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ENGINEERING CHANGE NOTICE

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CVDF ELECTRICAL SYSTEM DESIGN DESCRIPTION (SYSTEM 20)

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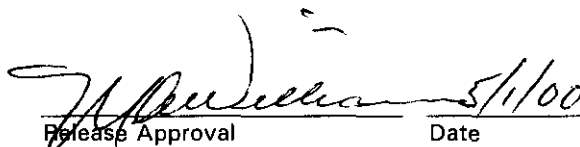
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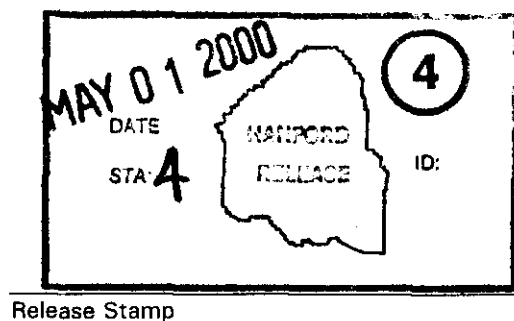
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Assistant Secretary for Environmental Management

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Richland, Washington


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**COLD VACUUM DRYING FACILITY
ELECTRICAL SYSTEM
DESIGN DESCRIPTION**

SYSTEM 20

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1.0 INTRODUCTION

This system design description (SDD) provides a technical explanation of the design and operation of the electrical system for the Cold Vacuum Drying Facility (CVDF). This SDD also identifies the requirements, and the basis for the requirements and details on how the requirements have been implemented in the design and construction of the facility. This SDD also provides general guidance for the surveillance, testing, and maintenance of this system.

1.1 System Identification

The electrical system is comprised of six subsystems that, together, provide normal power, lighting, grounding, uninterruptible power, lighting/surge protection, and standby power. The sections presented below provide a brief summary of each of these subsystems.

1.1.1 Electrical Power Distribution System (Subsystem 20.1)

The normal electrical power distribution system is comprised of the 13.8 kV, 480Y/277 V, and 208Y/120 V systems and equipment required for the distribution and transformation of electrical power. The normal electrical system supports all of the operational activities conducted by this facility. This system is a radial type feed from a single 13.8 kV overhead line, a service transformer, and main switchboard. Figure 1-1 shows how this distribution is accomplished.

1.1.2 Lighting System (Subsystem 20.2)

The lighting system comprises the CVDF interior and exterior general lighting, emergency lighting fixtures, emergency exit lights, and the associated switching equipment. The system uses high-efficiency, high-intensity discharge and fluorescent type sources and fixtures for general exterior and interior illumination. Emergency and exit lights house integral batteries that provide lighting in case of normal power failure. Provision is also made for backup lighting during high-intensity discharge lamp restrike periods. Lighting is provided in all areas of the CVDF.

1.1.3 Ground System (Subsystem 20.3)

The ground system provides the power system neutral ground reference, the instrumentation signal ground reference, the ground electrode connection for dissipating static and lightning, and the equipment grounding and bonding paths for ground fault current flow. The ground system consists of the grounding electrode system, grounding electrode conductors, and the equipment-grounding conductors.

1.1.4 Uninterruptible Power Supply System (Subsystem 20.4)

The facility Uninterruptible Power Supply (UPS) system includes the batteries/rectifier/charger/inverter assembly and associated 208Y/120 V distribution panelboard LPN-2. This system operates online continuously and converts rectified normal AC power or battery DC power to

clean AC power. On failure of the facility UPS system itself, an automatic bypass feeds the normal AC input to the system load. Figure 1-2, panel DG-DP-001 circuits 8 and 14, depicts this system.

1.1.5 Lightning/Surge Protection System (Subsystem 20.5)

The lightning/surge protection system provides protection against high voltage switching and lightning-induced surges in the power system, low voltage transients, and direct lightning strikes. This system consists of surge arrester equipment, lightning air terminal and grounding equipment, and low voltage transient suppression equipment.

1.1.6 Standby Power System (Subsystem 20.6)

The standby power system consists of a diesel generator, transfer switches, motor controllers and distribution cable to power specific loads in the event of a power failure. The primary function of the facility standby power system is to maintain process cell HVAC exhaust flow in the ductwork and a negative differential pressure in the process bays with respect to the reference outside air. Figure 1-2 depicts this system.

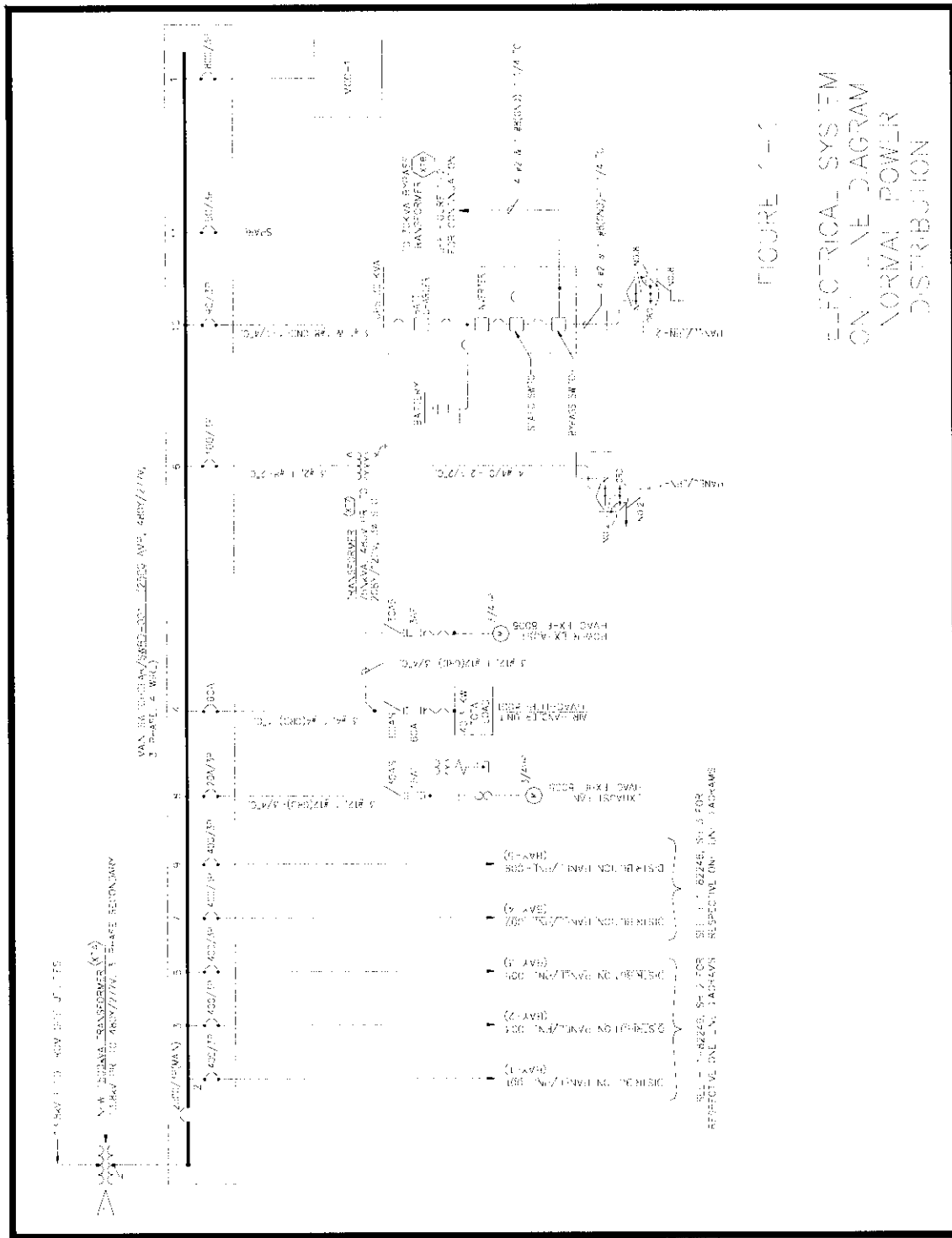


Figure 1-1. One-Line Diagram of the Power Distribution System

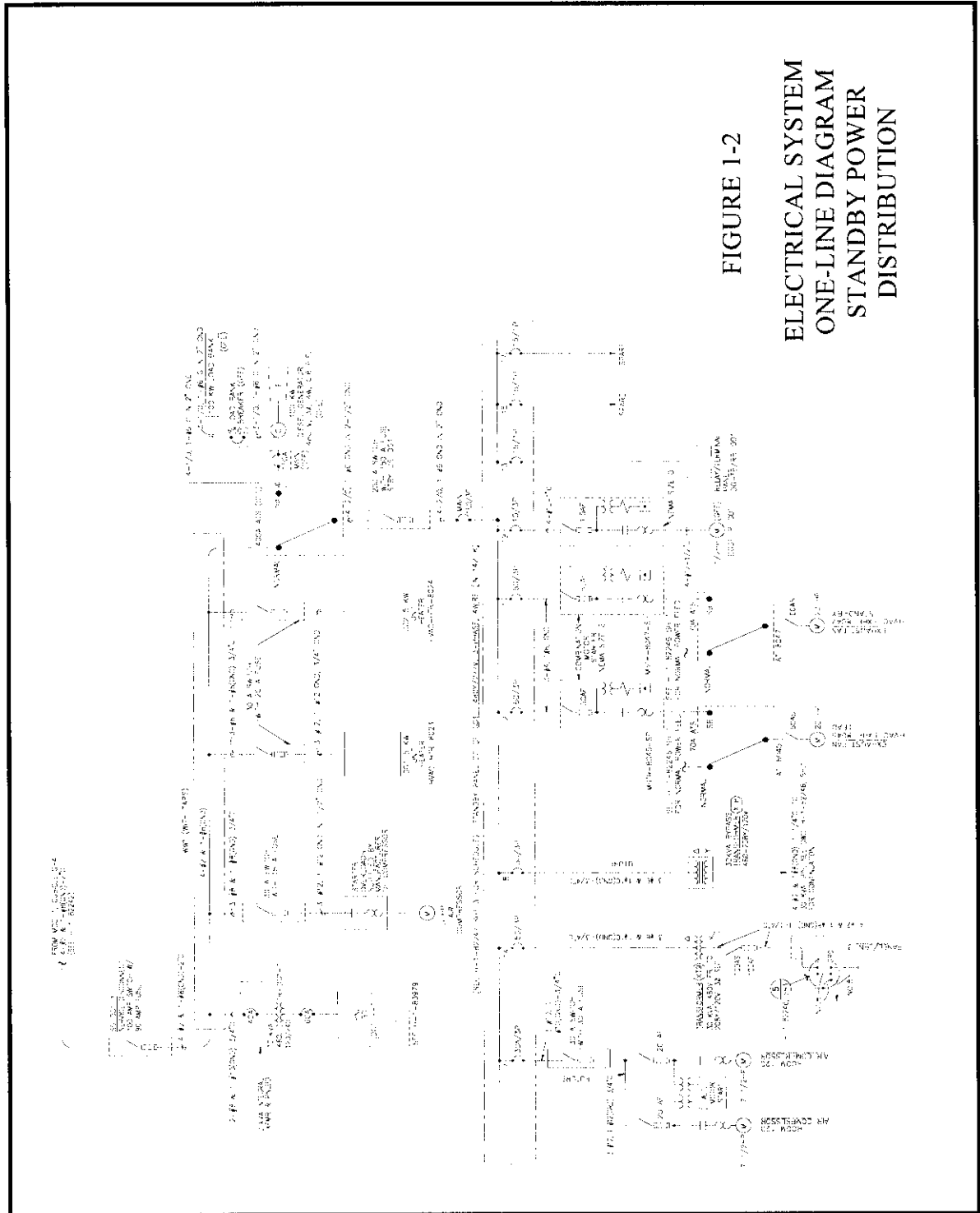


FIGURE 1-2
ELECTRICAL SYSTEM
ONE-LINE DIAGRAM
STANDBY POWER
DISTRIBUTION

ACA 1.1.1.1 3075.1.1 2.0.00

Figure 1-2. One-line Diagram of the Standby Power System

1.2 Limitations of This SDD

The SDD does not include any electrical systems beyond the perimeter of the CVDF or any of the process-related systems. This SDD has been prepared with the best available information taken from reviewed and approved design documents and drawings. Final update of this SDD will incorporate future design changes, construction information, as built, and test/operating data.

This SDD, when used in conjunction with the other elements of the Definitive Design package, provides a complete picture of the electrical system for the CVDF. Elements of SDD include functions, requirements, and descriptions. Other documents comprising the Definitive Design of the electrical system 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)
- Sequence of Operations (see HNF-2356)

1.3 Definitions

The CVDF Design Authority assigned to the electrical 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 Standard Institute
ARMs	area radiation monitors
ATS	automatic transfer switch
AWG	American Wire Gauge
CAMS	Continuous Air Monitoring System
CVDF	Cold Vacuum Drying Facility
DOE	U.S. Department of Energy
FM	Factory Mutual
FSAR	Final Safety Analysis Report
HVAC	heating, ventilating, and air conditioning
IEEE	Institute of Electrical and Electronics Engineers
IES	Illuminating Engineering Society
MCC	Motor Control Center
MCO	Multi-Canister Overpack
MCS	Monitoring and Control System
NEC	National Electric Code
NEMA	National Electric Manufacturer's Association
NFPA	National Fire Protection Association

SNF-3075 REV 1

PWC	Process Water Conditioning
QA	Quality Assurance
SCIC	Safety Class Instrumentation and Control (system)
SDD	System Design Description
SNF	Spent Nuclear Fuel
SNM	special nuclear material
TSR	Technical Safety Requirements
UL	Underwriter's Laboratories
UPS	Uninterruptible Power Supply
VFD	Variable Frequency Drives

2.0 GENERAL OVERVIEW

2.1 System Functions

This section lists the both normal functions and safety functions of the electrical system.

2.1.1 Normal Functions

The electrical system consists of several subsystems that perform specific functions, including: power distribution, lighting, grounding, UPS service, and lightning/surge protection.

2.1.2 Safety Analysis Report Safety Functions

The CVDF electrical system includes a safety-significant standby power system that provides defense in depth by maintaining flow in the process bay local exhaust heating, ventilating, and air conditioning (HVAC) system.

The safety functions require the standby power subsystem to provide 100 kW of power within 30 seconds after loss of normal power. Restart circuitry is also to be provided as necessary for the restart of the process bay local exhaust HVAC motors and process hood isolation dampers, and to power the UPS for the differential pressure alarms in the process bay areas. Standby power is to be available for the duration of the normal power outage.

2.2 System Classification

The facility standby power system is designated safety significant. Other electrical system components are designated general service. The electrical system components are designated Performance Category 2 using U.S. Department of Energy (DOE) standard DOE-STD-1020-94, *Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities*.

2.3 Basic Operational Overview

The basic operations are listed below for each subsystem of the CVDF electrical system.

2.3.1 Electrical Power Distribution System (Subsystem 20.1)

The normal electrical power distribution system provides the normal electrical power for the CVDF interior and exterior needs. This system supplies the 480/277 V and 208/120 V power for all of the process equipment within the CVDF and supplies power for external equipment (e.g., pole-mounted lights). The design includes the extension of an overhead 13.8 kV primary circuit from existing poles at a point adjacent to the site. The existing circuit is extended and routed overhead to a point near the south edge of the CVDF site. Using fused cutouts and lightning arresters, the extended overhead circuit is converted to an underground circuit to supply the CVDF pad-mount transformer. The source of the normal electrical power distribution system is

the existing 13.8 kV overhead line C7-L14 fed from breaker C7X14 located in 230 V/13.8 kV substation A7 switchgear building. See drawing H-1-5223.

2.3.2 Lighting System (Subsystem 20.2)

The lighting system provides the necessary non-safety-class illumination in all areas of the CVDF, internal and external, that allows personnel to carry out their duties for operations and maintenance.

Exterior building lighting is provided using metal-halide, wall-mounted fixtures with photocells installed at all exterior doors. Interior facility lighting consists of energy-efficient fixtures typically operated at 120 V. High-bay area lighting consists of metal-halide fixtures when ceiling height permits. Lighting for storage areas and mechanical areas are high-output industrial fluorescent fixtures. Other interior lighting consists of surface or flush-mounted commercial fluorescent fixtures. Multiple-level switching is generally provided for areas with fluorescent fixtures.

System emergency lighting is provided inside the facility in accordance with American National Standard Institute (ANSI)/NFPA 101, *Life Safety Code*. Emergency lighting in areas with fluorescent lighting is provided by use of fluorescent fixtures with integrally mounted backup battery packs with a 90-minute capacity. Exit signs are provided at the interior of each building exit. In areas where means of egress are not readily apparent, directional exit signs are provided. Exit signs include integral chargers, batteries, and relays to provide illumination automatically upon failure of the normal power source.

2.3.3 Ground System (Subsystem 20.3)

Grounding characteristics at the Hanford Site are such that supplemental cable for a ground grid or loops and attachment to well casings is required to satisfactorily reduce ground resistance. The ground system provides the non-safety, normal ground connection and ground reference for the normal utility service and separately derived power systems for the CVDF and processes. This system supports both the interior and exterior needs of the CVDF. Equipment grounding conductors are provided in accordance with Article 250-57(b) of ANSI/NFPA 70, *National Electrical Code* and ANSI-C2, *National Electrical Safety Code*. A minimum of a No. 12 American wire gauge (AWG) copper ground conductor is used with low-voltage power circuits. Grounding conductors are sized as a minimum in accordance with ANSI/NFPA 70 and ANSI/Institute of Electrical and Electronics Engineers (IEEE) 142, *Practice for Grounding of Industrial and Commercial Power Systems*.

2.3.4 Uninterruptible Power Supply System (Subsystem 20.4)

The facility UPS system provides reliable, clean AC power for those lighting and instrumentation and control system loads that require continuous, stable electrical power. A central facility UPS system is provided for the radiation monitoring instrumentation, oxygen-monitoring system, special purpose receptacles, and for monitoring and control system (MCS).

This UPS system is supplied for clean power to these systems. Note: Any security system and safety class instrumentation and control (SCIC) UPS requirements are met by those systems.

One 30-kVA UPS system is provided. The UPS system is complete with isolation and bypass transformers, battery charger, battery packs, battery disconnect switch and circuit breaker, manual bypass switch, and a maintenance bypass switch. The facility UPS system distribution panel provides continuous power during, but not after, a design basis accident to the MCS programmable logic controllers, process bay remote input/output panels, operator control stations A and B, Hanford Local Area Network receptacles, continuous air monitors (CAMs), area radiation monitors, and oxygen monitors for a minimum of one-hour run time at full load.

The safety-class instrumentation and control (SCIC) system local control panels (one each in process bays two through five) and the annunciator panel (in the control room) do not require a UPS directly; a power-conditioning device is required that is derived from a UPS device. The SCIC system UPS is provided as part of the SCIC system design. Seismic trip equipment is provided with a self-contained UPS system. The SCIC is described in SNF-3091.

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

2.3.5 Lightning/Surge Protection System (Subsystem 20.5)

The lightning/surge protection system provides protection against high voltage surges and transients in the power system that may damage process and facility equipment. This system protects the CVDF electrical system from damage due to direct lightning strikes on the external CVDF and components.

Lightning protection is provided for the CVDF using pole-line mounted lightning arresters and roof mounted air terminals. The lightning protection system complies with the requirements of the latest edition of ANSI/NFPA 780 and ANSI/NFPA 70. The lightning protection system is passive. The building trim, stairs, ladders, railings, structures, and siding are of conductive material and are bonded to the building ground grid. Conductive pipe and ducting systems are continuous and bonded to the ground grid.

2.3.6 Standby Power System (Subsystem 20.6)

The standby power distribution system provides the standby electrical power for the CVDF process bay local exhaust HVAC and process vent system to provide confinement in the process bays and dilution flow within the local exhaust duct during facility loss of electrical power. This system supplies the 480Y/277 V power from a 100 kW diesel generator for all the process bay local exhaust HVAC fans(one at a time), the local exhaust isolation damper actuator solenoid valves, the bypass transformer to pickup UPS loads if batteries are depleted, instrument air compressors, and the CVDF lighting fixtures. The heated diesel generator building consists of two rooms that house two diesel generators, air start system, and control panel for the operating generator. The diesel is fueled from a 50 gal. day tank in the building and a 500 gal. supply tank

located outside the building in an above ground area. The capacity of fuel will allow at least 24 hours of operation without refueling.

3.0 REQUIREMENTS AND BASES

3.1 General Requirements

This section of the SDD lists the functional safety, environmental, mission-critical, and general requirements of the CVDF electrical system.

3.1.1 System Functional Requirements

Functional requirements of the electrical system include design requirements, safety requirements, environmental requirements, mission critical requirements, and general requirements.

3.1.1.1 Safety Functional Requirements

3.1.1.1.1 Safety Class Requirements. There are no safety class functions associated with this system.

3.1.1.1.2 Safety Significant Requirements

1. **Requirement:** Provide sufficient standby power to supply designated safety significant loads for a minimum period of 24 hours.

Basis: HNF-3553 (FSAR), Section B.4.4.7.3.

How the system meets the requirement: A 100 kW diesel generator will be used to power the standby power system.

2. **Requirement:** The building shall be maintained at a temperature above 40°F to meet vendor recommendations. The diesel fuel in the day tank shall be maintained above minimum temperature setting of 40°F to support engine start capability.

Basis: HNF-3553 (FSAR), Section B.4.4.7.3.

How the system meets the requirement: The diesel generator has electric unit heaters to heat the building. The diesel fuel in the Day Tank will be maintaining a the minimum fuel viscosity.

3. **Requirement:** Provide restart circuit to perform necessary functions to restart the process bay local exhaust HVAC and process vent system including fan motor logic and damper positioning within 1 minute after loss of normal power. Provide power to the facility UPS bypass transformer, air compressor motors, and CVDF lighting fixtures, which enhances the reliability of these general service systems that are not mandatory but provide defense in depth.

Basis: HNF-3553 (FSAR), Section B.4.4.7.3.

How the system meets the requirement: The automatic transfer switch (ATS) senses the loss of normal voltage and sends a start signal to the diesel generator. When the generator reaches 70 percent of normal voltage the transformer switch will disconnect the generator load bank and transfer the process local bay exhaust HVAC, process vent system, UPS bypass transformer, instrument air compressor and CVDF lighting fixtures to the standby diesel generator.

4. **Requirement:** Ensure the standby power system is operable, the system instrumentation is reading correctly, and periodic testing is conducted.

Basis: HNF-3553 (FSAR), Section B.4.4.7.3.

How the system meets the requirement: The diesel generator has a load bank that allows testing of the diesel generator without interruption of normal power.

5. **Requirement:** Provide a safety-significant standby power system that is qualified to Performance Category 2 criteria for natural phenomenon.

Basis: HNF-3553 (FSAR), Section B.4.4.7.3.

How the system meets the requirement: The diesel generator has been designed for Performance Category 2 natural phenomenon criteria.

3.1.1.1.3 Other Safety Requirements. There are no safety requirements for the electrical system.

3.1.1.2 Environmental Requirements. There are no specific environmental requirements for the electrical system.

3.1.1.3 Mission-Critical Requirements. There are no mission-critical requirements for the electrical system.

3.1.1.4 General Operational/Function Requirements. The operating life of the facility is scheduled to be three years; the design life is five years.

3.1.2 Subsystem and Major Components

This section details the requirements of the electrical supply, the normal power distribution, standby power distribution, UPS power, grounding, lightning/surge protection, and interior and exterior lighting systems of the CVDF.

3.1.2.1 Electrical Power Distribution System

1. **Requirement:** The primary voltage for distribution of normal power shall be 13.8 kV from the supporting utility.

The 480/277 V power for the process bays shall be available at local panelboards. The power for non-process equipment may be fed from the main switchboard fed from the CVDF 13.8 kV- 480Y/277 V transformer or a motor control center (MCC) connected to this switchboard.

The general use power shall be 208/120 V three-phase and single-phase supplied from panelboards in local areas.

Basis: These requirements are based on standard industry codes and practices.

How the system meets the requirement: The one-line drawings H-1-82246 and H-1-83987 and panel schedules H-1-82247 show implementation of this requirement.

2. **Requirement:** (a) Oil –filled insulated transformers shall be located outside of buildings or inside in approved vaults. (b) Distribution transformers shall be indoor, dry type with 480 V delta-connected primaries and 208Y/120 V secondaries with the neutral solidly grounded. (c) Each transformer shall have four 2.5 percent full voltage taps, two above and two below rated primary voltage. d) Where possible the transformers should be located adjacent to their associated panelboards.

Basis: These requirements are based on standard industry codes and practices

How the system meets the requirement: Drawing H-1-82242 shows the oil-filled transformer outside the CVDF. The one-line drawings H-1-82246 and the Construction Specification W-441 C1 give the transformer requirements.

3. **Requirement:** (a) Outside transformers shall be a minimum distance away from the facility or the transformer shall be placed adjacent to special fire-resistant walls. (b) Outdoor combustible liquid insulated transformers, 500kVA or larger, shall be provided with the following fire protection: (at least) one hydrant; connection to an adequate water supply; standard hose house; Underwriter’s Laboratories (UL)-approved A-B-C fog nozzles in the vicinity.

Basis: These requirements are based on standard industry codes and practices

How the system meets the requirement: Drawing H-1-82242 shows the oil-filled transformer outside the CVDF. The Construction Specification W-441 C1 specifies the transformer oil to be “less flammable” which meets the National Fire Protection Association (NFPA) requirements, therefore no additional fire protection is required.

4. **Requirement:** (a) Kilowatt-Hour Meters with Demand Metering shall be provided for the facility and site load management program (field data acquisition system). (b) The switchgear power bus shall be isolated or insulated such that bare bus bars shall not be exposed when a door is opened or a rear panel is removed. (c) Switchgear main breakers shall have solid-state trip units with selective characteristics to facilitate overload and short circuit protection, ground fault protection, and system coordination. d) Panelboards

for 480-277 V ac and 120 V ac supply shall be located in each of the process bays and in the office area electrical room of the building, and shall be National Electric Manufacturer's Association (NEMA) PB 1 circuit breaker type. Separate panelboards for general use, power and process bay loads shall be provided. The panelboards shall include the following minimum features:

- 1) Main circuit breakers shall be installed in all panelboards.
- 2) Branch circuit breakers shall be of the bolt-on thermal magnetic, molded case, overload and short circuit-type with a minimum trip rate of 15 amp and a minimum interrupting rate of 10,000 amp for 120/208 V branch circuits and 14,000 amp for 277/480 V branch circuits and shall be limited to no greater than the 400 amp trip rating size.
- 3) Latch and tumbler-type lock on door of trim.
- 4) Insulated neutral bar.
- 5) A separate, uninsulated equipment ground bus.
- 6) Approximately twenty percent spare bus capacity in each panelboard for future loads in addition to loads identified during design (design goal for initial design).
- 7) Approximately twenty percent spare circuit breakers in each panelboard in addition to loads identified during design (design goal for initial design).
- 8) Panelboards in accordance with the requirements of the National Electric Code (NEC) and UL.

(e) Disconnect switches shall be provided for all motors and located within sight of the motor-driven device. Disconnect switch handles shall be designed for padlocking in the "off" position. (f) Motor Control Centers (MCC) shall be in accordance with NEMA ICS standards and UL 508 (DOE Order 6430.1A, - 1640-2.5), metal-enclosed, free-standing, dead-front, with type I enclosure and type B, class I wiring. The MCC's columns shall be labeled alphabetically and the rows shall be numeric. (g) Motor control centers shall serve 460 V motors in the range of 0.5 hp through 100 hp. (h) Starters for 460 V, three-phase motors shall be combination-type consisting of an adjustable instantaneous trip circuit breaker or motor circuit protector, a magnetic contactor with overload relays in each phase, and other necessary control devices. Minimum starter size shall be NEMA size 1. Minimum contactor size shall be NEMA size 0. Control transformers shall be sized for 125 percent of the design connected load, with fused and grounded secondary. Starters shall in general be suitable for full voltage starting except for those cases where reduced voltage or adjustable speed control is required. (i) Feeder circuits shall be protected by thermal magnetic circuit breakers.

Basis: These requirements are based on standard industry codes and practices

How the system meets the requirement: The one-line drawings H-1-82246 and panel schedules H-1-82247 show the circuit breaker ratings and the Construction Specification W-441 C1 gives the panelboards, MCC and disconnect switches specifications. The switchboard requirements are on drawing H-1-82246.

5. **Requirement:** (a) Voltage and insulation levels, continuous current ratings, interrupting ratings, and mechanical strength shall be selected in accordance with calculated values, standard levels for the respective equipment and the recommendations of the codes and standards. (b) Feeder circuits to switchgear, transformers, and panelboards shall be rated to coordinate with associated equipment. (c) Demand factors applied in accordance with the NEC and used as the basis for sizing power transformers and switchgear. (d) Feeder ampere ratings for MCCs, dry-type transformers, and panelboards shall be based on the bus rating of the equipment.

Basis: These requirements are based on standard industry codes and practices

How the system meets the requirement: The one-line drawings H-1-82246 and panel schedules H-1-82247 show the circuit breaker ratings and supporting calculations set the requirements. The voltage, continuous current, interrupt current, and insulation levels have been selected to ensure safe operation of the feeders and equipment. The mechanical strength and durability of the medium voltage distribution feeders has been considered in the selection of the conductors

6. **Requirement:** (a) The system protective devices shall be selected and applied to minimize damage to the electrical system. These devices also shall limit the extent and duration of service interruptions due to overload or fault conditions. The devices shall be coordinated such that the interrupting device nearest to the point of short circuit (or overload) shall open first and minimize disturbances on the rest of the system. (b) The electrical components shall be completely coordinated in for short circuit capacity, interrupting duty and capability, insulation levels, protective relaying, reliability, interchangeability, transformer and line voltage drop, stability under normal conditions and restart on power dips and outages.

Basis: These requirements are based on standard industry codes and practices and DOE Order 6430.1A, sections 1630-2.1 and 1640-1.6.

How the system meets the requirement: The one-line drawings H-1-82246 and panel schedules H-1-82247 show the circuit breaker ratings and supporting calculations set the requirements. Panelboard and switchgear will be sized to exceed the available fault current interrupt ratings. The protective equipment has been selected to minimize the duration and magnitude of any overcurrent situation. In addition, the protective equipment has been chosen such that the device closest to a fault trips first and are installed as close as possible to the equipment that it protects to minimize the damage that is done to the power distribution system.

7. **Requirement:** Electrical enclosures shall be designed in accordance with NEMA 250 and suitable for the environmental conditions encountered.

Basis: These requirements are based on standard industry codes and practices.

How the system meets the requirement: The drawings and the Construction Specification W-441 C1 identify the appropriate enclosure specifications for the environmental conditions.

8. **Requirement:** (a) Switchgear bus capacity shall exceed the maximum transformer loading. (b) Distribution and lighting panelboards and transformers shall be sized for an additional 25 percent load capacity as an initial design margin for reliability and flexibility. (c) Batteries for the UPS shall be sized such that the maximum identified load on these systems shall be a maximum of 75 percent of the system capacity. (d) UPS inverters shall be sized such that the maximum identified load on this system shall be a maximum of 75 percent of the system capacity. (e) All terminal boxes (except motor terminal boxes) shall be designed as to have sufficient terminal points to terminate all conductors entering the box and should have 25 percent for future. (f) Underground pull boxes shall have a minimum of 25 percent spare space for conduits in each wall having one or more windows. (g) The switchboard bus section shall have a minimum of one spare breaker and one space. (h) The MCC shall have a minimum of three spaces for future feeder circuit breakers and motor starters:

Basis: These requirements are based on standard industry codes and practices.

How system meets the requirement: The Construction Specification W-441 C1 and one-line drawings H-1-82246 and panel schedules H-1-82247 show or specify the spare capacity for the UPS and the switchgear and panelboards.

9. **Requirement:** (a) The allowable voltage drop in feeder cables during normal operation at full load shall not exceed three percent. (b) The allowable voltage drop during motor starting shall not exceed 15 percent at the motor terminals or five percent on the MCC bus. (c) Load centers shall be directly connected to secondary switchgear. With voltage drop in accordance with ANSI C84.1. (d) Transformer regulation shall not be considered for normal operating conditions. (e) Transformer impedance shall be considered for voltage drop calculations during starting of large motors.

Basis: These requirements are based on standard industry codes and practices.

How the system meets the requirement: The conductors are sized appropriately so the line impedance does not cause excessive voltage drops during normal operation or motor startup conditions. Variable Frequency Drives (VFD) motor starters were used to reduce the starting current of the larger motors as necessary.

10. **Requirement:** (a) The design power factor, at the service bus, should be 0.95 under steady-state conditions. (b) For continuous-duty motors rated 20 hp and larger, capacitors or variable speed controllers shall be installed.

Basis: These requirements are based on standard industry codes and practices.

How the system meets the requirement: The Construction Specification W-441-C1 requires motors to be high-efficiency. Motors 20 hp and larger use VFD motor starters. Some of the other loads, including the lighting ballasts and UPS are specified to meet power factor requirements. The system power factor will not be finalized until all equipment is installed and the CVDF is operational.

11. **Requirement:** Sufficient access to and working space about electrical equipment shall be provided to permit ready and safe operation and maintenance of such equipment. Article 110 of NFPA 70 shall be used to determine the minimum access and working space.

Basis: These requirements are based on standard industry codes and practices.

How the system meets the requirement: The locations shown on the drawing for the switchgear, panelboards, and MCC allow sufficient working clearance in front of the equipment.

12. **Requirement:** Control voltage for the CVDF equipment shall be as follows:
- a. Motor controllers, control circuits for motors shall be 120 V, grounded systems.
 - b. Process equipment skids, control circuits shall be 24 V, grounded system.
 - c. Facility packaged mechanical equipment, control circuits shall be 120 V ac, grounded system.

Basis: These requirements are based on standard industry codes and practices.

How the system meets the requirement: The drawings and Construction Specification W-441 C1 require appropriate 120 V control circuits for motor control, relays and packaged equipment.

13. **Requirement:** (a) The wiring method known as “open wiring on insulators” (NEC Article 320) shall not be permitted for interior wiring. (b) Concealed knob-and-tube wiring (NEC Article 324) shall not be permitted for interior wiring. (c) The wiring methods known as “nonmetallic-sheathed cable-types NM and NMC” (NEC Article 336), “service-entrance cable-types SE and USE” (NEC Article 338), and “underground feeder and branch-circuit cable-type UF” (NEC Article 339) shall not be permitted for interior wiring. (d) All conductors shall be UL-listed and insulations shall be fire resistant. Type THHN/THWN insulation shall be specified. (e) Conductors for class 1 remote control and signal circuits shall be enclosed in cable and shall comply with NFPA 70. (f) Conductors for class 2 low-energy remote control and signal circuits shall be not smaller than No. 18 AWG. Power and lighting conductors shall be 600 V, type THHN/THWN or XHHW. Conductors required to be rated 90 °C (195 °F) in accordance with NFPA 70 shall be type RHH, THW, or THHN. (g) Conductors in high-temperature areas shall be NEC types FEP or TFE as required. (h) Bonding and grounding conductors shall be

sized in accordance with NEC Article 250. (i) The standard for all phasing and phase rotation shall conform to the existing site system. In general, the proper sequence for panels and switchgear is A-B-C from left to right, from top to bottom, front to back (as viewed from front), operating side of buses, breakers, panels, and switchgear. (j) Conductors for interior electrical systems shall be copper. (k) Conductors for low voltage power and lighting branch circuits shall be No. 12 AWG, minimum, except flexible cords and flexible cables, not in conduit, which shall be No. 16 AWG, minimum. (l) Power conductors in conduit shall be No. 12 AWG, minimum. (m) Conductors for control circuits should be stranded copper, No. 14 AWG, minimum, except that crane and elevator circuits, remote control circuits, signaling circuits, power limited circuits, fire protection signaling systems, class 2 low-energy data acquisition signal circuits, instrumentation and communication circuits shall be sized in accordance with the NEC, Articles 610, 620, 725, 760, and 800. (n) Conductors for class 1 remote control and signal circuits shall be enclosed in cable and shall comply with NFPA 70.

Basis: These requirements are based on standard industry codes and practices.

How the system meets the requirement: The drawing notes and Construction Specification W-441 C1 specify appropriate wire sizes and types all of all wiring which is allowed.

14. **Requirement:** (a) Selection and installation of raceways, elbows, couplings, and other fittings shall comply with the applicable sections of the DOE Order 6430.1A and the provisions of the NEC with the following restrictions. (b) Neither aluminum conduit nor electrical metallic tubing shall be embedded in concrete or buried in earth. (c) The wiring method known as “nonmetallic extensions” (NEC Article 342), “surface raceways” (NEC Article 352), and “multi-outlet assembly” (NEC Article 353) shall not be wall- or partition-mounted at elevations less than 1.2m (4 ft) above floor level unless protected by running boards or the building finish from contact (e.g., by moving furniture, benches). (d) Conduit and other raceways embedded in concrete or masonry shall be adequate in number and capacity for the initial and projected facility requirements. Polyvinyl chloride conduit shall be allowable for concrete-embedded applications; however offsets and bends shall be metallic. (e) Electric metallic tubing also shall be considered for wider use, in lieu of rigid metal conduit or intermediate metal conduit, except where the conduit would be subject to severe physical damage such as below a 2.4-m (8 ft) elevation in areas where forklifts or other vehicles operate, or corrosion damage, or where it would be embedded in concrete or buried. (f) Conduit installations shall not contain runs exceeding 61 m (200 ft) between pull points unless specifically approved. (g) Separate dedicated raceways shall be provided for each of the following systems: radiation and breathing air alarm, fire alarm, voice paging and building evacuation systems, telephone and data communication, and any other electrical systems as specified by the NEC. (h) Fittings and conduit bodies for both rigid galvanized steel and intermediate metal conduit shall be threaded and conform to NEMA FB-1 with material to match conduit. Pull boxes and junction boxes shall be NEMA 250, Type 4.

Basis: These requirements are based on standard industry codes and practices.

How the system meets the requirement: The drawing notes and Construction Specification W-441 C1 specify appropriate conduit sizes and type required for use in the specific areas where the conduit is installed.

15. **Requirement:** (a) Adequate ground continuity shall be maintained for all metallic conduit runs. An insulated ground wire shall be located in all conduit runs. The conduit shall not be used as a ground conductor. (b) Raceways shall be designed with the required separations between systems in accordance with DOE Order 6430.1A. (c) All spare ducts and conduits shall contain a pull rope to facilitate future installations. Conduits embedded in walls, ceilings and in or under floor slabs shall not be less than 0.75 inches in size. (d) Additional power distribution system capacity shall be designed into the system. (e) A minimum of 0.5-in.-sized conduit shall be specified for interior installations. (f) All conduit raceway systems entering the process bay areas and between floors shall be equipped with conduit seal-off fittings. All conduits containing wire or cables shall be sealed with an approved non-hardening compound. Spare conduits between these areas shall be sealed with an approved non-hardening putty-type compound. (g) Openings around electrical conduit penetrations through fire-rated walls, partitions, floor, or ceiling shall be fire-stopped using UL-approved methods. (h) All exposed raceways shall be provided with identification systems for maintenance and safety purposes. Raceways shall be identified with applicable markers at strategic locations to indicate such characteristics as the type of system and voltage for the circuit contained. Labeling shall be in accordance with Hanford Site standards per WHC-SD-SNF-DGS-002, *Spent Nuclear Fuel Project Equipment and Piping Labeling Guide*. (i) The use of cable trays shall be considered for large multiple-cable applications. Separate trays shall be used for instrumentation and control applications. The use of cable trays in areas of potential contamination shall be avoided.

Basis: These requirements are based on standard industry codes and practices.

How the system meets the requirement: The drawing notes and Construction Specification W-441 C1 specify conduit sizes and type, grounding and sealing requirements for the specific areas. The conduits will be identified per WHC-SD-SNF-DGS-002.

16. **Requirement:** (a) Wall-mounted duplex convenience outlets shall be provided in all rooms in accordance with NFPA 70. (b) General outlets shall be NEMA type 5-20R. Special receptacles, color-coded orange, shall be specified for any clean power outlets. (c) All outlets shall be labeled for voltage above 120 V ac with the applicable voltage and number of phases. (d) An outlet shall be provided at each process bay exit within a distance of 0.9-m (3 ft) from the door for support of portable monitors. (e) Convenience outlets for the process bays shall consist of 115 V ac, three-prong grounding outlets, per NEMA type 5-20R for areas that potentially will be decontaminated and shall have ground fault current interrupters at the feeder breaker. (f) Receptacles within 1.8 m (6 ft) of sinks, located within enclosures with sinks, or in any other area where sinks are

present shall be provided with ground-fault interrupter protection. (g) All outside receptacles shall be provided with ground-fault interrupter protection.

Basis: These requirements are based on standard industry codes and practices.

How the system meets the requirement: The drawing H-1-82242 and H-1-82247 and Construction Specification W-441 C1 specify and show ground fault receptacles or circuit breakers in the process cells, outdoor locations, wet areas and near sinks. Drawing H-1-82242 sheet 2 shows the receptacles for the personnel contamination monitors. Receptacles fed from the UPS system will be identified via orange color-coded receptacles.

3.1.2.2 Lighting System

1. **Requirement:** (a) Exterior lighting shall use metal-halide fixtures located where personnel or vehicle traffic is encountered and over all doorways and exits. This lighting shall be controlled with timers or photo cells. (b) Security or obstruction lighting is not required. (c) Emergency lighting and exit signs shall have integral battery backup. In areas with fluorescent lighting, the fixtures are equipped with integral emergency modules. Elsewhere, self-contained emergency fixtures with Parabolic Aluminized Reflector lamps shall be used. (d) The general lighting levels shall be in accordance with the Illuminating Engineering Society (IES) handbook.

Basis: Lighting level is to be a minimum of 0.2 ft candles at the floor level or per DOE 6430.1A whichever is more conservative and the IES handbook. The emergency and exit signs have a battery capacity of 40 minutes.

How the system meets the requirement: Illumination of the process bays is accomplished with metal-halide, high-intensity discharge fixtures that produce a minimum lighting level of 0.5 ft candles at floor level. Interior lighting is comprised of high-efficiency fluorescent and metal-halide lamps. Lighting is installed as required by DOE 6430.1A and the IES handbook to provide adequate lighting for a safe work environment. High-voltage and high-efficiency lighting are used where practical.

3.1.2.3 Ground System

1. **Requirement:** (a) Supplemental cable for a ground grid or loops shall be provided to satisfactorily reduce ground resistance to less than 25 ohms. (b) Ground systems shall comply with ANSI/NFPA 70, Article 250 and ANSI/IEEE-142. (c) A separate green insulated copper ground conductor (minimum #12 AWG) shall be run with each power circuit so the raceway or cable tray is not relied upon as the ground fault path.

Basis: The requirement for the addition of a ground grid or loops is based upon previous knowledge of the sites grounding characteristics. The other requirements are standard industry practice.

How the system meets the requirements: The ground grid was designed using the foundation footing rebar and installed in accordance with ANSI/NFPA 70, Article 250 and ANSI/IEEE-142 (drawing H-1-82246).

3.1.2.4 Facility Uninterruptible Power Supply System

1. **Requirement:** (a) A central facility UPS system is provided for production of clean electrical power. (b) The facility UPS system is capable of supporting its connected load on loss of normal AC power for one hour. (c) The UPS system shall operate the MCS, CAMs, and area radiation monitors (ARMs) in the event of normal power loss.

Basis: These requirements are based on engineering judgment and operation of similar facilities.

How the system meets the requirement: The UPS system and its battery is capable of operating the UPS system for one hour while the UPS is supplying its maximum rated load. The UPS is sized such that the maximum load placed upon the UPS no more than 75 percent of its maximum battery rating and 75 percent of its output inverter rating. The CAMs, ARMs, oxygen monitoring system, MCS, stack monitoring system, and other loads are provide UPS power through Panel LPN-2.

3.1.2.5 Lightning/Surge Protection System

1. **Requirement:** (a) Insulation levels of electrical equipment shall be coordinated with protective levels of surge equipment. (b) Electrical power and communication services from overhead lines shall have lightning and surge protection. (c) Lightning protection shall be provided per ANSI/NFPA 780 and include roof-mounted air terminals, a minimum of four downcomers, and bonding of exposed building metal to the building ground grid. (d) the exhaust stack shall include air terminals connected to a ground grip.

Basis: The lightning/surge protection system provides protection for facility equipment that could be damaged by the lightning strikes or other surges in the electrical system.

How the system meets the requirements: Pole-mounted lightning arresters (drawing H-1-82095) and the exhaust stack air terminals (drawing H-1-82211) and roof mounted air terminals (drawing H-1-83981) were installed. The building steel is bonded to the lightning protection ground system.

3.1.2.6 Standby Power

1. **Requirement:** Standby power shall be provided to maintain the process bay local exhaust HVAC and process vent system flow to accomplish sufficient differential pressure in process bays for confinement during an electrical outage that occurs during and after a gaseous release, internal or external hydrogen explosion, thermal runaway reaction, or multi-canister overpack (MCO) over pressurization accidents.

Basis: HNF-3553 (FSAR), Section B.4.4.7.1.

How requirements are met: These requirements are met by providing standby power system consisting of a generator, ATSS, motor starters to power the process bay local cell exhaust HVAC fans and local exhaust isolation damper solenoid valves. Fuel capacity is provided for a minimum operational period of 24 hours. The one-line drawing for the standby power is shown on H-1-83978.

2. **Requirement:** The standby power system shall provide a restart circuit to perform necessary functions to restart the process bay local exhaust HVAC and process vent system including fan motor logic and process hood isolation damper control during and after a gaseous release, MCO, internal or external hydrogen explosion, thermal runaway reaction, or MCO over pressurization accidents.

Basis: HNF-3553 (FSAR), Section B.4.4.7.1.

How requirements are met: These requirements are met by providing standby power generators, ATSS, motor starters to power the local process cell exhaust fans within 30 seconds after loss of normal power. The one-line drawing for the standby power is shown on H-1-83978. *An additional 30 seconds is allowed for the fans to provide the required flow.*

3. **Requirement:** (a) The standby power system shall meet the requirements of the National Phenomenon Hazard Design and Evaluation Criteria for DOE facilities.

Basis: This facility is in accordance with Performance Category 2 requirements using DOE-STD-1020-94.

How requirements are met: These requirements are met by providing standby power with a diesel generator, piping and instruments qualified and installed for Performance Category 2 natural phenomenon events.

3.1.3 Boundaries and Interfaces

3.1.3.1 Power Distribution. The power distribution system extends from the 13.8 kV line that is extended above ground with lightning arrester protection and then underground to the 13.8 kV – 480Y/277 V transformer. The 15 kV underground conductors must be tested upon receipt before installation, and tested after installation to ensure it is properly in place and adequate for reliable service.

The other boundary of the power distribution system is the main circuit breaker in the main switchgear where it interfaces with the loads from the 13.8 kV – 480Y/277 V transformer. These loads are protected via proper circuit breaker/disconnect placement and sizing, and installed according to their individual specifications.

3.1.3.2 Lighting System. The lighting system interfaces with the power distribution and grounding systems. Appropriately sized conductors and circuit protection are specified.

3.1.3.3 Grounding System. The grounding network interfaces with all systems that require grounding. It has no support requirements. Systems that interface with it have some connection requirements, such as minimum conductor size to ensure an adequate current path.

3.1.3.4 UPS Power System. The UPS power system interfaces with normal/standby power and loads that require uninterrupted service. These uninterruptible loads include the MCS, CAMS, and ARMS, and other support circuits. The UPS system is capable of operating for an hour without normal /standby power support.

3.1.3.5 Lightning/Surge Protection System. The lightning/surge protection system interfaces with the ground system and 13.8 kV power supply. The building's conducting materials are tied to the building ground grid.

3.1.3.6 Standby Power System. The standby power system extends from the 100 kW diesel generator and an ATS to the standby load panelboard. The standby panelboard feeds the process bay local exhaust system, CVDF lighting fixtures, facility air compressors, local exhaust isolation damper actuator solenoid valves, and the facility UPS bypass transformer.

3.1.4 Codes, Standards, and Regulations

The electrical system is designed and constructed in accordance with the following codes and standards. The DOE criteria refers to specific ANSI/IEEE and NEMA standards that are commonly used.

UL or Factory Mutual (FM) must list all materials and equipment, with label attached, when such products are available and listed.

- DOE Order 6430.1A, General Design Criteria, Division 16, *"Electrical Design Criteria"*
- ANSI/NFPA 70, *National Electrical Code*.

3.1.4.1 Electrical Power Distribution System

- ANSI/NFPA 70, *National Electrical Code*
- ANSI-C2, *National Electric Safety Code*

3.1.4.2 Lighting System

- ANSI/NFPA 101, *Life Safety Code*
- IES, *Illuminating Engineering Society Lighting Handbook*

3.1.4.3 Ground System

- ANSI/IEEE-142, *Practice for Grounding of Industrial and Commercial Power Systems*

3.1.4.4 Facility Uninterruptible Power Supply System

- UL-1778, *Uninterruptible Power Supply Equipment*

3.1.4.5 Lightning/Surge Protection System

- ANSI/NFPA 780, *Standard for the Installation of Lightning Protection Systems*
- IEEE C67 Series, *Guide for Surge Protection*

3.1.5 Operability

With the exception of the standby power, the electrical system does not serve any safety functions and is classified as general service. There are no unique operability requirements placed on these sections of the electrical system.

The standby power system is considered to be safety-significant and is designed in accordance with the DOE Performance Category 2 requirements.

The standby power shall maintain local exhaust flow to accomplish sufficient differential pressure in process bays during electrical outage during and after a gaseous release, over pressurization, and internal or external hydrogen explosion accidents.

The standby power system provides a restart circuit to perform necessary functions to restart the process bay local exhaust HVAC and process vent system including fan motor logic and damper positioning within 1 minute of losing normal power.

3.2 Special Requirements

This section of the report identifies special requirements that have been determined related to radiation and other special hazards.

3.2.1 Radiation and Other Hazards

The electrical system provides normal, standby and UPS power to all systems within the CVDF. The standby power system is classified as safety significant. All other portions of the electrical system are classified as general service. The electrical system is not responsible for the prevention or response to any radiation or other hazard.

3.2.2 As Low As Reasonably Achievable

Engineering controls and maintenance features are considered and incorporated into the design of the CVDF electrical system as appropriate. These features include:

- Design that allows the operation and maintenance of the equipment in low-dose rate areas.

- Local shielding provided in work areas that minimizes operator dose if the equipment cannot be placed away from significant sources of radiation.

Essential elements of the as low as reasonably achievable (ALARA) program are defined in G10 CFR 835/B2-Rev.0, *Implementation Guide for Use with Title 10, Code of Federal Regulations, Part 835 Occupational Radiation Protection*. The ALARA program implemented at the Spent Nuclear Fuel (SNF) Project facilities is documented in SNF-AP-5-006, *ALARA Goals, Training, and Control Level Administration*; SNF-AP-5-012, *Radiological ALARA Work Planning Process*; and SNF-AP-5-013, *Radiological ALARA Process*, which establish lines of responsibility for administering ALARA practices.

3.2.3 Nuclear Criticality Safety

The electrical system is not responsible for any nuclear criticality safety functions.

3.2.4 Industrial Hazards

There are no special electrical hazards for the CVDF electrical system.

3.2.5 Operating Environment and Natural Phenomena

All equipment enclosures and raceway systems used for electrical components and wiring distribution are environmentally suitable for the locations in which they are placed and the functions they support. Each CVDF room or physical area is considered individually in determining its classification, depending on the properties and quantities of the potential radioactive contamination, vapors, liquids, gases, chemicals, combustible dusts, or fibers that may be present. Special precautions are designed into the system for all areas with corrosive or hazardous atmosphere. In areas where no special requirements are identified, equipment capable of general service support is used.

3.2.6 Human Interface Requirements

There are no special human interface requirements placed upon the CVDF electrical system.

3.2.7 Specific Commitments

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

3.3 Engineering Disciplinary Requirements

This section identifies requirements that are derived from considerations directly related to an engineering discipline.

3.3.1 Civil and Structural

3.3.1.1 Seismic Calculations

1. **Requirement:** Seismic calculations on major components are to be made by a qualified individual. A documentation procedure for the calculations shall be provided.

Basis: Construction Specification W-441-C1 and good engineering practices.

How the system meets the requirement: Calculations were for a design basis earthquake using an equivalent static analysis. Design ground accelerations were 0.87g in each horizontal direction and 0.58g in the vertical direction. The accelerations provided are 1.5 times greater than the peak acceleration. The effects of the three orthogonal directions are combined on a square root of the sum of the square basis. Each force is assigned to produce the most conservative estimate. Loading combinations and allowable stresses for components are considered and the connections and anchorage's are in accordance with standard codes. Design loads include live, dead, wind, and seismic loads.

3.3.2 Mechanical and Materials

The construction specifications require that mechanical and material stress be considered for junction boxes, conduit, and wire raceways. In addition, it specifies that the working environment of the equipment is considered so that appropriate equipment can be selected for hazardous or wet environments.

3.3.3 Chemical and Process

There are no chemical or process requirements for the electrical system.

3.3.4 Electrical Power

The electric power requirement of this facility is that a 13.8 kV overhead line is extended to the CVDF and is capable of powering the 1,500-kVA transformer. The 1,500-kVA transformer in turn is capable of providing power to the entire facility.

3.3.5 Instrumentation and Control

Adequate power demand instrumentation must be available to allow operators to log the power consumption and demand.

The UPS system has sufficient instrumentation to be able to determine its availability and current status.

3.3.6 Computer Hardware and Software

Not applicable.

3.3.7 Fire Protection

Outside transformers shall be a minimum distance away from the facility. There are not outdoor combustible liquid insulated transformers, 500k VA or larger, requiring the following fire protection:

- (at least) one hydrant
- connection to an adequate water supply
- standard hose house
- UL-approved A-B-C fog nozzles in the vicinity.

3.4 Testing And Maintenance Requirements

This section lists the testing and maintenance requirements for the electrical systems.

3.4.1 Testability

The design, by using national codes and standards, has incorporated features to make the electrical system testable. Any unique testing requirements will be specified in the CVD test specification.

3.4.2 Technical Safety Requirement-Required Surveillances

Technical safety requirements (TSRs) (ref. HNF-3673 B3.5) for the CVDF electrical standby power system include the operability of the diesel generator. Surveillance requirements for the standby power system are defined in HNF-3673, section 3.5.

3.4.3 Non-Technical Safety Requirement Inspections and Testing

Testing requirements for the CVDF electrical system are:

- Monthly and annual testing of all emergency lights, required per ANSI/NFPA 101.
- Periodic testing and inspection, as recommended by the facility UPS system vendor, conducted to establish availability of the facility UPS system

3.4.4 Maintenance

All replacement and spare parts must be the same manufacturer and model number as the original or an engineering-approved equivalent. This includes the use of materials and equipment that are listed by UL or FM with attached labels when such products are listed.

Sufficient access to and working space around electrical equipment is provided to permit ready and safe operation and maintenance of such equipment. Specific maintenance requirements will be identified in the maintenance procedures.

3.5 Other Requirements

This section lists requirements that have been developed related to security and special nuclear material (SNM) protection, special installation requirements, reliability, availability, and preferred failure modes, quality assurance (QA), and other miscellaneous requirements.

3.5.1 Security and Special Nuclear Material Protection

Normal power shall be provided to the security system. For additional information on the security system, refer to SDD SNF-3089, *Cold Vacuum Drying Facility Security System Design Description*.

3.5.2 Special Installation Requirements

There are no special installation requirements at this time.

3.5.3 Reliability, Availability, and Preferred Failure Modes

The electrical system has been design according to standard practices for a general service electrical system as related to normal and UPS power distribution, grounding, lighting, and lightning/surge protection. It is designed to remain reliable throughout its service period of two years without maintenance above and beyond small-wear items, such as the replacement of lighting sources.

The electrical system availability is primarily determined by the availability of local electric utilities for normal power, but there is also potential for downtime to replace equipment that fails in the field. Because this system is classified as general service, all critical systems that are supported by the electrical system have been designed to fail-safe in the event of electrical power loss as applicable to the individual systems.

3.5.4 Quality Assurance

The electrical system fabrication quality assurance/control program is based on the safety classification of structures, systems, and components as detailed in HNF-SD-SNF-SEL-002, *Safety Equipment List*, SNF-4148, *Cold Vacuum Drying Facility Master Equipment List*, and application of a graded approach as described in HNF-MP-599, *Project Hanford Quality Assurance Program Description*.

4.0 SYSTEM DESCRIPTION

The system description and operations presented in this section discuss those system features that satisfy the CVDF functional requirements listed in Section 3.0 of this SDD. In addition, by demonstrating that the functional requirements are met, the system description also demonstrates that the safety functions listed in Section 2.0 are met.

4.1 Configuration

The configuration information section describes the electrical system's subsystems and major components, boundaries and interfaces, physical location and layout, principles of operation, and reliability and control features.

4.1.1 Description of System, Subsystems, and Major Components

4.1.1.1 Normal Electrical Power Distribution. The electrical power distribution system includes an extension of a 13.8 kV overhead primary distribution line to a power pole with fused cutouts and lightning arresters. The line is converted to an underground cable feed for the new oil-filled, pad-mounted transformer to convert the 13.8 kV to 480Y/277 V power. The transformer (XTA) is capable of converting 1,500 kVA of power. The transformer is located above a utility vault that allows routing of the service entrance feeder cables to the building main switchboard through an underground duct bank. Also, outdoor type potential transformers, current transformers, and the metering cabinet are provided at the last pole for the energy monitoring and providing input to the electrical utilities field data acquisition system.

The transformer neutral is bonded to the ground system that comprises ground rods around the transformer to create the 480 V system neutral.

- The service entrance and main switchboard (SWGR-001) are located in the electrical equipment room 108 in the office area. The 480 V switchboard is rated 480Y/277 V; 2,500 amps; three-phase; four-wire, and comprises a free-standing, metal-enclosed assembly of power busses, neutral and ground buses, power and molded case circuit breakers, and metering equipment.
- The main switchboard (SWGR-001) distributes 480 V, three-phase power through circuit breakers to the facility and process loads, and includes the following.
 1. Five 400-amp breakers feed to a 480Y/277 V distribution panel (PNL-001, PNL-003, PNL-005, PNL-007, PNL-009) located in each process bay. These panels supply the 480 V loads and a 15kVA dry type transformers (XT1 through XT5) and 50 amp, 208Y/120 V lighting/distribution panels (PNL-002, PNL-004, PNL-006, PNL-008, PNL-010) in each bay.
 2. A 800 amp breaker feeds to service area MCC-1 located in mechanical equipment room 207, which contains starters and distribution breakers for equipment, such

as chillers, exhaust fans, water pumps, and duct heaters. MCC-1 also feeds a 15 kVA dry type transformer (XT6) and 50 amp, 208Y/120 V distribution panel (PNL-011) located in mechanical equipment room 207.

3. A 100-amp breaker feeds a 75-kVA transformer (XT7) and lighting panels (LPN-1 and LPN-3) for the office area lights and receptacles, and outdoor lights.
4. A 20-amp breaker feeds the exhaust fan (HVAC-EXHF-8005) for the administration area.
5. A 60-amp breaker feeds the air handling unit (HVAC-HPT-8001) for the administration area.

4.1.1.2 Lighting System. The lighting system includes the following fixtures and features:

- **Office areas** - recessed, parabolic troffer-type fixtures with two or three 32WT48 fluorescent lamps rated at 120 V and mounted in a lay-in ceiling grid.
- **Equipment rooms and walkways** - surface-mounted, two-lamp fluorescent fixtures with prismatic diffuser or chain-suspended, two-lamp or four-lamp fluorescent fixtures with solid top reflector rated at 120 V.
- **Hallways and entrances** - architectural-type fluorescent fixtures, both open and round reflector and square lens, double twin tube lamps rated at 120 V.
- **Exterior locations** - wall-mounted, photocell-operated, metal-halide lamp fixtures rated at 120 V.
- **Process low bay areas** - surface-mounted, two-lamp fluorescent fixtures with prismatic diffuser, rated at 120 V.
- **Process high bay areas** - high bay, 400 W metal halide fixtures with a backup 150 W quartz, restrike lamp, through wire power hook disconnect support, rated at 120 V. High bays, metal-halide fixtures are supplied with a quartz lamp to provide illumination at startup or during periods in which the metal halide lamp is restriking.
- Emergency power battery packs provided on selected fluorescent fixtures to provide up to 90 minutes of reduced illumination on loss of normal power.
- High bays, metal-halide fixtures are supplied with a quartz lamp to provide illumination at startup or during periods in which the metal halide lamp is restriking.

4.1.1.3 Ground System

- The ground system includes bonded neutral and ground electrode connections at both the 480Y/277 V utility service transformer (XTA) and the 480Y/277 V service entrance main switchboard (SWBD-001)
- Bonded neutral and grounding electrode connections are provided at each separately derived system neutral (i.e., each 208Y/120 V transformer).
- An insulated equipment ground conductor is run with each power feeder in conduit.
- Exothermic welded connections are used where bolted or compression type connections are not accessible.

4.1.1.4 Facility Uninterruptible Power Supply System

- The facility UPS system includes the UPS assembly that is rated at 30 kVA, 208Y/120 V, three-phase, four-wire; a 30 kVA, 208Y/120 V, three-phase, four-wire bypass transformer (XT8), batteries and a 150-amp, 208Y/120-V distribution panelboard (LPN-2). The UPS, panel, batteries and bypass transformer are located in electrical equipment room 129.
- The facility UPS system capacity is rated 30 kVA at 0.8 power factor.
- The facility UPS system operates at rated capacity in the following modes:
 1. **Normal** - the inverter section supplies clean AC power to the load. The rectifier/charger section converts normal AC to regulated DC, which charges the storage battery and serves as the inverter input.
 2. **Emergency** - on loss of normal AC, the inverter derives its input from the batteries sized so the UPS has a minimum of one-hour run time at full load, the transfer being made without interruption to the load.
 3. **Bypass** - on failure of the facility UPS system, the load is automatically transferred without interruption to the normal bypass transformer AC source.
 4. **Maintenance** - during UPS maintenance the loads can be manually bypassed to the bypass transformer AC source without interruption to the load.
- There are no safety function requirements to provide UPS power to any of the SCIC panels or equipment (including the annunciator panel in the control room). To aid in the control room response to a loss of site power, the two SCIC annunciators do have UPSs to provide 30 minutes of power to aid in the transition from the normal state to a loss of power state. The seismic monitors have battery power that is normally being charged with normal site power. On loss of power, the seismic equipment will continue to operate to record valuable data for restart. This feature is not required for safety.

4.1.1.5 Lightning/Surge Protection System

- The lightning/surge protection system includes surge arresters on the 13.8 kV power pole where the overhead is converted to underground cable to protect the service transformer from switching and lightning-induced surges.
- Low voltage (<600 V) surge arresters and transient voltage surge suppressors are installed with certain distribution and sensitive load equipment to protect against switching surges within the facility.
- The system will include a building lightning protection system, consisting of roof-mounted air terminals, copper wire grid and downcomer wires connected to the ground system. In addition, all nearby metal objects are bonded to the lightning system to create equi-potential surfaces during lightning surges.

4.1.1.6 Standby Power System. The standby power system includes a diesel generator, ATS, and cable to provide power to the local process cell exhaust fans.

- The diesel generator is rated at 100 kW 480Y/277 V three-phase, four wire and fuel tanks with the capacity of running the generator for 24 hours.
- A 400 amp ATS will switch the loads from the normal power system upon loss of power and provide a signal to start the diesel generator.
- A 480Y/277 V standby panel (DG-DP-001) rated at 150 amps feeds the instrument air compressors, UPS system, process bay heat trace and the local exhaust fans.

The signal to start the backup power system comes from the ATS that monitors normal power to the CVDF. The transfer to emergency power will be initiated upon reduction of normal power to 70 percent of nominal voltage. When the diesel engine starts the generator voltage and frequency have obtained setpoint values, the ATS will disconnect the generator from the load bank and transfer to the emergency source loads. Transfer back to normal power shall occur when the normal electrical power source restores 90 percent of nominal voltage.

The diesel engine controls are operated by a 12V DC lead acid battery that is continuously charged and mounted on the engine skid. The control panel has readouts for all pertinent engine and generator operating parameters. Startup of the engine is accomplished by use of an air start system that will initiate upon loss of normal power in excess of the setpoint. The air start system relies on air from a 400-gal. reservoir tank that is continuously kept at pressure by a general-service air compressor. The air compressor supplies air through a regulator and double check valves and a gauge is provided to monitor reservoir pressure. Air starting will crank the engine until the speed exceeds 650 revolutions per minute or until 8 seconds elapses.

4.1.2 Boundaries and Interfaces

4.1.2.1 Normal Electrical Power Distribution System. The electrical power distribution system extends from the 13.8 kV overhead utility line tap to the 480Y/277 V and 208Y/120 V branch circuit protective devices feeding the CVDF general electrical utilities for the process equipment. This system includes the process bay and office area receptacles.

The electrical power distribution system provides non-safety electrical power for support of all of the CVDF and process systems. It interfaces with the 13.8 kV utility system as an extension of an overhead 13.8 kV primary circuit from existing poles at a point adjacent to the site. The design provides for installation of feeders (conduit and wire) adequately sized for equipment to be installed. The electrical power system also interfaces with safety systems to provide normal power. The electrical power distribution system is supported by the ground and lightning/surge protection systems.

4.1.2.2 Lighting System. The lighting system provides non-safety class illumination in all areas of the facility to allow personnel to carry out their duties in operations and maintenance. System emergency lighting is provided inside the facility. Exit signs are provided at each building exit.

The lighting system is supported by the electrical power distribution system.

4.1.2.3 Ground System. The building ground system extends from the service entrance neutral point and other separately derived neutrals (208Y/120 V transformers) to the ground or earth electrode. The earth electrode includes bonding all building structural steel, underground metallic piping, buried ground cable, and concrete-encased structural rebar. Ground conductor paths include structural steel and ground conductor runs with power circuits. The system interfaces with the electrical distribution system and the lightning protection system.

4.1.2.4 Facility Uninterruptible Power Supply System. The facility UPS system extends from the output of 30 kVA shielded isolation bypass transformer (XT8) and the 30 kVA UPS to the branch circuits in 208Y/120 V distribution panel (LPN-2).

The facility UPS system supports radiation monitoring instrumentation, the oxygen monitoring system, special purpose receptacles, and MCS. The facility UPS system is not part of the cold vacuum drying safety systems. The facility UPS system is supported by the electrical power distribution system and the ground system.

4.1.2.5 Lightning/Surge Protection System. The lightning/surge protection system provides protection against high voltage surges and transients in the power system that may damage process and facility equipment.

The lightning protection system is passive. The building structures, stairs, ladders, railings, and siding are of conducting material and are bonded to the building ground grid. Conducting pipe/ducting are continuous and bonded to the ground grid. The lightning protection system supports the electrical power distribution system and is supported by the ground system.

4.1.2.6 Standby Power System. The electrical standby power distribution system extends from the 480Y/277 V diesel generator and ATS located in the CVD Generator Building to the standby power panel (DG-DP-001) for the process bay HVAC equipment. This system includes the process bay local HVAC exhaust fans, process hood isolation damper control, instrument air compressors, CVDF lighting and the facility UPS bypass transformer.

The standby electrical power distribution system provides safety electrical power for support of the CVDF process bay local exhaust HVAC and process vent system to provide confinement in the process bays and dilution flow within the local exhaust duct during facility loss of power. It interfaces with the 480Y/277 V normal power system at the ATS. The design provides for installation of feeders (conduit and wire) adequately sized for equipment to be installed. The standby electrical power distribution system is supported by the ground and lightning/surge protection systems.

The selected loads to be supplied by standby power are each of the local exhaust fans (only one operating at a time), the solenoid valves that control the actuators to the local exhaust isolation dampers, CVDF lighting, the facility UPS bypass transformer, and the facility air compressors. The local exhaust isolation dampers fail closed on initial loss of power and will move to the open position once power is restored to the solenoid valves because the actuators are provided a safety significant source of compressed air for the power loss situation. Restoration of power to the instrument air compressors provides a defense-in-depth capability to provide air for operation of

the actuators. Restoration of power to the facility UPS provides defense-in-depth such that differential pressure instrumentation may be available during standby power operation although it is not required as calculations demonstrate sufficient differential pressure is maintained under the controlled conditions of standby power operation.

4.1.3 Physical Location and Layout

This section summarizes the layout of important equipment for each of the subsystems of the electrical system.

4.1.3.1 Power Distribution Equipment Location and Layout. The main switchgear (SWDB-001) is located in Room 108 of the office building, and is powered by an underground feed from the main transformer (XTA). The main transformer is pad-mounted located outside the west wall of the office building. The main switchgear (SWDB-001) feeds distribution panels (PNL-001, -003, -005, -007 and -009) located on the first floor of the individual process bays via conduit. The one-line diagrams can be found in Figure 4-1 for bays 1 and 2. The one-line diagram for bays 3 through 5 are identical to the bay 2 one-line diagram. The bay 1 one-line also feeds the Process Water Conditioning (PWC) tank room, process water pumps as well as the bay 1 loads. The distribution panels (PNL-001, -003, -005, -007 and -009) on the first floor of each bay area also feed 208Y/120 V sub-distribution panels (PNL-002, -004, -006, -008, and -010) via transformers (XT1 through XT-5) in each bay. The first floor equipment location can be found in Figure 4-3.

MCC-1 (see Figure 4-2 for attached loads and protective equipment) is located on the second floor mechanical equipment room (Room 207) and feeds larger HVAC motor loads for the facility and also feeds a 208Y/120 V sub-distribution panels (PNL-011) via transformer (XT6) located on the second floor mechanical equipment room (Room 207). The second floor equipment locations can be found in Figure 4-4.

For more information on the power distribution, refer to Drawings H-1-82242, Sheets 1-3, for equipment location; H-1-42246, Sheets 1-3 for the one-line diagrams; H-1-42247 Sheets 1-3 for individual panel schedules; and H-1-42280 Sheets 1-12 for wire run and conduit schedules.

4.1.3.2 Lighting Equipment Location and Layout. The lighting equipment in the office area is provided primarily by florescent lights located overhead, via grid, surface, or suspension mounting. In most areas, lighting with a battery backup is available for a safe operating environment in the event that normal power is lost. For more information about the office lighting location, refer to Drawing H-1-82241, Sheet 1.

On the first floor of bays 2 through 5, lighting is provided by battery backup florescent lighting that is surface-mounted around the perimeter of the bay. Emergency exit lights are also located near the exit doors of the bays and/or the building. Each of the changing rooms also have battery backup lighting, but the equipment rooms located adjacent to them have only normal power lighting. The PWC tank room has normal power lighting and supplemental battery backup lighting, all suspended from the ceiling. Lighting located in the hallway is provided by

suspended florescent lights with battery backup. The first floor lighting plan is shown in Drawing H-1-82242, Sheet 2.

Lighting for the entire first bay is provided by three high-power fixtures located on the second floor hook mounted and centered in the bay. The second floor of bays 2 through 5 are provided with the high-intensity lights that are hook-mounted and centered in each bay. Second floor lighting is shown on Drawing H-1-82242, Sheet 3.

4.1.3.3 Grounding Equipment Location and Layout. Grounding of the power system is located on connection details on Drawing H-1-82246 Sheet 3 and H-1-82242 Sheet 1. The connections to the rebar electrode system and the conduit ground wire are not shown but included in notes, details and in the conduit and raceway schedules. Grounding for the Generator building is shown on Drawing H-1-83979 Sheet 1.

4.1.3.4 UPS Equipment Location and Layout. The UPS and its battery and distribution panel are located in Room 129. The first floor equipment location can be found in Figure 4-3. For more information on the UPS distribution, refer to Drawings H-1-82242 Sheet 1 for equipment location; H-1-83987 for one-line diagram; H-1-42247 Sheet 2 for individual panel schedule; and H-1-42280 Sheets 1-12 for wire run and conduit schedules.

4.1.3.5 Lightning/Surge Protection Equipment Location and Layout. The 13.8 kV lightning/surge protection is shown on H-1-82095 Sheet 2. No information regarding the location and layout of the roof mounted air terminals and equipment could be found at the time this document was prepared.

4.1.3.6 Standby Power System. The standby system diesel generator is located in the Generator Building 142KA (see Figure 4-5) located northwest of the CVDF 142K. The diesel generator feeds the standby distribution panel (DG-DP-001) located in the CVDF transfer corridor (116) via an ATS located in the Generator Building. The standby distribution panel (DG-DP-001) feeds the process bay local HVAC exhaust fans, facility air compressors, UPS facility bypass transformer, and the CVDF light fixtures. The one-line diagram can be found in Figure 1-2.

For more information on the standby power distribution, refer to Drawings H-1-82242, Sheets 1-3, and H-1-83977, Sheet 1 for equipment location; H-1-83978, Sheets 1 for the one-line diagrams; H-1-83979 Sheets 1 for individual panel schedules; and H-1-83977 Sheet 1, H-1-83979 Sheet 1, and H-1-83978 Sheets 1 for wire run and conduit schedules.

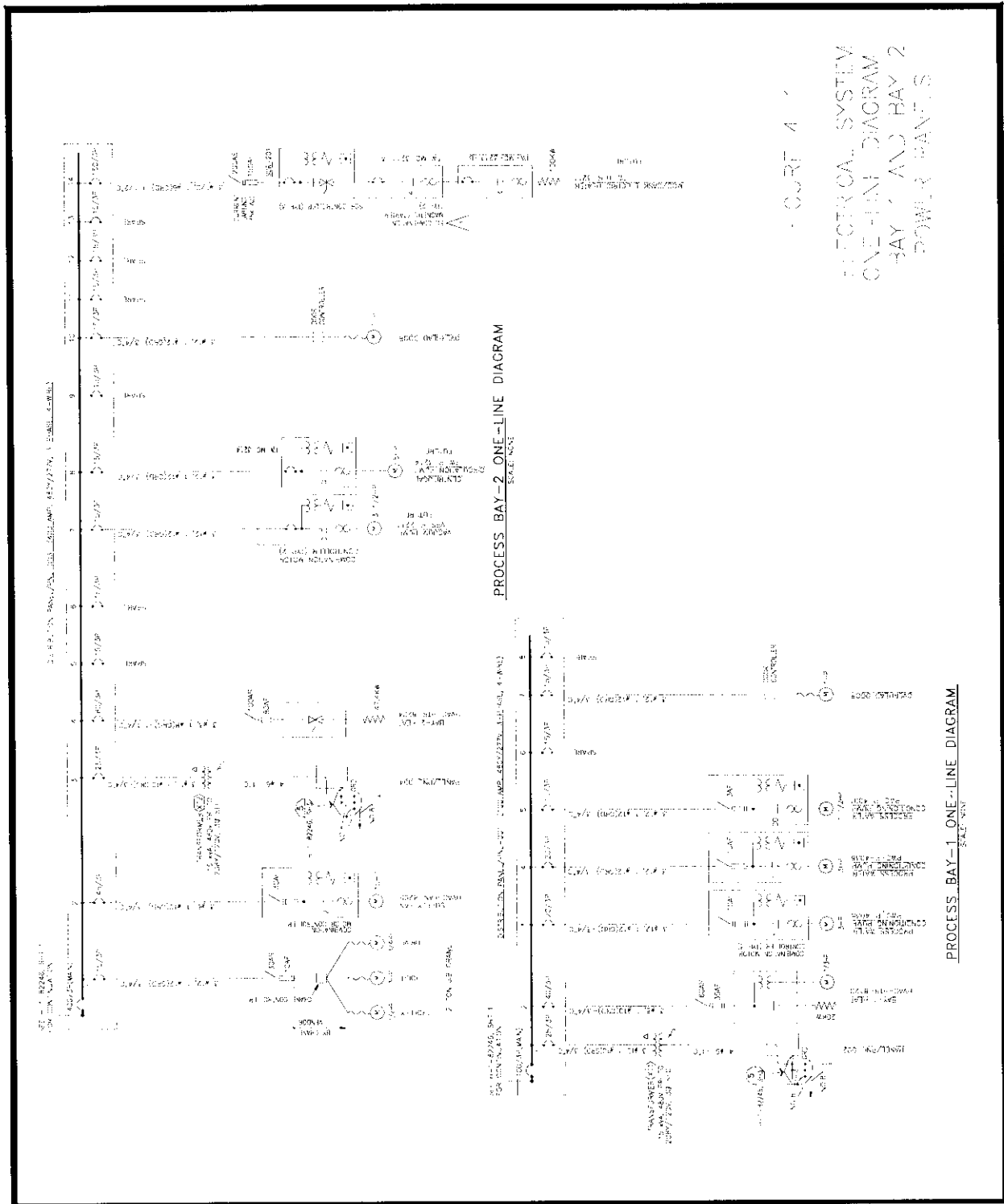


Figure 4-1. One-Line Diagram of the Bay 1 and Bay 2 Power Panels

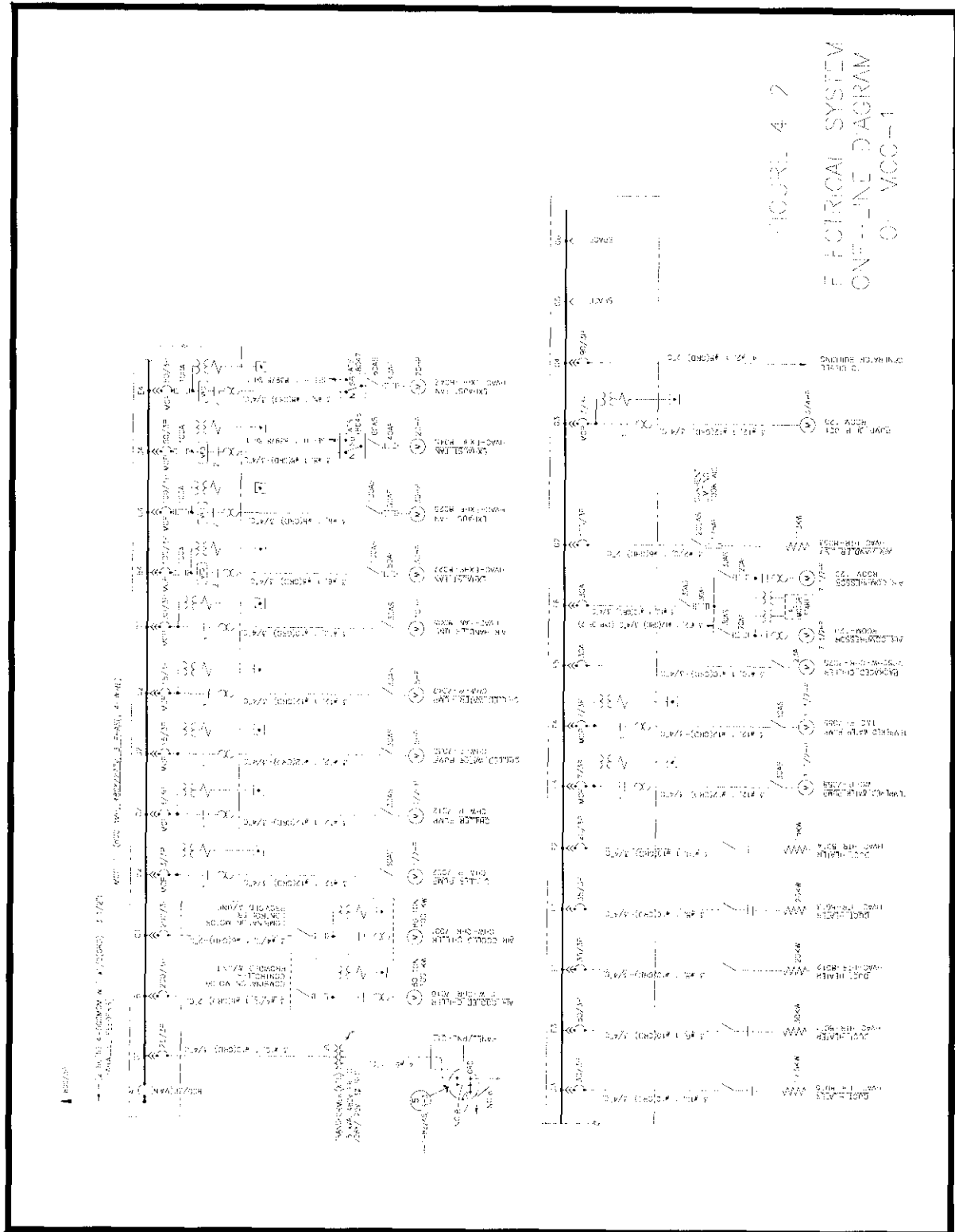


Figure 4-2. One-Line Diagram of MCC-1

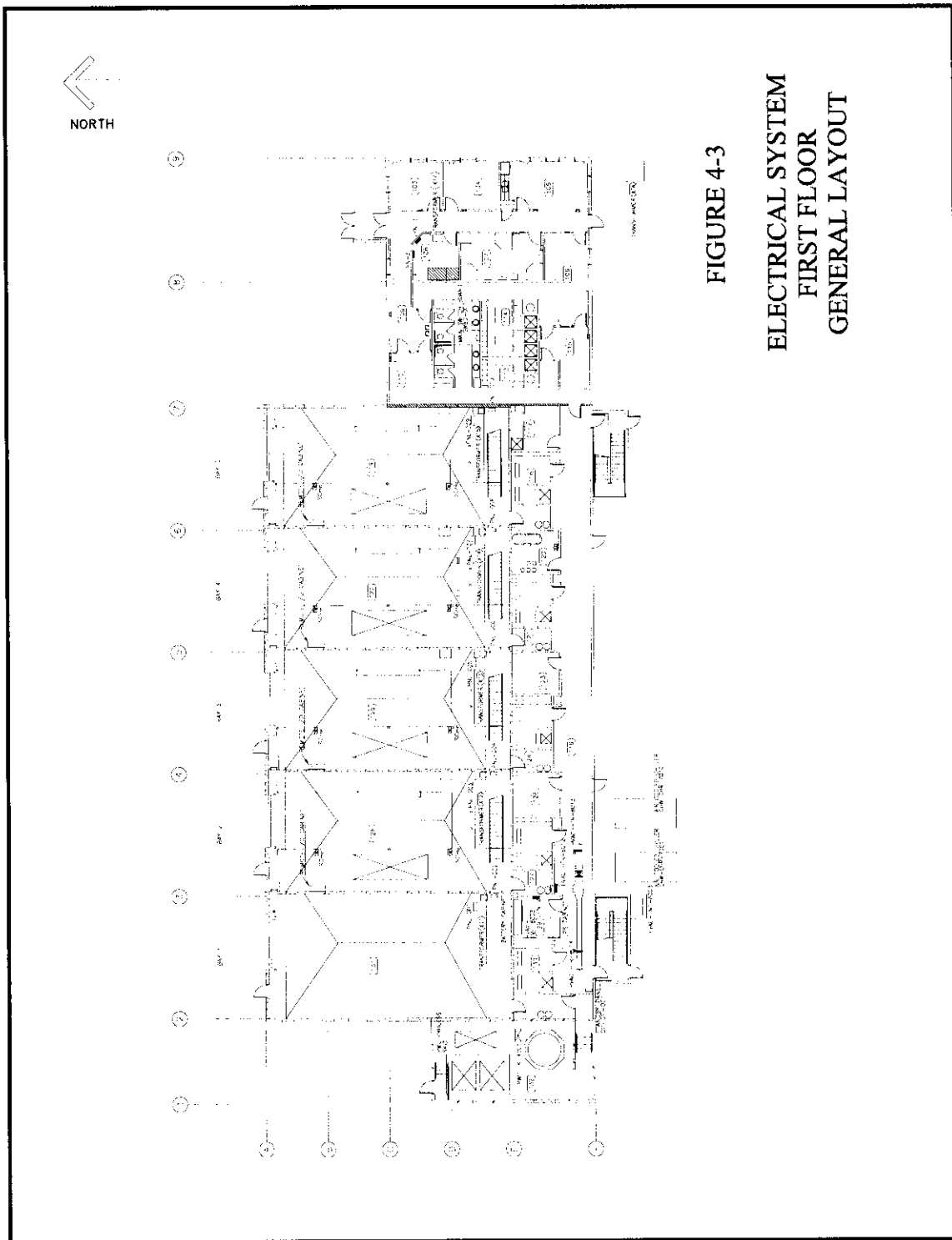


Figure 4-3. First Floor Equipment Plan

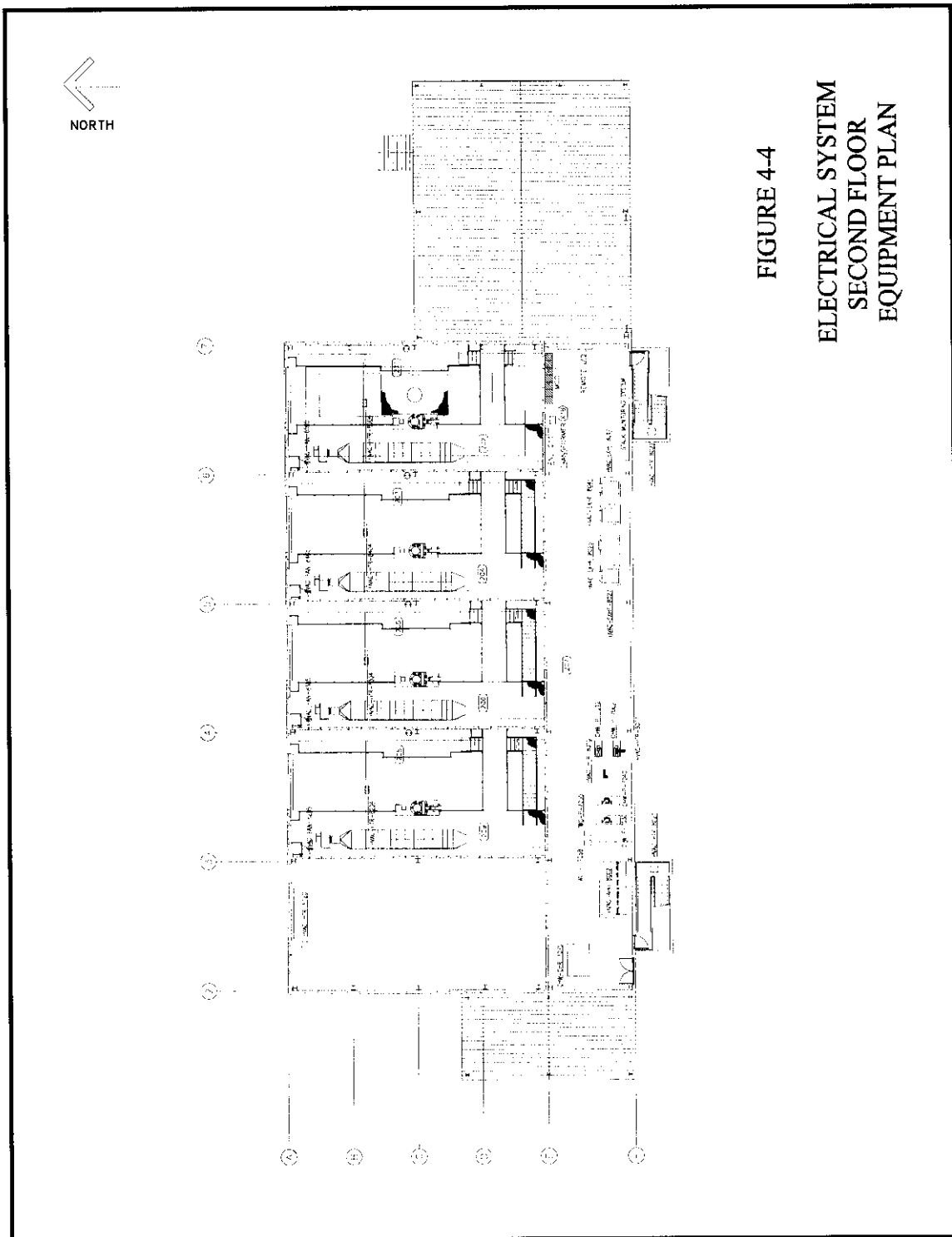


FIGURE 4-4
ELECTRICAL SYSTEM
SECOND FLOOR
EQUIPMENT PLAN

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Figure 4-4. Second Floor Equipment Plan

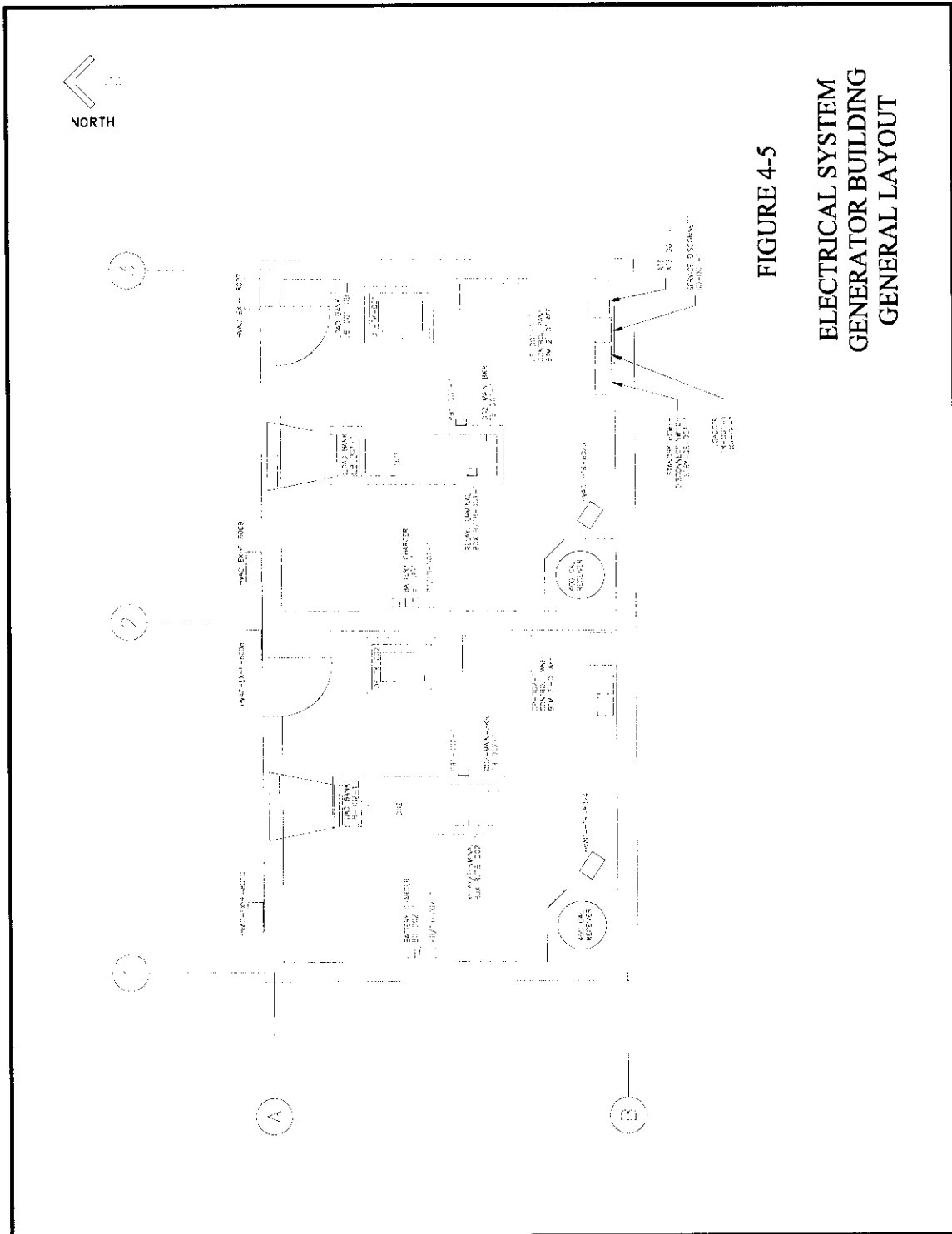


Figure 4-5. Generator Building Equipment Plan

4.1.4 Principles of Operation

Not applicable.

4.1.5 System Reliability Features

The system was specified to have a five-year design life so it would be reliable over its three-year operational period.

4.1.6 System Control Features

This system does not contain any unique control features.

4.2 Operations

System operations are detailed in HNF-2356, *Spent Nuclear Fuel Project Cold Vacuum Drying Facility Operations Manual*.

4.2.1 Initial Configurations (Pre-Startup)

Remote ground resistance test to measure the effective resistance of the ground electrode system. Testing is required for all conductors to test for continuity to ground.

The 13.8 kV conductor connecting the existing utility located adjacent to the CVDF site is tested in accordance with construction specifications.

After installation and prior to energizing, Construction Contract Management has Site Utilities perform transformer tests and DC over potential (Hi-Pot) tests on cable to verify acceptability of installation.

Demonstration of facility lighting is to be performed to show the equipment is in good operating condition.

Interior installations are tested for insulation resistance after all wiring is complete and ready for attachment of fixtures and equipment, and again when fixtures and equipment are connected ready for use.

If any of the tests yield defective wiring or parts, the defective equipment is replaced and all applicable tests rerun.

Other per-startup activities/tests will be identified in the test specification.

4.2.2 System Startup

Startup testing and alignment requirements will be specified in the test specification.

4.2.3 Normal Operations

During normal operation, the power distribution system interfaces with all systems that require and deliver power, and the grounding they require for operation. Should a fault occur, circuit protection attempts to prevent any damage to the electrical system and minimize damage to faulty equipment. Lighting provides a safe working environment, and lightning/surge protection prevents damage to the facility caused by electrical anomalies. Operational procedures will be developed identifying all operator actions.

4.2.4 Off-Normal Operations

Normal Power Failure - In the event of normal power failure, integral battery backup powered lights provide adequate temporary lighting for a safe environment while exiting. In addition, the UPS power system supplies power to the MCS, CAMS, ARMS, and emergency power outlets, which allow necessary work to continue. Standby power is provided to the local process bay exhaust system to maintain flow, heat tracing for the process cell fire protection and de-ionized water lines and the UPS system. The operational procedures will specify operator actions.

4.2.5 System Shutdown

There are no system shutdown requirements.

4.2.6 Safety Management Programs and Administrative Controls

Administrative controls and procedures will be developed consistent with the SNF integrated safety management plan.

4.3 Testing And Maintenance

During the life of the facility, testing of the power distribution circuits may be required. During the life of the facility, the following periodic tests should occur as often as recommended by the manufacturers of the equipment. The testing and service procedures themselves should also be conducted as recommended by the manufacturer.

- Inspect general service interior and exterior lighting and replace burnt out lights or repair fixtures if required.
- Inspect interior emergency lighting and emergency exit signs, replace burnt out lights or repair fixtures if required.
- Test the internal batteries in the emergency lights and the emergency exit signs to ensure that they are charged. Replace battery or light if required.
- Periodically test the UPS system as recommended by the equipment manufacturer.
- Test the diesel generator per TSR HNF-3673.

Other testing requirements will be identified in the test specification.

4.3.1 Temporary Configurations

The electrical system has no temporary configurations.

4.3.2 TSR-Required Surveillances

Required surveillances for the electrical diesel generator system in the CVDF are identified in HNF-3673.

4.3.3 Non-TSR Inspections, and Testing

Only routine functions are normally recommended or required after initial testing and energizing. Routine functions include the following.

- Visual inspection and logging of power distribution system energy consumption and demand.
- Visual inspection and monitoring of facility UPS system indicators and meters.
- Periodic visual inspection of exposed cable and bolted connections of the ground system.
- Periodic inspection of the lightning/surge protection system equipment and connections.
- Visual inspection of the lighting system. Failed lamps are replaced, as necessary, to maintain lighting at a safe level within the interior and exterior areas of the CVDF.

In addition to the visual inspections, a standardized test program for the major components is to be instituted as identified in the test specification. Lockout and tagout procedures are utilized to ensure that personnel work on de-energized circuits only.

4.3.4 Maintenance

Adequate spare parts per the maintenance manuals must be on hand or readily available to handle any downtime situation in a timely manner.

All replacement and spare parts must either be the same manufacturer and model number as the original or be an engineering-approved equivalent.

Maintenance procedure will be developed for this system.

Appendix A
Source Documents

INDUSTRY STANDARDS AND CODES

ANSI/IEEE-142, 1991, *Practice for Grounding of Industrial and Commercial Power Systems*, Institute of Electrical and Electronics Engineering, Piscataway, New Jersey.

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

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

ANSI/NFPA 780, 1995, *Standard for the Installation of Lightning Protection Systems*, National Fire Protection Association, Quincy, Massachusetts.

IEEE C67 Series, *Guide for Surge Protection*.

IES, *Illuminating Engineering Society Lighting Handbook*, Illuminating Engineering Society of North America, New York, New York.

UL-1778, 1994, *Uninterruptible Power Supply Equipment*, Underwriters Laboratories, Northbrook, Illinois.

GOVERNMENT DOCUMENTS

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

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.

SPENT NUCLEAR FUEL PROJECT DOCUMENTS

Design

HNF-3553 Appendix B 1993, *Safety Analysis Report*, for the Cold Vacuum Drying Facility, Fluor Hanford, Incorporated, Richland, Washington.

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

Safety

HNF-SD-SNF-SEL-002, 1999, *Spent Nuclear Fuel Project Cold Vacuum Drying Facility Safety Equipment List*, Rev. 6, Fluor Hanford, Inc., Richland, Washington.

Supporting Documents

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

Operations

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

**Appendix B
System Drawings**

SNF-3075 REV 1

The **electrical power distribution system** is defined on the overhead service plan one-line and panel schedule Drawings H-1-82095 Rev 1, H-1-82242 Rev. 2, H-1-82246 Rev. 2, and H-1-82247 Rev. 2.

The **facility UPS system** is shown on the one-line and panel schedule Drawings H-1-83987 Rev. 0 and H-1-82247 Rev.2. The standby power distribution system is defined on the service one-line H-1-83978 Rev. 0.

The **ground system** neutral connection and equipment bonding is defined on one-line Drawing H-1-82246 Rev. 2. The utility service transformer grounding is defined on Drawing H-1-82242 Rev. 2. The facility ground loop and foundation rebar tie-ins are shown on Drawing H-1-82246 Rev. 2. The Generator Building ground loop is shown on Drawing H-1-83979 Rev. 0.

The **lightning/surge protection system** is defined on the overhead service plan and lightning protection plan Drawings H-1-82095 Rev. 1 and H-1-83981.

The **lighting system** is defined on lighting plan Drawing H-1-82241 Rev. 2.

Appendix C
System Procedures

System procedures have not been developed at this time. This section will be updated as procedures are developed.

Appendix D
System History

This section reserved for future system modifications or changes considered to be significant, such as changes to requirements, bases, TSRs, and setpoints. The Maintenance and repairs considered to be of major significance will also be identified here. Each such modification or change, and maintenance or repair action should be briefly summarized and the appropriate documentation (such as, design change packages or work packages) referenced.

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