801, Section 3-6.

   Requirement Compliance: All openings in firewalls and ventilation systems penetrating rated fire separations are provided with fire doors or fire dampers of the appropriate ratings in accordance with NFPA 90A.

d. **Requirement:** Penetrations in fire-rated separations shall be sealed with fire-rated materials that have been tested in accordance with ASTM E-119, and listed UL or approved FM. All sealing materials shall be suitable for the fire rating of the wall, floor, or ceiling and listed for use with the applicable building materials and the penetration configuration.

   Basis: The penetrations cannot defeat the fire rating in a wall, floor, or ceiling.

   Requirement Compliance: A fire stopping sealant is specified by brand name, which is approved by UL.

3.2 Instrumentation and Control Requirements

3.2.5 Instrument Interlock Requirements

The FPS interfaces with the facility monitoring and control system. It is a standalone system with a dedicated control panel and an uninterruptible power supply (UPS) and a RFAR. All FPS power is non-safety, supplied by the facility power grid. Isolation from power transients and failures is provided such that detection functions are accomplished under power loss or transient conditions. Upon failure of the building power supply, the UPS is automatically activated.

3.2.6 Special Control Feature Requirements

There are no special control feature requirements unique to the FPS at the CVD Facility.

3.2.7 Interface Compatibility Requirements

There are no special interface compatibility requirements associated with the FPS at the CVD Facility.

3.3 Testing and Maintenance Requirements

3.3.1 Testability Requirements

a. **Requirement:** Bypass test switches shall be provided for all smoke detectors that operate dampers and shut down HVAC equipment.

Basis: The use of bypass switches permits detector testing without affecting the operation of other plant equipment. Testing can be accomplished without shutting dampers that need to be open during normal plant operation or shutting down HVAC equipment that needs to remain in operational.

Requirement Compliance: Bypass test switches for all smoke detectors that operate dampers or shut down HVAC equipment are provided. Test switches are provided as indicated on Drawing H-1-82244.

b. **Requirement:** An alarm test connection that gives a flow equivalent on one sprinkler of the type having the smallest orifice installed on a particular system shall be provided to test each waterflow alarm device for each system.

Basis: The alarm test connection is used as a means of testing the waterflow alarm switches and give an indication that adequate flow will be available in the system.

Requirement Compliance: The sprinkler system at CVD is equipped with appropriate alarm tests connections

3.3.2 Maintenance Requirements

Requirement: Main drain test connections shall be provided at locations that will permit flow tests of water supplies and connections.

Basis: NFPA 13 requires that a main drain test connection be provided to drain systems when system maintenance is necessary and can be used to indicate that an adequate water supply is available.

Requirement Compliance: The automatic wet pipe sprinkler riser at CVD is equipped with a main drain connection.

3.3.3 TSR-Required Surveillance Requirements

Requirement: Implement a performance based approach to limit, control and monitor combustible material loading per the requirements of the facility FHA, SNF-4268.

Basis: Each recommendation identified in Section 18.0 of the FHA provided options for resolution. A performance-based approach was selected in lieu of engineering solutions for some of the recommendations. Those recommendations being resolved using a performance based approach require proceduralized combustible loading limits and surveillance frequencies to ensure compliance in the applicable areas.

Requirement Compliance: The fire protection systems have no Safety Analysis Report (SAR) functional requirements listed in Chapter B4.0 of the CVD Facility SAR, HNF-3553, Annex B – Cold Vacuum Drying Facility. Combustible loading controls are described in chapter B11.4 of

the SAR. Chapter B11.4 references section B5.5.7.7 for Technical Safety Requirement AC 5.13 – Combustible Loading Limits for the CVDF. These limits are required per the facility FHA, SNF-4268, Rev. 0 and documented in SNF-4942, Rev. 0, *Spent Nuclear Fuel Cold Vacuum Drying Facility Implementation Plan for Fire Hazards Analysis Suggested Actions*. The combustible loading controls have been implemented through the SNF fire protection administrative procedure, FP-4-014-02 and through the following operating procedures:

1) CP-24-001V, Control of Combustible Material Within CVD Facility
2) CP-24-002V, Inspection of Vehicles Entering CVD Facility Bays

3.3.4 Non-Technical Safety Inspection, Testing and Maintenance Requirements

Requirement: All fire protection systems (including those identified in facility technical specifications or similar documents) shall be at a minimum inspected, tested and maintained in accordance with the requirements described in HNF-PRO-351, *Fire Protection Inspection, Testing and Maintenance*. Full compliance with HNF-PRO-351 requires the HFD and facility management to establish a testing, inspection and maintenance program for the facility.

Basis: HNF-PRO-351 establishes the minimum testing, inspection and maintenance requirements for fire protection systems and equipment in government owned facilities under the Project Hanford Management Contract contract. These requirements are based on testing, inspection and maintenance codes, and standards and equipment manufacturer recommendations. The NFPA codes are the primary source of the requirements.

Requirement Compliance: Documented testing, inspection and maintenance is routinely performed in accordance with HNF-PRO-351 by both the HFD and facility management personnel.

3.4 Other Requirements

3.4.1 Security and Special Nuclear Material Protection

This section does not apply to this SDD.

3.4.2 Special Installation Requirements

This section does not apply to this SDD.

3.4.3 Reliability, Availability, and Preferred Failure Modes

The CVD Facility FPS has no unique requirements with regard to reliability and availability and preferred failure modes.

3.4.4 Quality Assurance

The fire prevention system fabrication quality assurance/control program is based on the Master Equipment List (SNF-4148) and application of a graded approach as described in the Project Hanford Quality Assurance Program Description (HNF-MP-599).

3.4.5 Miscellaneous

A conceptual decontamination and decommissioning plan for the CVD Facility, is identified in the guidelines of DOE-STD-3009-94, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Safety Analysis Reports*, is included in HNF-SD-SNF-SAR-002. General service computer hardware and software are described in SDD SNF-3090 for the Computer Software Design Description (CSDD) for the Monitoring and Control System (MCS).

4.0 SYSTEM DESCRIPTION

4.1 Description of System, Subsystems and Major Components

The fire protection system for the CVD Facility consists primarily of a fire water supply system, a sprinkler system and a fire alarm system. The FPS services all of the process bays, the process bay support area and the operations support area. The FPS equipment includes the following components:

1. Firewater supply piping from the 190-KW tunnel
2. Fire hydrants
3. Sprinkler system piping and sprinklers
   a. Process bays
   b. Process bay support area
   c. Operations support area
4. Fire Alarm System
   a. Fire Alarm Control Panel
   b. Radio Fire Alarm Reporter
   c. Space smoke detectors
   d. Ventilation duct smoke detectors
   e. Generator building heat detectors
   f. Manual pull boxes
   g. Fire alarm strobes
   h. Fire alarm bells
   i. Portable fire extinguishers
5. Fire barriers

The discussion that follows includes a description of the location and layout of the systems and a description of applicable subsystems and major system components.

4.1.1 Firewater Supply Piping

Firewater is received from the existing service water supply header in the 100 K Area. An 8-inch pipeline that taps into the existing 24-inch service water header in the 190 KW tunnel at the 100 K Area delivers water for fire suppression to the CVD Facility. The piping is routed directly west approximately 350 feet underground from the tie-in point with little elevation gain to a point east of the CVD (142-K) where the piping tees and forms a loop around the building. A 6-inch line tees into the 8-inch line at the southeast corner of 142-K. The 6-inch line connects with the sprinkler system riser located in Room 110 of the CVD Facility. Water supply data indicates a static pressure of 112 psi and a residual pressure of 92 psi with 1110 gpm flowing.

4.1.2 Fire Hydrants

Two fire hydrants are provided at the CVD Facility. One is located near the southeast corner of the building (FH-23) and a second is located at the northwest corner of the building (FH-22). Each hydrant is located approximately 50 feet from the building.

4.1.3 Sprinkler System Piping and Sprinklers

The FPS is configured as described in the following paragraphs (see Figure 4-1 for a general layout of the FPS).

A single wet pipe automatic sprinkler system designed and installed in accordance with NFPA 13, *Installation of Sprinkler Systems*, provides fire suppression for the CVD Facility. The sprinkler system is supplied by service water as described in Section 4.1.1. Water to the sprinkler system piping is provided through a 6-inch sprinkler riser located in room 110 of the administrative area. The first component in the riser is a reduced pressure backflow preventer assembly. A reduced pressure backflow preventer is required since some of the protected areas are potentially radiologically contaminated. Sprinkler water passes through the backflow preventer to the 6-inch alarm check valve. The alarm check valve will open initiating flow of water in the event that a fusible link in a sprinkler head melts from the heat of a fire or is broken. The alarm check valve is fitted with standard trim (piping and valves) to achieve proper operation. From the alarm check valve, fire protection water enters a 6-inch feed main, which runs from east to west along the north wall above the ceiling of the administrative area. The feed main delivers water to the cross mains. The cross mains supply the branch lines that supply water directly to the sprinkler heads. Fire protection water is delivered to three separate areas. They are the process bay area, the process bay support area, and the operations support area.

Process Bay Area

The portion of the sprinkler system that services the process bay area is designed for an Ordinary Group 2 occupancy. Sprinkler system water is supplied to the first and second floor of the process bays via two 4-inch cross mains. The cross main supply from the feed main is near process bay 5. The first floor process bay header is routed south to north along the west side of the bays running through each bay and terminating just short of process bay 1. The first floor level of the process bay 1 does not have sprinkler protection. The second floor process bay header is routed in the same manner but includes process bay 1 coverage. The cross mains begin as 4-inch piping. Cross main piping size is reduced to 3 inches at the northern end of the CVD Facility on both the first and second floor levels. Sprinkler heads are mounted on the sprinkler system branch lines that run perpendicular to the cross main. Branch line pipe sizes range from 1-1/2" to 1" depending on the number of supplied sprinkler heads. The sprinkler heads installed in the process bays are all upright sprinklers with standard spray patterns. All sprinkler heads on the first floor of the process bays, except for under the stairs leading to the second floor and all the sprinkler heads on the second floor, have a temperature rating of 212°F. The process bays will be exposed to ambient conditions when the equipment doors are open. During the summer months, temperatures in the process bays could get relatively high. Sprinkler heads with a temperature rating of 212°F provide an added margin of safety against inadvertent activation without compromising fire safety.

4.1.3.1 Process Bay Support Area

Sprinkler system water is delivered to the first floor of the process bay support area (process corridor) via a cross main that begins as a 4-inch header and reduces to a 3-inch header. The cross main originates from the same point as the cross-mains that supply the process bay area. The process bay support area header runs south to north and is centered along the length of the corridor (Room 116). Branch lines ranging in size from 1-1/2" to 1" tee from the cross-main header and supply the sprinkler heads in the change rooms and the tank room. The sprinkler heads throughout the process bay support area are 165°F rated heads. There are both upright sprinklers with standard spray patterns and pendant sprinklers with standard spray patterns. Pendants are located below the drop ceiling and uprights are located above the drop ceiling and in areas having no drop ceiling.

4.1.3.2 Operations Support Area

Sprinkler system water is delivered to the operations support area (administrative) via a 3-inch cross main header that tees from the feed main above Room 111. Branch lines ranging in size from 1-1/2" to 1", tee from the cross main and supply the sprinkler heads located throughout the administrative area. The sprinkler heads in the administrative area are all 165°F rated heads and they are all pendants.

4.1.4 Fire Alarm System

4.1.4.1 Fire Alarm Control Panel

The FACP for the CVD is a Pyrotronics System 3, CP-35. The FACP is located in room 109 and is depicted on Drawing H-1-82244. The FACP has the capability to monitor 16 different zones. There are 12 zones on the CVD Facility FACP that are being used. The remaining 4 zones are spares (see Table 4-1). A fire alarm signal is received at the CVD FACP facility if a smoke detector is activated, a heat detector is activated, the sprinkler system flow switch is activated or a manual pull box is activated. The FACP also has the capability to self-monitor the fire alarm system circuitry and initiating devices and will provide a trouble alarm if an abnormal condition is sensed. Loss of power and will also result in a trouble alarm at the FACP. The CVD Facility has two OS&Y valves and one PIV fitted with tamper switches. Manipulation of the valve from the monitored position will cause a supervisory alarm signal to be sent to the FACP.

The FACP at the CVD facility also provide relay circuitry for automatic shutdown of the HVAC system in bays 2 thru 5 and shutdown of the HVAC system in Operations Support Area and in the mechanical room (room 110) in the event a fire alarm signal is received from that respective area.

The FACP provides notification in the form of fire alarm bells and strobe lights to alert building occupants that a potential fire situation has occurred. The FACP monitors the circuitry of the bells and strobes and initiates a trouble alarm in the event of an off-normal condition.

Table 4-1, Fire Detection Zones

ZONE	AREA COVERED	COMPONENT (Annunciation Type)
1	Zoned Areas 3 through 11	Flow alarm Switch (Fire alarm)
2	Spare	None
3	Cell 132 (Tank Room)	1 Photoelectric Smoke Detector, 1 Manual Pull station (all Fire Alarms)
4	Cells 131, 211 and 212 (Process Bay 1)	3 Photoelectric Smoke Detectors, 1 Manual Pull Station, (all Fire Alarms)
5	Cells 128, 209 and 210 (Process Bay 2)	7 Photoelectric Smoke Detectors, 1 Manual Pull Station, 1 Duct Photoelectric Smoke Detector (all Fire Alarms)
6	Cells 125, 205 and 206 (Process Bay 3)	7 Photoelectric Smoke Detectors, 1 Manual Pull Station, Duct 1 Photoelectric Smoke Detector (all Fire Alarms)
7	Cells 122, 203 and 204 (Process Bay 4)	7 Photoelectric Smoke Detectors, 1 Manual Pull Station, 1 Duct Photoelectric Detector (all Fire Alarms)
8	Cells 119, 201 and 202 (Process Bay 5)	7 Photoelectric Smoke Detectors, 1 Manual Pull Station, 1 Duct Photoelectric Detector (all Fire Alarms)
9	Cells 116 (First Floor Transfer Corridor)118, 121, 124, 127, and 130 (Process Bay Change Rooms) 117, 120, 123, 126 and 129 (Equipment rooms)	15 Photoelectric Smoke Detectors (Fire Alarms), 3 manual pull stations (Fire Alarm)
10	Operations Support Area (Administrative Area)	14 Photoelectric Smoke Detectors, 3 Manual Pull Stations, 1 Duct Photoelectric Detector (all Fire Alarms)
11	Cells 207 and 208 (Mechanical Room on Second Floor Above Transfer Corridor and Change Rooms)	8 Photoelectric Smoke Detectors, 2 Manual Pull Stations, 1 Duct Photoelectric Detector (all Fire Alarms)
12	Spare	None
13	Generator Building	2 Heat Detectors, 1 Manual Pull Station (all Fire Alarms)
14	Spare	None
15	Local Panel Trouble (LPT)	1 PIV Tamper Switch, 2 OS&Y Tamper Switches (Supervisory Alarm)
16	Spare	None

4.1.4.2 Radio Fire Alarm Reporter

Remote indication is accomplished by use of a RFAR, which is located near the southeast corner of the operations support area. Signals received by the FACP are transmitted to the RFAR, which transmits the signals to the 200 Area HFD.

4.1.4.3 Space Smoke Detectors

Smoke detectors are installed in all occupied areas of the CVD Facility. Fire alarm zones 3 thru 11 all contain at least one smoke detector. The space smoke detectors are Cerberus Pyrotronics PE-11 Series Photoelectric smoke detectors. Each detector has a multicolored light emitting diode (LED) indicator. A flashing green LED indicates normal operation. A flashing red LED indicates an alarm condition. The detector also has self-testing circuitry, which tests the detector for defective operation. If a problem is detected, the multicolored LED will flash amber until the problem is corrected.

4.1.4.4 Ventilation Duct Smoke Detectors

There are a total of six smoke detectors located in the ventilation ducts throughout the CVD. The ventilation duct smoke detectors are all photoelectric detectors of the same type as the space detectors. There is one located in each of the supply air handling units for process bays 2 thru 5. These detectors are located downstream of their respective HEPA filters on the discharge side of the fan. There is one smoke detector located downstream of the HEPA filter and fan on the general supply air-handling unit. This unit supplies the mechanical equipment room and the transfer corridor. There is also one smoke detector located in the supply to the operations support (administrative) area. A heat pump is used to provide the ventilation supply to the administrative area.

4.1.4.5 Ventilation Duct Heat Detectors

A heat detector is located in the inlet to the general exhaust system HEPA filtration train and on the inlet to the local exhaust system HEPA filtration train. These heat detectors are not, however components of the facility fire protection system and will not be described in further detail.

4.1.4.6 Generator Building Heat Detectors

The generator building has two heat detectors. One heat detector is located in each of the two sections of the building that houses a generator.

4.1.4.7 Manual Pull Boxes

Cerberus manufactures the manual pull boxes used in the CVD Facility. Model MS-501 is used in all applications. Manual pull boxes are located on the latch side of each personnel egress door. A manual pull box is installed for each process bay (including process bay 1). There are five manual pull boxes located in the process bay support area. There are a total of four, one at each exit, along the process bay support corridor and there is one at the exit in the tank room

(room 132). There are also two pull stations located on the second floor of the process bay support area (equipment room), one at each exit stair. There are two manual pull stations located in the operations support area, one at the east entrance and one at the west entrance.

The boxes require a double action to activate. The initiator is required to push in a tab then pull actuating lever down. After activation, the lever is locked in the "down" position. Restoration to normal is accomplished by opening the cover of the hinged housing and then opening, closing, and locking the cover.

4.1.4.8 Fire Alarm Bells

The fire alarm bells used at the CVD Facility are set at 92 DBA. The bells are located in each process bay (including process bay 1) against the west wall. There are three bells located along the process bay support corridor and one in the tank room (room 132). Fire alarm bells are also located against the south wall of the second floor of process bays 2 thru 5 and at each exit stair on the second floor of the process bay support area. The operations support area has three bells, one in the hallway and one in each restroom.

Five dedicated circuits from the FACP supply the fire alarm bells. Four of the circuits power four bells each. The fifth circuit powers two bells.

4.1.4.9 Fire Alarm Strobes

The fire alarm strobes at the CVD Facility are used for visual indication of a fire or emergency and have a minimum rating of 75 candelas. They are located on the east wall of each process bay and adjacent to the fire alarm bells on the west wall in each process bay. There are also fire alarm strobes located adjacent to each fire alarm bell in the process bay support area corridor and the tank room on the first floor and adjacent to the fire alarm bells at the exit stairs on the second floor. The operations support area has a total of four strobes. Two are located adjacent to the fire alarm bells in each restroom and a strobe is located at each of the exits.

Two dedicated circuits from the FACP supply the strobes. On circuit contains eight strobes, the second contains 13 strobes.

4.1.4.10 Fire Extinguishers

Type ABC fire extinguishers are strategically located throughout the CVD Facility in accordance with NFPA 10, *Portable Fire Extinguishers*. Manual fire extinguishers are provided in each of the process bays, including Bay 1, along the west wall of the transfer corridor, at the north and south ends of the mechanical equipment room, and in each of the main corridors of the administrative section.

4.1.5 Fire Barriers

The CVD Facility is divided into three separate fire areas. They are the process bays, the process bay support area and the operations support (administrative) area. Two-hour fire barriers are provided that separate the administrative area from the process bays and process bay support area and that separate the process bays from the process bay support area at the first floor level. The fire barriers are either fire rated walls or are qualified as equivalent to rated fire barrier walls (see section 3.2.4). There is no ventilation ducting that penetrates the fire barriers. There are six personnel access ways through the fire barrier walls that require fire rated door assemblies. Five of these connect each process bay with the process bay support area and one connects the process bay support area corridor with the administrative area.

Figure 4-1. General Layout

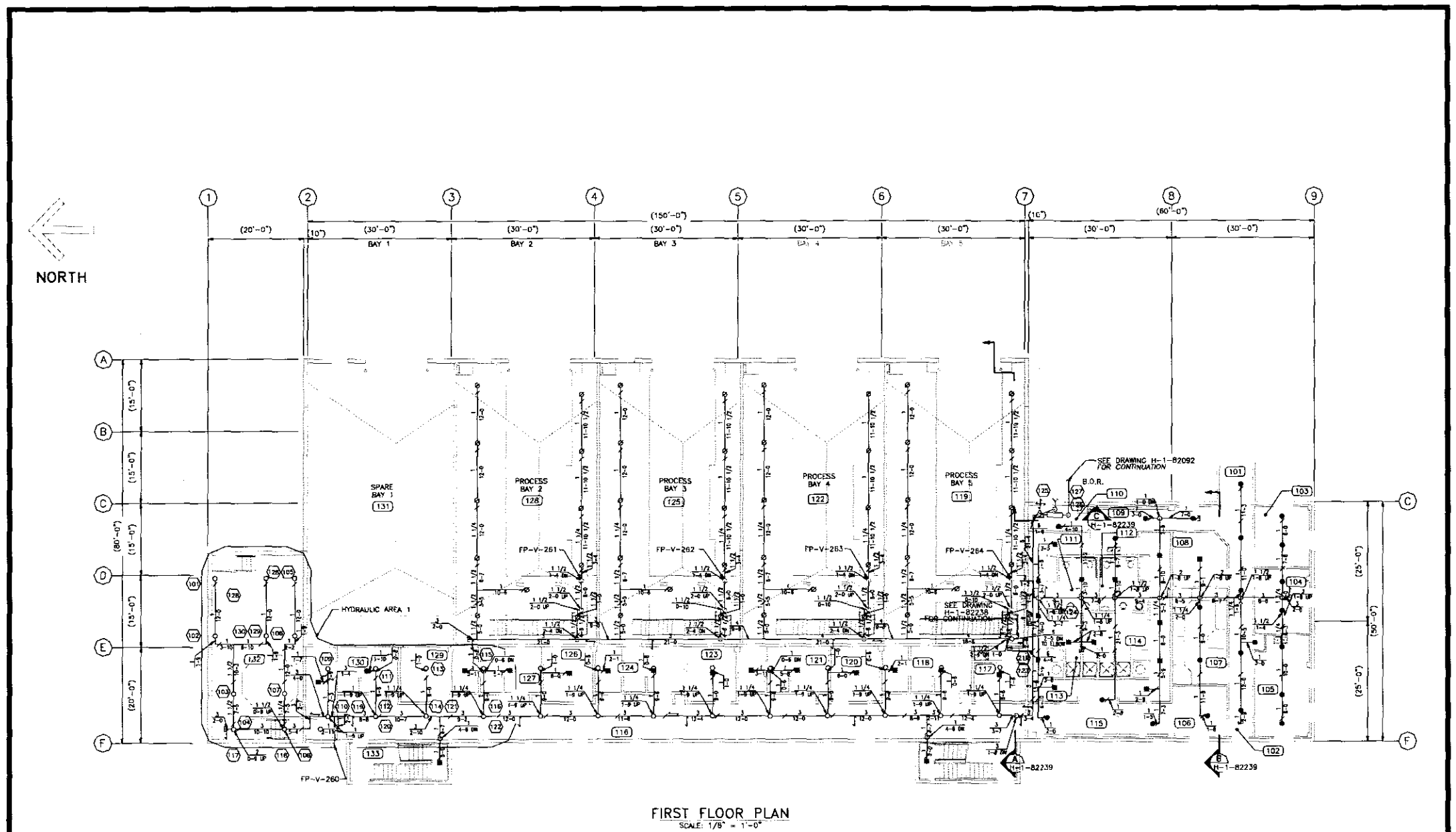

FIGURE 4-1

GENERAL LAYOUT

4.2 Boundaries and Interfaces

4.2.1 System Boundaries

The boundaries for the FPS water supply to the CVD Facility are from the origin of the supply in the165 KW cross-tie tunnel to three termination points. The termination points are two fire hydrants that tap off an underground loop around the CVD Facility and the sprinkler system riser located in room 110. The sprinkler system provides protection to all areas of the CVD Facility except the first floor of process bay #1. The boundaries for the CVD fire alarm system extend to the systems that the fire alarm system interfaces with and areas that the fire alarm system services. These include the electrical power distribution system, the HVAC system, the process bay drain system, the automatic sprinkler system, the RFAR and all occupied areas of the CVD Facility. The boundaries in the occupied areas consist of the manual pull boxes, fire alarm bells and strobes.

The fire barriers that divide the CVD into separate fire areas also define the fire protection system boundaries. Fire barriers divide the CVD into three separate fire areas. They are the process bay area, the process bay support area, and operations support area.

4.2.2 Fire Protection System Interfaces

4.2.2.1 Service Water Main Tie-In in the 190KW Tunnel

Fire protection water is supplied to the CVD Facility through an 8-inch pipe that taps into the 24-inch service water header in the 165 KW cross-tie tunnel.

4.2.2.2 RFAR

Fire, trouble and supervisory signals from the CVD Facility are transmitted to 200 Area HFD via the RFAR. Signals are sent to the RFAR from the FACP.

HVAC System

The CVD Facility HVAC system contains smoke detectors as described in section 4.1.4.4. The general supply HVAC fan, the administrative supply HVAC fan and the HVAC recirculation fans for process bays 2 through 5 each have a smoke detector downstream of the fan. Actuation of a duct smoke detector will shutdown the respective HVAC system fan and result in a fire alarm signal from the respective zone to the FACP. The alarm will be transmitted to the HFD through the RFAR.

The HVAC general and local exhaust system fans will shutdown in the event that a duct heat detector actuates in order to provide over-temperature protection to the building HEPA filters. As stated in section 4.1.4.5 above, the duct heat detectors are not components of the CVD FPS.

4.2.2.3 Process Bay Drain System

Floor drains are installed in each process bay for the purpose of routing drainage to the respective bay sump. The piping and associated valve for each respective sump is connected to an underground header, which is routed to a containment basin through a single pipe and valve arrangement. The containment basin valve and the valves associated with each sump interface with the facility FPS.

4.2.2.4 Fire Protection System Electrical Power Supply

Normal 120V power to the CVD fire alarm system is supplied to the FACP by the building electrical power distribution system through lighting panel LPN-1 located in room 109. Power for normal operation is provided to LPN-1 by Main Switchboard/SWBD-1 via a 480V to 120V transformer. LPN-1 also supplies power to the RFAR.

4.3 Physical Location and Layout

Documents comprising the definitive design of the FPS include:

Design Requirements Document, HNF-SD-SNF-DRD-002
Fire Hazard Analysis, HNF-4268, Rev. 0
Master equipment list, SNF- 4148
Data and calculation matrix tracking list, SNF-3001
Sequence of operations, HNF-2356

General CVD Drawings

a.) H-1-82246, Sheet 1, Cold Vacuum Drying Facility Electrical Service Area One-Line Diagram
b.) H-1-82247, Sheet 3, Cold Vacuum Drying Facility Electrical Service Area Panel Schedules
c.) H-1-82280, Sheet 3, Cold Vacuum Drying Facility Electrical Wire Run List and Conduit Schedule
d.) H-1-82280, Sheet 4, Cold Vacuum Drying Facility Electrical Wire Run List and Conduit Schedule
e.) H-1-82090, Cold Vacuum Drying Facility Drawing List and Vicinity Maps

Drawings depicting the definitive FPS system and component design are listed below.

Fire Protection Water Supply

a.) H-1-82092, Cold Vacuum Drying Facility Civil Site Plan, Legend
b.) H-1-82093, Cold Vacuum Drying Facility Civil Scanned Utility Plan
c.) H-1-82094, Cold Vacuum Drying Facility Civil Site Utility Details

Automatic Sprinkler System

a.) H-1-82237, Cold Vacuum Drying Facility Fire Protection, First Floor Plan
b.) H-1-82238, Cold Vacuum Drying Facility Fire Protection, Second Floor Plan
c.) H-1-82239, Cold Vacuum Drying Facility Fire Protection Sections
d.) H-1-82240, Cold Vacuum Drying Facility Fire Protection Details.

Fire Alarm System

a.) H-1-82244, Sheet 1, Cold Vacuum Drying Facility First Floor Fire Alarm Plan
b.) H-1-82244, Sheet 2, Cold Vacuum Drying Facility Second Floor Fire Alarm Plan
c.) H-1-82244, Sheet 3, Cold Vacuum Drying Facility Electrical Fire alarm Control Panel
d.) H-1-82244, Sheet 4, Cold Vacuum Drying Facility Electrical Fire Alarm Wiring Diagrams

Process Bay Drain System

H-1-82223, Cold Vacuum Drying Facility Mechanical Utilities Drainage System P&ID

Heating, Ventilation and Air Conditioning

a.) H-1-82205, Cold Vacuum Drying Facility HVAC P&ID General Supply
b.) H-1-82191, Cold Vacuum Drying Facility HVAC Abbreviations, Symbols and General Notes
c.) H-1-82192, Cold Vacuum Drying Facility HVAC Air Flow Diagram Process Bays
d.) H-1-82195, Cold Vacuum Drying Facility HVAC Air Flow Diagram Administration Area

Fire Barriers, Fire Doors, Structural

a.) H-1-82101, Cold Vacuum Drying Facility Architectural First Floor Plan
b.) H-1-82112, Cold Vacuum Drying Facility Architectural Door Schedule, Details
c.) H-1-82125, Cold Vacuum Drying Facility Structural Precast Panels

4.4 Principles of Operation

The FPS serves two primary purposes. The first purpose is to notify the building occupants and the HFD of a fire alarm condition and the second purpose is to provide fire suppression capabilities. The first purpose is achieved for the building occupants through the use of fire alarm bells and strobes and for the HFD by signal transmission through the RFAR. In the event that a fire condition exists of sufficient size, the building automatic sprinkler system will activate. The building fire alarm bells and strobes are activated throughout the facility by actuation of the automatic sprinkler system flow switch or by actuation in zones 3 through 11 from a space or duct smoke detector or by actuation of a manual pull station. The FACP will receive a fire alarm signal from actuation of these devices and transmit the alarm to the HFD via the RFAR.

The sprinkler system installed at the CVD is an automatic wet pipe sprinkler system. The system contains water under pressure at all times and utilizes a series of closed sprinkler heads. The sprinkler heads each contain a thermal fusible link that will melt when the link reaches the design temperature. The heat generated from a fire will raise the temperature of the compartment and the fusible link until the link melts. Once the link melts the following series of events occur. Pressure in the sprinkler piping downstream of the alarm check valve decreases. A decrease in the downstream pressure caused by the open sprinkler head causes the alarm check valve to open. Once the alarm check valve opens, water from the sprinkler supply system repressurizes the sprinkler system piping and water flow from the open sprinkler head is initiated. Concurrently, water flows to the water motor gong located at the sprinkler system riser and the sprinkler system flow switch is activated. Actuation of the sprinkler system flow switch results in a fire alarm signal being received at the FACP. The fire alarm signal is transmitted from the FACP to the HFD via the RFAR. Actuation of the flow switch also causes the building fire alarm bells and strobes to operate. **NOTE:** There is one sprinkler system flow switch for the entire CVD building. Actuation of the flow switch means that a fire condition could exist in any portion of the building supplied by the sprinkler system (zones 3 through 11).

The CVD Facility smoke detectors are all photoelectric type detectors. This type of detector responds to the presence of suspended smoke particles generated during the combustion process due to the affect the particles have on the propagation of a light beam passing through the air. The detectors installed at the CVD use the light scattering principle for operation. The detectors contain a light source and a photosensitive device arranged so that light rays normally do not fall onto the device. When smoke particles enter the light path, light strikes the particles and is scattered onto the photosensitive device, causing the detector to respond.

The facility FPS interfaces with the process bay drain system (see Section 4.2.1.4). Actuation of the sprinkler system flow switch will cause the containment basin valve to open. The process bay sump valves all remain closed upon sole actuation of the sprinkler system flow switch. For process bays 2 through 5, actuation of a duct smoke detector, space smoke detector or manual pull box in conjunction with a sprinkler flow alarm will cause the containment basin valve and the process bay sump valve in the alarming zone to open.

Actuation of a duct smoke detector, space smoke detector or manual pull box will also cause a shutdown of the respective HVAC system supply fan for the alarming zone. The process bay fans, the general supply fan and the administrative supply also have dampers that fail closed in the event the fans are shutdown either purposely or through interlocks. Actuation of the smoke detectors or manual pull station causes the FACP to go into an alarm mode.

4.5 System Reliability

The FPS is designed to be highly reliable in its operation. Routine preventive maintenance and testing is scheduled and performed by the HFD in accordance with NFPA and HNF-PRO-351, to ensure the system remains functional and reliable. The FPS is designed to operate when required throughout the life of the CVD Facility.

4.6 System Control Features

The FPS operates in a passive mode with no operator interface under normal conditions. Setpoints are built in with equipment type and are not adjustable by building occupants. The FPS has the capability monitor system components and to self-monitor system circuitry (see Section 4.1.4.1).

5.0 OPERATIONS

5.1 Operational Summary

The CVD FPS is designed to monitor the CVD without operator intervention. In the event of a fire or emergency, the FPS system will operate automatically. The FPS fire alarm system can also be actuated manually through the use of the manual pull boxes. A fire alarm will result in a response from the HFD. The HFD will assess the situation and provide emergency response if required. Following the incident, the HFD will restore the FPS to the normal mode.

5.2 System Startup

Startup, alignment, prerequisite testing, and formal start up activities will be identified in the test specification. A test specification will be developed identifying the requirements for all testing associated with this system. This specification will address factory acceptance tests (FATs) and construction acceptance tests (CATs), and pre-startup tests.

5.3 Normal Operations

Normal operation of the FPS is described in Section 4.1.4. Operational procedures providing detailed information on operating modes and activities (including alarm response, shutdown, etc.) will be developed. Operating procedures CP-24-001V, *Control of Combustible Material Within CVDF* and CP-24-002V, *Inspection of Vehicles Entering CVDF Bays*, have been developed to address facility combustible material loading and vehicle inspections.

5.4 Off-Normal Operations

An off-normal operation of the FPS would be characterized by an inability of any portion of the system to function as designed. This is termed a discrepancy by HNF-PRO-351, *Fire Protection System Testing/Inspection and Maintenance*. There are four different types of discrepancies. They are termed deficiency, restriction, planned impairment, and emergency impairment. The appropriate response to FPS discrepancies is addressed in HNF-PRO-351 and in the SNF Fire Protection Administrative Procedure, FP-4-014-02.

5.5 System Shutdown

Once in operation, non-emergency shutdown of the FPS is performed only by the HFD to support maintenance and system modification activities or if requested by the facility in order to support non-routine activity. A request by the facility for a FPS shutdown requires approval by the Hanford Fire Marshal's Office. In the event that a system discrepancy requires an emergency shutdown of a FPS, the HFD should be notified immediately.

5.6 Safety Management Programs and Administrative Controls

Fire Protection administrative procedure FP-4-014-02 addresses the controls necessary to ensure that combustible materials within the CVD Facility are managed in accordance with the requirements of the facility FHA.

6.0 TESTING AND MAINTENANCE

6.1 Temporary Configurations

The FPS may be placed in a temporary configuration provided the configuration has been reviewed and approved by the Hanford Fire Marshal's Office. A Hanford Fire Marshal's permit, establishing the requirements for the temporary configuration, shall be obtained prior to performing the configuration change.

6.2 Technical Safety Requirement Required Surveillance

There are no TSR's associated with the FPS at the CVD Facility.

6.3 Non-Technical Safety Requirement Inspections and Testing

Non-TSR inspections and testing per are conducted per HNF-PRO-351 and the applicable NFPA requirements. The HFD regularly schedules periodic inspections and testing of FPS equipment and systems.

6.4 Maintenance

Routine FPS maintenance activities are regularly scheduled by the HFD, using approved HFD maintenance procedures. Spare parts meeting the appropriate quality level are procured and used. Routine as well as non-routine FPS maintenance is scheduled and conducted through the use of the work control system.

6.5 Equipment Calibration

Equipment requiring calibration per the requirements of applicable NFPA codes is calibrated or replace with new calibrated components. Calibration and test connections are provided to enable in-service testing and calibration when practical.

Appendix A
Source Documents

INDUSTRY STANDARDS AND CODES

ASME B31.1, 1995, *Power Piping Code*, American Society of Mechanical Engineers, New York, New York.

AWS-D1.1, 1994, *Structural Welding Code Steel*, American Welding Society, Miami, Florida.

AWWA C151/A21.51-96, 1996, *Ductile-Iron Pipe, Centrifuge Cast, for Water*, American Water Works Association, Denver, Colorado.

NFPA 13, 1996, *Standard for the Installation of Sprinkler Systems*, National Fire Protection Association, Quincy, Massachusetts.

NFPA 24, 1995, *Standard for the Installation of Private Fire Service Mains and their Appurtenances*, National Fire Protection Association, Quincy, Massachusetts.

NFPA 70, 1996, *National Electrical Code*, National Fire Protection Association, Quincy, Massachusetts.

NFPA 72, 1996, *National Fire Alarm Code*, National Fire Protection Association, Quincy, Massachusetts.

NFPA 80, 1995, *Standard for Fire Doors and Fire Windows*, National Fire Protection Association, Quincy, Massachusetts.

NFPA 90A, 1993, *Standard for the Installation of Air Conditioning and Ventilating Systems*, National Fire Protection Association, Quincy, Massachusetts.

NFPA 101, 1997, *Life Safety Code*, National Fire Protection Association, Quincy, Massachusetts.

NFPA 252, 1995, *Standard Methods of Fire Tests of Door Assemblies*, National Fire Protection Association, Quincy, Massachusetts.

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

NFPA 1963, 1995, *Standard for Screw Threads and Gaskets for Fire Hose Connections*, National Fire Protection Association, Quincy, Massachusetts

ASTM A135, 1993, *Standard Specification for Electric-Resistance-Welded Steel Pipe*, American Society for Testing and Materials, West Conshohocken, Pennsylvania.

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Works Association, Denver, Colorado.

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

UBC 504.6, 1997, *Uniform Building Code, General Building Limitations, Allowable Floor Areas, Area Separation Walls*, International Conference of Building Officials, Whittier, California.

UL, 1994a, *Electrical Appliance and Utilization Equipment Directory*, Underwriters Laboratories, Northbrook, Illinois.

UL, 1994b, *Electrical Construction Material Directory*, Underwriters Laboratories, Northbrook, Illinois.

UL, 1994c, *Fire Protection Equipment Directory*, Underwriters Laboratories, Northbrook, Illinois.

UL, 1994d, *Fire Resistance Directory*, Underwriters Laboratories, Northbrook, Illinois.

GOVERNMENT DOCUMENTS

A-A-1922A, 1995, *Shield, Expansion (Caulking Anchors, Single Lead)*, Federal Specifications.

A-A-1923A, 1995, *Shield, Expansion (Lag, Machine and Externally Threaded Wedge Bolt Anchors)*, Federal Specifications.

A-A-1924A, 1995, *Shield, Expansion (Self Drilling Tubular Expansion Shell Bolt Anchors)*, Federal Specifications.

A-A-1925A, 1995, *Shield, Expansion (Nail Anchors)*, Federal Specifications.

A-A-1556A, 1996, *Sealing Compound (Elastomeric Joint Sealant)*, Federal Supply Service.

A-A-55614, 1995, Shield, Expansion (Non-Drilling Expansion Anchors), Federal Specifications.

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DOE Order 6430.1A, 1989, *General Design Criteria*, section 1300-12.4.10, U.S. Department of Energy, Washington, D.C.

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

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