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U.S. DEPARTMENT OF ENERGY

WASTE ISOLATION PILOT PLANT

HEATING, VENTILATION AND AIR CONDITIONING SYSTEM

SYSTEM DESIGN DESCRIPTION (SDD)

SDD-HV00

Prepared by
Nuclear Waste Partnership LLC
Carlsbad, New Mexico

For

U.S. Department of Energy

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0	7/91	Sections 1.0, 2.0, 3.0, and 3.3	ECP 1-HV91-29 ECO No. 5608
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2	2/96	All Sections	ECP 2-HV94-021 ECO No. 7165 ECP 1-HV95-065 ECO No. 7830 ECP 2-HV95-032 ECO No. 7906 ECP 1-FP95-044 ECO No. 7760 ECO No. 8388
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3	7/98	All Sections	ECP 1-GP97-109 ECO No. 8864 ECP 1-GP97-111 ECO No. 8907 ECO No. 8880 ECO No. 9184
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SUMMARY

The Waste Isolation Pilot Plant (WIPP) facility surface Heating, Ventilation and Air Conditioning (HVAC) system is designed to provide heating, ventilating, and air conditioning necessary for personnel comfort and satisfactory equipment operation; and to limit potential radioactive contamination releases to As Low As Reasonably Achievable (ALARA) for the Waste Handling Building (WHB) as defined by the WH01 and WH02 subsystems.

The system consists of components such as air handling units, distribution ductwork, High Efficiency Particulate Air (Filter) (HEPA) filter units, unit heaters, exhaust fans, instrumentation and controls and other accessories to make the system complete and operate as required.

The surface HVAC system (system HV00) consists of independent subsystems which serve different surface buildings and/or areas. Subsystem HV01 serves the WHB Contact Handled (CH) waste handling area; subsystem HV02 serves the Remote Handled (RH) waste handling area and the TRUPACT Maintenance Facility (TMF); subsystem HV03 serves the Support Building (SB); subsystem HV04 serves the Exhaust Filter Building (EFB) and its adjacent equipment sheds; subsystem HV05 provides HVAC services to the Safety and Emergency Services Facilities Building, the Warehouse Building, and the Water Pumphouse Building; and subsystem HV06 serves the remaining surface support structures.

The Chilled Water System (subsystem CW02) provides support services to the surface HVAC system. Specific requirements on the system CW02 are included in this SDD. The major components of system CW02 include air cooled water chillers, chilled water pumps, piping, expansion tanks, and controls and instruments.

Chapter G
SDD HV00 General Requirements Chapter

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Chapter G

System HV00, HVAC General Design and Performance Requirements

1.0 PRIMARY FUNCTIONS

1.1 The WIPP surface HVAC system, consisting of six (6) subsystems, provides heating, ventilating and air conditioning services to the WIPP surface buildings and structures. The surface HVAC system shall perform the following primary functions.

1.1.1 Provide climatic conditioning during Normal Operation for personnel comfort and satisfactory equipment operation within the WIPP surface buildings and structures, including but not limited to the WHB, SB, EFB, Warehouse Building, Effluent Monitoring Equipment Room, Guard and Security Building, Water Pumphouse, Meteorological Instrument Building, and the TMF.

1.1.2 Provide a negative differential pressure in WHB areas where a potential for contamination exists, and provide for confinement during a design basis event. The CH Bay ventilation system is a once-through/recirculation system designed to provide a confinement barrier with HEPA filters providing the capability to limit releases of airborne radioactive contaminants from the CH Bay. The ventilation system maintains the CH Bay at a lower air pressure than the atmospheric pressure outside the WHB to ensure air flows into the CH Bay, which allows only HEPA filtered air to be exhausted from the CH Bay. **[DSA SS SSC 4.4.3]**

When performing waste handling and waste storage activities during the processing of 10-160B shipping containers, the Hot Cell Complex ventilation system is required to be operable. The Hot Cell Complex ventilation system is a once-through system designed to provide a confinement barrier with HEPA filters providing the capability to limit releases of airborne radioactive contaminants from the upper Hot Cell Complex. The ventilation system maintains the upper Hot Cell at a lower air pressure than the air pressure in the RH process areas (RH Bay, CUR, Transfer Cell, and FCLR). The Hot Cell complex ventilation system ensures airflow into the upper Hot Cell, which allows only HEPA-filtered air to be exhausted from the upper Hot Cell. **[DSA SS SSC 4.4.4]**

1.1.3 Provide for control and maintenance of the designed differential pressures among the areas and/or rooms within the WHB during Normal Operation to maintain the required airflow directions and to provide for ALARA compliance. This assures that airflow within the building are always directed from the area of least potential for contamination to area of highest potential for contamination.

1.1.4 Provide environmental control for the Central Monitoring Room (CMR) to supply a suitable environment for continuous personnel occupancy, including a slightly positive indoor pressure relative to outdoor and furnish required filtration of makeup air for radiation protection of the CMR operators during an emergency condition.

1.1.5 Provide for necessary filtration for ALARA compliance of exhaust air from all potentially contaminated areas within the EFB, which supports the operation of the U/G ventilation system and contains the equipment for filtering the air from U/G areas.

1.1.6 Provide for control and maintenance of ambient pressures within the EFB to ensure the required direction of airflow.

1.1.7 Air conditioning and ventilation for other areas shall be based on the requirements for providing a suitable environment for the occupancy, process, and installed equipment using applicable codes, standards, and good engineering practice.

2.0 DESIGN REQUIREMENTS

The functional classifications are defined in the Documented Safety Analysis (DSA) and the General Plant Design Description (GPDD).

2.1 General

2.1.1 Outdoor Design Conditions

The Surface HVAC system shall be designed for the outdoor design temperatures as presented below, with the exception of the CMR and computer room.

Outside Design Temperatures

Design summer dry bulb	100˚F
Design summer wet bulb	71˚ F
Design winter dry bulb	19˚ F

For the CMR and computer room outdoor design conditions, refer to Section 2.1.1 of Chapter III.

2.1.2 Indoor Design Conditions

The surface HVAC system shall be designed for indoor design temperatures, as presented in HVAC subsystem chapters Section 2.1.2.

2.1.3 Ventilation

In addition to providing environmental control for personnel comfort and satisfactory equipment operation, the surface HVAC systems shall be designed to provide for confinement of potential radioactive contamination releases and to provide for radiation protection of the plant workers for ALARA compliance as determined by regulatory requirements and engineering analysis.

2.2 Subsystem General Requirements

· Refer to Section 2.2 of all Chapters for the general requirements for subsystems.

2.3 Operational Requirements

The surface HVAC systems are required to provide heating, ventilating, and air conditioning to the WIPP buildings and surface structures for personnel comfort, satisfactory equipment operation, and control/confinement of air borne radioactive contaminants in support of the plant normal operation. The design life of the surface HVAC systems shall be 25 years.

Operation of the systems shall require utilities to be provided by the (surface) Electrical Power System (normal and backup electrical power), Compressed Air System, and Domestic/Utility Water System (makeup water).

- Refer to Section 2.3 of all Chapters for operational requirements for subsystems.

2.4 Structural

All surface HVAC system components and supports are functionally classified based on the service provided for the site. Equipment functional classifications definitions and design requirements are described in the GPDD SDD Section 2.0. Applicable structural design requirements are derived from the functional classification assigned to the equipment. The lowest functional design requirement will be used for the establishment of the design requirements based on function provided (i.e., temperature control, confinement ventilation, etc.)

2.5 General Arrangement and Essential Features

Refer to Section 2.5 of all Chapters for general arrangement and essential features for the subsystems.

2.5.1 Other Essential Features and Feature Specifications

2.5.1.1 Air locks shall be provided by systems CF00 and GC00 as prescribed in Section 2.9 , Interfacing Systems.

2.5.1.2 The surface HVAC systems shall be designed for compliance with the following requirements in support of the Fire Protection System:

- HVAC systems shall be designed to prevent recirculation of smoke and to aid in exhausting smoke where dictated by specific requirements.

- HVAC systems which recirculate room air shall have a smoke detector provided in the return air stream. Starters/switches for the fans shall be provided in a location accessible to the fire fighters.

- Where no engineered smoke control system is provided, all supply fans shall be shut down in the event of a fire.

2.5.1.3 The supply air handling unit's filters shall consist of low and moderate efficiency intake filters.

2.5.1.4 Supply air systems that are designed for 100% outside air during evaporative cooling and for recirculation during mechanical cooling and winter heating shall have evaporative cooling mode airflow rates increased to allow for the difference in supply air temperature and humidity conditions.

2.5.1.5 HEPA filters shall have a rated capacity of not more than 1,500 cfm per filter module. Each HEPA filter shall be individually shop tested and certified to have an efficiency of not less than 99.97% when challenged with a monodispersed 0.3 micron aerosol in accordance with MIL-F-51068D.
CH Bay exhaust air SHALL flow through at least one stage of HEPA filters in either filter unit 41-B-814 or 41-B-815 with > 99% efficiency.
[TSR LCO 3.2.1] Hot Cell Complex filter units 41-B-877A, 41-B-877B, and 41-B-877C SHALL have one stage of HEPA filters with > 99% efficiency.
[TSR LCO 3.2.2]

2.6 Maintenance

2.6.1 All mechanical components of the HVAC systems shall be accessible for inspection and repair, and shall be arranged in such a way that they can be isolated for maintenance.

2.6.2 Arrangement of all HEPA filter units shall permit aerosol testing.

2.6.3 Space shall be provided around all HEPA filter units for contaminated filters to be bagged and sealed prior to being transported away from the area.

2.7 In-Service Inspections

2.7.1 Instrumentation for HVAC systems shall be provided to permit periodic in-service inspections of system operability.

Systems shall be designed to permit equipment inspection and testing of repaired equipment during plant operation.

2.7.2 HEPA Filter housings shall be bag-in/bag-out type for systems HV01, HV02, HV03, and HV04 applications. All the filter housings shall be accessible for inspection, testing and maintenance per ASME N510.

2.8 Instrumentation and Control (I&C)

2.8.1 Monitoring Requirements

Operating status of major equipment, flows at critical locations, pressure differential across HEPA filters, and pressure differential between outside and critical areas shall be monitored in the CMR, via an interface requirement on the CMS (CM01). Abnormal conditions shall be displayed in the CMR.

WP 04-AD3001, Facility Mode Compliance, specifies the daily verification that one CH Bay confinement ventilation system exhaust fan, 41-B-816 or 41-B-817, is IN-SERVICE. **[TSR SR 4.2.1.1]** CH BAY exhaust air is flowing from a HEPA filter unit to an exhaust fan. **[TSR SR 4.2.1.2]**

WP 04-AD3001 specifies the daily verification that one Hot Cell Complex confinement ventilation system exhaust fan, 41-B-878A or 41-B-878B is IN-SERVICE. **[TSR SR 4.2.2.1]** The Hot Cell Complex exhaust air is flowing from at least two HEPA filter units to the exhaust fan. **[TSR SR 4.2.2.2]**

2.8.2 Operational Requirements

2.8.2.1 The HVAC instrumentation and controls shall be designed to:

Control the start and stop of HVAC equipment and the performance of this equipment to provide the required environmental conditions within the buildings which they serve, including static pressure as required.

Provide the designated controls from local control panels.

Actuate valves and dampers that control the flow of air through facility buildings.

Control air pressure in the different areas of the WHB, EFB, and SB, as required.

In areas where TRU and TRU mixed materials are present, HVAC systems and equipment shall be controlled to ensure that under all operating conditions area pressures are maintained at the required negative value.

The WHB Zone 2, consisting of the AHUs, HEPA filters, and exhaust fans, which supply the Contact Handling (CH) areas is operated using WP 04-HV1021, Waste Handling Building Zone 2 HVAC, which maintains the confinement ventilation system for the CH BAY in an OPERABLE condition. An OPERABLE confinement ventilation system consists of the following elements:

- Exhaust fan, 41-B-816 or 41-B-817 SHALL be IN-SERVICE; and
- CH BAY exhaust air SHALL flow through at least one stage of high-efficiency particulate air (HEPA) filters in either filter unit, 41-B-814 or 41-B-815. **[TSR LCO 3.2.1]**

WHB Zone 4 consisting of the AHUs, HEPA filters, and exhaust fans which supply the Remote Handling (RH) areas, is operated using WP 04-HV1061, WHB RH Area Zone 4 HVAC, which maintains the Hot Cell Complex confinement ventilation system in an OPERABLE condition. An OPERABLE confinement ventilation system consists of the following elements:

- Exhaust fan 41-B-878A or 41-B-878B SHALL be IN-SERVICE;
- Exhaust air SHALL flow through two of the following filter units: 41-B-877A, 41-B-877B, or 41-B-877C. **[TSR LCO 3.2.2]**

2.8.3 HVAC System Isolation Requirements

Power assisted, spring loaded, pneumatic or electric actuators shall be provided for isolation dampers. The controls for these dampers shall be designed so that the dampers will fail closed or open as required in the event of the loss of electrical power or instrument air.

2.8.4 Operational Environment for Instrumentation Equipment

The instrumentation equipment shall be designed and installed to withstand the same environmental conditions that its related HVAC equipment has been designed to accommodate.

2.8.5 Functional Classification

I&C for the HVAC systems shall be assigned the same functional classification as that of the corresponding HVAC system mechanical components.

2.9 Interfacing Systems

2.9.1 General

The interfacing systems are divided into the Primary Systems and Secondary Systems.

The primary system in an interface is the system that requires the functions and services or support provided by others at the specific interface so that the primary system can satisfy the required design criteria.

The secondary system in an interface is the system that provides the functions and services or support to another system (i.e., the primary system) so that the latter can satisfy the required design criteria.

2.9.2 Primary Interface

The Surface HVAC system is the primary system with the interfacing systems listed below:

- Fire Protection System (FP00)
- (Surface) Electrical System (ED00)
- Confinement Facilities and Plant Buildings and Equipment (CF00) and (GC00)
- U/G Hoist System (UH00)
- Compressed Air System (CA00)
- Water Distribution System (WD00)
- Plant Monitoring and Communications System (CM00)
- Waste Handling System (WH00)

Primary Interface Requirements

Appendix C-1 contains an outline of the HV00 primary interface from each of the above systems.

2.9.3 Secondary Interfaces

The Surface HVAC system is the secondary system to the following interfacing systems:

- Radiation Monitoring System (RM00)
- U/G Ventilation System (VU00)
- Fire Protection System (FP00)
- Waste Handling System (WH00)
- U/G Hoist System (UH00)
- Environmental and Process Monitoring System (EM00)
- Plant and Communications System (PC00)

Secondary Interface Requirements

Appendix C-2 contains an outline of the secondary interface requirements from each of the above systems.

2.10 Quality Assurance

For Quality Assurance requirements, see GPDD, Section 2.5.

2.11 Codes and Standards

Listed below are the codes, standards, regulatory requirements, and Department of Energy (DOE) Orders that are to be applied to the design, construction, testing, and operation of the Surface HVAC systems and components:

Order DOE 6430: General Design Criteria Manual, "The majority of the system has been designed in accordance with 6430; all new designs or modifications must meet requirements set forth in DOE Orders 420.1C, *Facility Safety*, and 430.1B, *Real Property Asset Management*".

DOE/CAO-94-1012	Quality Assurance Program Description
10 CFR 830.120	Quality Assurance
10 CFR 835	Occupational Radiation Protection
29 CFR Part 1910	Occupational Safety and Health Standards
ANSI/ASME NQA-1-1979	Quality Assurance Program Requirements for Nuclear Power Plants
DOE-HDBK-1169-2003	Nuclear Air Cleaning Handbook
ASME AG-1-1997	Code on Nuclear Air and Gas Treatment
ACGIH Industrial Ventilation Manual	

American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE) Standards

24	Methods of Testing for Rating Liquid Coolers
52	Methods of Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter
55	Thermal Environmental Conditions for Human Occupancy
62	Ventilation for Acceptable Indoor Air Quality

American National Standards Institute (ANSI)

N509	Nuclear Power Plant Air Cleaning Systems
N510	Standard for Testing of Nuclear Air Cleaning Systems

Air Moving and Control Association (AMCA)

210-	Laboratory Methods for Testing Fans for Rating
500-	Test Methods for Louvers, Dampers, and Shutters

Air-Conditioning and Refrigeration Institute (ARI)

210-	Unitary Air-Conditioning Equipment
410-	Forced Circulation Air-Cooling and Air-Heating Coils
430-	Central-Station Air Handling Units
850-	Commercial and Industrial Air Filter Equipment

National Fire Protection Association Standards (NFPA)

90A-	Standard for the Installation of Air Conditioning and Ventilating Systems

Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA)

85-	HVAC Duct Construction Standards and HVAC Air Duct Leakage Test Manual
90-	HVAC Systems Duct Design Manual

Underwriters' Laboratories, Inc. (UL)

555-	Standard for Fire Dampers and Ceiling Dampers
586-	High Efficiency Particulate Air Filter Units
900	Safety Standard for Air Filter Units

2.12 Reliability Assurance

2.12.1 General

In addition to the controlled design process and Quality Assurance (QA) requirements, reliability assurance shall be achieved through degrees of redundancy, independence of systems, and maintenance.

Refer to Section 2.12 of each chapter for the specific subsystem reliability assurance requirement.

2.12.2 HEPA Filter Units

HEPA filters shall be changed at a frequency based on a pre-established pressure drop across the filters in accordance with the filter manufacturer's specifications and the recommendations of DOE-HDBK-1169-2003. Filters will also be changed out based on age limitations per DOE-HDBK-1169-2003.

CH BAY filter units 41-B-814 or 41-B-815 SHALL have one stage of HEPA filters with 99% efficiency. **[TSR LCO 3.2.1]** Hot Cell Complex filter units 41-B-877A and 41-B-877B and 41-B-877C SHALL have one stage of HEPA filters with > 99% efficiency. **[TSR LCO 3.2.2]**

2.13 System Performance Characteristics

Subsystem-specific performance characteristics are presented in each of the subsystem chapters, Section 3.3.

3.0 DESIGN DESCRIPTION

3.1 Summary Description

HVAC in all WIPP surface facilities is provided by the six HVAC subsystems of system HV00 and the subsystem CW02 which are described in this System Design Description. The principal features of these systems are summarized as follows in this section:

- The HVAC arrangements in those parts of subsystems HV01 (Chapter I), HV02 (Chapter II), and HV04 (Chapter IV), which cover the waste handling and exhaust filter complex of buildings, are outlined in Section 3.1.1.

- HVAC arrangements in those parts of subsystems HV03 (Chapter III), HV05 (Chapter V), and HV06 (Chapter VI), which serve other permanent buildings on the site, are outlined in Section 3.1.2.

- The three chilled water systems which comprise subsystem CW02 (Chapter VII) are outlined in Section 3.1.3.

- Section 3.1.4 describes the arrangement of system and equipment descriptive information, both within Section 3.0, and elsewhere in this SDD.

3.1.1 HVAC in the Waste Handling Building Areas

Refer to Section 3.2.1 of Chapter I which describes the HVAC for the CH area of the WHB. The RH area HVAC is identical to that described for the CH area of the WHB and is referenced accordingly in Section 3.2.1 of Chapter II.

3.1.2 HVAC in Other Permanent Buildings

For select areas of the SB (subsystem HV03) that have special HVAC requirements refer to Section 3.1.1 of Chapter III.

HVAC systems in other administrative and auxiliary buildings, as described in Chapter V (HV05) and Chapter VI (HV06), are designed to normal commercial standards.

3.1.3 (CW02) Subsystems

Refer to Section 3.1.1 of Chapter VII for a summary description of the three chilled water systems.

3.2 Detailed System Description

Refer to Section 3.2 of each SDD HV00 subsystem chapters to obtain subsystem-specific detailed system descriptions.

3.3 System Performance Characteristics

Refer to Section 3.3 of each SDD HV00 subsystem chapters to obtain subsystem-specific performance characteristics and requirements.

3.4 Heating Ventilating and Air Conditioning System Arrangement

As the HVAC subsystems fulfill a service function their equipment arrangement is closely integrated with the buildings which they serve. This section describes the layout of the major HVAC components in subsystems HV01 to HV04 and the specific design features which these layouts address.

Individual components are described in Section 3.5. Control and monitoring instrumentation is described in Section 3.6.

The layout of the equipment for subsystems HV01, HV04 and CW02 is described in Section 3.4.1 of their respective chapters.

In the case of HVAC equipment provided for subsystems HV05 and HV06 no description of layout is provided. This is because the systems are small or are made up of widely distributed components for which a discussion of arrangement is less significant. The description provided in Section 3.2 and its accompanying diagrams covers arrangement as applicable to these systems.

In the case of all HVAC systems, inlet and exhaust air louvers are widely separated to ensure that there is a minimum risk of the introduction of exhaust air to the inlet air stream.

3.5 Component Design Description

3.5.1 Air Handling Units

The different types of air handling units in use in system HV00 can be conveniently grouped in three categories as follows:

- Subsystems HV01, HV02 and HV03 in the WHB and Support Buildings contain single zone AHUs.
- Subsystems HV04, HV05 and HV06 contain modular units supplied by various other manufacturers. These may be either single or multizone designs.

- Several different types of small single zone ceiling mounted air handling units are installed in the Support, Safety and Emergency and Guard House Buildings. These units come from different manufacturers.

3.5.1.1 General Construction

The units were factory fabricated in one piece and were installed as completely assembled packages. Mixing sections with dampers, back draft dampers, tornado dampers and flow measuring elements were provided as indicated in the block diagrams depicted in Figures HV G-1 through HV G-3. Figure HV G-1 shows the layout of a typical AHU.

The bases are constructed of continuously welded 8" steel channel. Auxiliary cross members of 6" WF beam or angle are welded in place under critical sections where supports are needed for internal equipment such as fans, coils or evaporative cooling sections. Floor supports are 16 gauge formed "H" channels welded in place on 2" centers.

Double floors are used which consist of 2" of rigid insulation sandwiched between a 14 gauge sheet metal top plate and a 24 gauge sheet metal lower plate. This double floor is welded to the base channels.

Walls and roof are of 14 gauge, galvanized steel, single wall construction. The wall sheets are double channel locked and are neoprene coated. The insides are insulated with 3 pounds/sq ft insulation held in place with weld pins.

Access doors are of double wall construction 1" thick with rubber gasket seals.

Louvers are formed of 16 gauge sheet metal reinforced as required. Louvers are removable and are designed to withstand a wind load of 20 lbs/sq ft. Bird screens are attached to the insides of the louvers.

3.5.1.2 Supply Fans

Supply fans are rated and certified in accordance with AMCA Standard 210. Fan characteristics for each AHU are listed in the data sheets in Appendix B-2. These fans incorporate the following design features:

- Pre-lubricated spherical roller type fan bearings are used, mounted in sealed self-aligning split pillow blocks.

- The fan assemblies, including casing, motor and impeller, are mounted either on rubber in shear isolators or on open spring type vibration isolators. The fan discharge is flexibly connected to the AHU.

- Fan drives utilize a belt and sheave configuration in which the minimum belt horsepower capacity is 150% of the motor nameplate horsepower. Open type belt guards are provided.

- Airflow control is provided by the use of either variable inlet vanes or variable frequency drives. Variable inlet vanes for fans with wheel diameters less than 24" are furnished by an 8 blade external configuration. If the diameter is greater than 24" an 11 blade internal "nested" design is used. For a further description of variable frequency drive operation, see Section 3.5.1.7.

- Impellers for smaller capacity fans (< 5000cfm) are generally of the backward inclined type. Larger capacity fans utilize impellers with a BAC (air foil) design.

- Discharge from the fans is either top horizontal (THD) or up-blast (UBD).

3.5.1.3 Filters

Two types of filter are in use in AHUs: low efficiency filters and moderate efficiency filters. These are discussed below.

- Low Efficiency Filters

Low efficiency filters are 2", pleated, disposable type. Each filter consists of a non-woven cotton fabric media; media support grid and enclosing frame. The filter media have an average efficiency of 25-30% on ASHRAE Test Standard 52-76. They have an average Arrestance of 90-92% in accordance with that test standard.

The media support is a welded wire grid bonded to the filter media to eliminate the possibility of media oscillation or pull-away. The enclosing frames are constructed of rigid, heavy-duty, high wet strength board with their inside periphery bonded to the filter packs.

- Moderate Efficiency Filters

Moderate efficiency filters are, high performance extended area disposable type filters. Each filter consists of high density glass microfiber media, individual dust holding compartments and a corrosion resistant galvanized steel enclosing frame.

The filter media have an average efficiency of 50-55% on ASHRAE 52-76 and have an average arrestance of not less than 97% on that standard.

3.5.1.4 Electrical Heating Coils

The heating coils are mounted on L shaped flange mounted frames designed to slip into their compartments in the AHU. The finned heating elements consist of 80/20 nickel/chromium resistance wire, helically wound and centered in copper plated steel tubes filled and compacted with magnesium oxide. Silicone rubber seals prevent contamination. High temperature aluminum coating protects elements from corrosion.

The side frames contain terminations, automatic reset and manually resettable thermal switches and magnetic contactors for controlling electrical supply to the heating coils in accordance with temperature control system requirements.

Dimensions and ratings for heating coil assemblies in each AHU are contained in the data sheets in Appendix B-2.

3.5.1.5 Chilled Water Cooling Coils

Cooling coils are constructed of 5/8" outside diameter copper tubes and aluminum fins. The fins are mechanically bonded to the tubes. The coils are mounted in steel frames with intermediate stiffeners when they exceed 5 ft in length. The coils are designed for 200 psig maximum working pressure and 200 degrees Fahrenheit maximum working temperature.

3.5.1.6 Evaporative Coolers

Evaporative coolers are fitted to the majority of the AHUs. The only AHUs with evaporative coolers in operation are those in the Maintenance Shop, Water Pumphouse, and the EFB. All other evaporative coolers have been rendered inoperative with cooling supplied by direct expansion refrigeration units or chilled water.

The evaporative coolers utilize an air washer system. This design contains the following elements:

- A 12" thick media into which water is sprayed and through which the AHU airflow passes to evaporate, cool, and humidify the air. The media is made up of long glass fibers bound together using organic, non crystalline fillers.

- A water recirculation system consisting of a submersible pump located in a sump at the bottom of the evaporator unit. The pump discharge is piped to an upper distribution header which distributes the water over the evaporative media. Balancing cocks, pressure gauges and inlet flow strainers are provided to assist operation of this equipment.

- Makeup water flow is regulated by a brass makeup valve with a brass ball float located in the sump. The sump also contains a manual quick fill valve and an overflow connection to a drain.

- A moisture eliminator located in the main airflow downstream from the evaporative media collects any water droplets entrained in the air stream.

3.5.1.7 Air Handling Units in Subsystems HV04, HV05 and HV06

There are thirteen AHUs located in the EFB, the engineering building, the guard house, the two warehouses and the water pumphouse. The location, function and the number of zones (where applicable), served by these units are listed in Table HV G-2.

Table HV G-2: Summary of AHUs in Subsystems HV04, HV05, and HV06

Subsystem	AHU Number	Location	Area Serviced
HV04	41-B-870, 41-B-871	EFB Mech Eq Rm	Exh Filter Bldg
HV05	45-B-301, 45-B-315	Tool Crib	Warehouse Areas
	45-B-601	Water Pumphouse	Water Pumphouse
HV06	45-B-417, 45-B-419	Engineering Bldg (EB) Roof Area	EB 6 Zones each
	45-B-418		EB 3 Zones
	45-B-419		EB single zone
	45-B-401, 45-B-402	G&S Bldg, Mech Rm	G&S Bldg
	45-B-412		Vent Locker Rm
	45-B-639	Aux Warehouse	Aux Warehouse

Features of the single zone AHUs listed above are generally similar to those described in Section 3.5.1 for the Waste Handling AHUs.

The following sections contain a description of the multizone AHUs which supply the Engineering Building.

3.5.1.8 Engineering Building Air Handling Units

These air handling units are blow through two-deck multizone air movers. Figure HV VI-2, Chapter VI shows the layout of AHU 45-B-420 which is typical of these units.

The AHU sections are rectangular in form with connecting flanges at each end. The flanges can be bolted together with interposing gaskets or connected through flexible couplings. The three main sections in each AHU can be described as follows:

- A combination filter/mixing box provides for the connection of outside air and recirculating air ducts. Dampers in the inlets are used to control relative proportions. This unit also contains two 30% throwaway 4" filters.

- A centrifugal fan is mounted on a frame in the fan section. The fan impeller is carried on a shaft driven by a belt mounted on an external sheave. The drive motor is mounted on the top of the fan section.

- A two-deck cooling and bypass section receives the output of the fan section. The lower or cold deck contains a cooling coil assembly supplied as indicated in Figure HV VI-3, Chapter 6. The upper deck is the bypass deck. The outlet air leaving these decks is divided into six passages which supply the six zones. The relative proportions of the airflow passing through the two decks to each zone is adjusted by outlet dampers controlled by the temperature control system shown in Figure HV VI-2, Chapter 6.

Individual electrical zone heating coils are mounted in each zone duct at the outlet of the cooling/bypass section.

3.5.1.9 Ceiling Mounted Air Handling Units

Ceiling mounted air handling units are provided in the safety and emergency building as shown in Figures HV V-1 and HV V-2, Chapter V. This equipment is described below.

3.5.1.10 Safety and Emergency Building Air Handling Components

The following two functionally different, but similarly constructed, types of units are used in the safety and emergency building:

- Zone fan coil units condition air drawn in from the ceiling plenum and duct it to the registers in that zone. These units contain both chilled water cooling sections and electric heater sections.

- Makeup Air units condition air drawn in from the outside to provide makeup air to the common ceiling plenum. These units contain only electrical heater conditioning sections.

Figure HV G-3 illustrates the layout of a typical zone fan coil unit. All units operate on a constant volumetric flow rate basis and share the following design features:

- The basic section in each unit contains a centrifugal fan mounted within a return air plenum. The enclosure is fabricated of 18-gauge galvanized steel and has a ½" glass fiber insulation lining, an inlet track for a 2" throwaway filter and a one inch discharge collar. Provision is made for easy removal of the filter and blower assembly.

- The fans are forward curved double width impellers. The blower housings are of formed galvanized steel with formed inlet cones.

- The chilled water coils in the cooling section are constructed of ½" or ⅝" outside diameter copper tubes with mechanically bonded aluminum fins and certified for 250 psig working pressure.

- A single power connection is provided for both electric heater and fan motor. Heaters are provided with either fan interlock terminals or an airflow switch. Heater element wire is of high resistance nickel chrome alloy.

3.5.2 Exhaust/Return Fans

Three different types of exhaust fan are in use at the facility:

Mainly floor or pad mounted units are in service in all the major waste handling areas and the SB. These units are described in Section 3.5.2.1.

Ceiling mounted units are used to exhaust air from the Engineering Building. These units are described in Section 3.5.2.2.

Roof mounted units are in service in many ancillary buildings. These units are described in Section 3.5.2.3

3.5.2.1 Exhaust/Return Fans in the WHB, Safety Building and EFB

There are approximately 30 exhaust fans included in subsystems HV01, HV02, HV03 and HV04 as described in Section 3.2 of this SDD. These fans range from fractional horsepower ceiling fans to 60 horsepower units used to serve the HEPA filters in the Mechanical Equipment Room.

Figure HV G-4 shows the layout of a typical exhaust fan. The following features shown in this diagram are common to most major exhaust fans:

- The fan is centrifugal in operation. Inlet air enters through variable inlet vanes.
- The impeller is mounted on a cantilevered shaft supported by two pillow block bearings. All drive configurations are AMCA 9 with the exception of the four CH and RH area exhaust fans which are AMCA 1. Sheaves keyed to the other end of the impeller shaft are driven by V-belts from sheaves on the drive motor.
- The drive motor, bearing support and fan housing are mounted on a 6" by 2" channel frame which is supported from a concrete foundation by antivibration mounts.
- The variable inlet vanes are positioned by linkages connected to a circumferential operating ring which is in turn moved by a control lever and pneumatic operator. Fans with variable frequency drives have the vortex locked open.
- A shaft seal is located where the impeller drive shaft enters the fan housing.
- Flexible connections connect the fan housing with the inlet and outlet ducts.
- The outlet duct contains both back draft and manually operated isolation or flow balancing dampers.

3.5.2.2 Ceiling Mounted Exhaust Fans

Eight fan units are suspended within the roof space along the north and west sides of the engineering building as shown in Figure HV VI-1, Chapter 6. Figure HV G-5 contains a diagram showing the layout of one of these units.

These fan units have the following features in common:

- Each fan is located within a rectangular steel casing which is bolted to angle iron hanger supports.
- Air enters the unit through a spun inlet venturi which directs flow to a centrifugal fan wheel. The fan wheel is mounted on a shaft supported by bearings bolted to a plate welded to the unit frame.
- A sheave on the drive end of the fan shaft is connected by a V-belt to a sheave on the fan motor mounted on top of the casing.

- Enclosures round the drive belt and shaft bearings prevent air leakage from the fan casing which acts as a high pressure plenum for the fan.

- Air leaving the fan casing is ducted to control dampers and screens at an outlet grill on the building wall.

3.5.2.3 Roof Mounted Exhaust Fans

These are generally fractional horsepower units.

Figure HV G-5 shows the layout of a typical roof exhaust fan. The following features shown in this diagram are common to most roof exhaust fans:

- The fan is designed for operation on the roof of the building where it will exhaust air from the roof space to the outside atmosphere.

- The fan is centrifugal in operation. Inlet air enters through a back draft damper and grill on the vertical axis of the impeller housing.

- The drive motor is mounted on a steel frame adjacent to the impeller to which it is connected by a V-belt passing over sheaves on the impeller and motor shafts.

- The fan and drive unit are contained in a weatherproof aluminum housing mounted on a curb cap covering the opening in the roof through which the fan operates.

3.5.3 Filter Assemblies

There are fifteen Filter Assemblies associated with the performance of the heating and ventilating systems in the WHB, SB and EFB. The location, service performed, flow rate and filter configuration present in each of these assemblies are described in Table HV G-3.

With one exception these filter assemblies are used to house HEPA filters which provide for the removal of any contaminants generated during waste handling. CH BAY exhaust air SHALL flow through at least one stage of HEPA filters in either filter unit 41-B-814 or 41-B-815 with > 99% efficiency. **[TSR LCO 3.2.1]** Hot Cell Complex filter units, 41-B-877A and 41-B-877B and 41-B-877C SHALL have one stage of HEPA filters with > 99% efficiency. **[TSR LCO 3.2.2]**

The exception is filter assembly, which performs an odor absorber function.

The operation of these assemblies in conjunction with other HVAC equipment is described in Section 3.2 for the subsystems concerned.

The construction and design of the filter assemblies are described in Section 3.5.3.1. The procedures for replacing filters are described in Section 3.5.3.2. Performance and test verification are outlined in Section 3.5.3.3

TABLE HV G-3: Summary of Filter Assemblies in Subsystems HV01 to HV04

Number	Location	Area Served	Flow Rate in cfm	Filter Configuration (no of std. filters)		
				Mod	HEPA 1	HEPA 2
41-B-801	WHB Rm 200	RH	18,490	15	15	15
41-B-802	WHB Rm 200	RH	18,490	15	15	15
41-B-814	WHB Rm 200	CH	18,490	15	15	15
41-B-815	WHB Rm 200	CH	18,490	15	15	15
41-B-834	WHB Rm 200	Batt Rech	2,500	2	2	2
41-B-979	WHB Rm 200	Batt Rech	2,500	2	2	2
41-B-877A	WHB Filt Gal	WHB Hot Cell	3,400	3	3	3
41-B-877B	WHB Filt Gal	WHB Hot Cell	3,400	3	3	3
41-B-877C	WHB Filt Gal	WHB Hot Cell	3,400	3	3	3
45-B-109	SB Roof	SB Zone 3				
45-B-116	WHB Rm 200	SB Lab area	2,200	2	2	2
45-B-117	WHB Rm 200	SB Lab area	2,200	2	2	2
45-B-134	SB Roof	SB CMR area	430	1	1	1
41-B-883	EFB ex eq rm	EFB	1,890	2	2	2
41-B-884	EFB ex eq rm	EFB	1,890	2	2	2

3.5.3.1 Filter Assembly Construction

The Filter Assemblies are listed in Table HV G-3. The housings are of total welded construction and are designed to operate at a maximum pressure of +/- 20 "wg. A base and framework of stainless steel channels carries an enclosure built of 11 ga and 14 ga T-304 stainless steel. Figure HV G-6 shows the layout of the two filter assembly design configurations present in the mechanical equipment room.

Door Openings in the sides of the housings allow filters to be inserted horizontally in banks to provide the total numbers indicated in Table HV G-2.

Vertical spaces (horizontal in the case of 41-B-877A, B and C) between the filter banks provide facilities for testing and verifying the performance of individual units.

Plenums at the upstream and downstream ends of the assembly have flanges to which inlet and outlet ducting is bolted.

3.5.3.2 Filter Changing

In order to remove filters from the assembly, each bag-out housing door is opened and the folded plastic bag contained within the door is extended to contain the first filter which can then be drawn into it. The bag is closed by means of the shock cord at its entry and the bagged filter is removed from the assembly. A space of about 5 ft is required at the side of the assembly for this operation. If the assembly contains more than one filter in line, a further plastic bag is inserted into the door opening so that the next filter can be drawn into it and the removal process repeated.

If HEPA filter replacement is required, radiological controls will be determined by the radiation safety program in accordance with site procedures. Specific radiological controls such as bag-out and PPE will be determined in accordance with the RWP process.

3.5.3.3 Filter Testing

A maximum leakage of no greater than 0.05% (efficiency of 99.95%) is specified for each HEPA filter bank when subject to in place aerosol testing. It is required that this performance be verified by annual tests. Built in test features allow an aerosol sample to be injected at each filter in turn. Measuring points at each filter allow measurements to be taken of the concentration of aerosol entering and leaving the filter. From these a calculation of the efficiency of the filter can be made.

These tests are applied only to the HEPA filters. No tests are required for pre-filters or moderate efficiency filters.

CH BAY exhaust air SHALL flow through at least one stage of HEPA filters in either filter unit 41-B-814 or 41-B-815 with > 99% efficiency.
[TSR LCO 3.2.1] Annually, one stage of HEPA filters in unit 41-B-814 and 41-B-815, is verified to have an efficiency of > 99% using PM041154, In Place Testing of HEPA Filter Units. **[TSR SR 4.2.1.3]**

Hot Cell Complex filter units, 41-B-877A and 41-B-877B and 41-B-877C SHALL have one stage of HEPA filters with > 99% efficiency.
[TSR LCO 3.2.2]. Annually, one stage of HEPA filters in units 41-B-877A and 41-B-877B and 41-B-877C is verified to have an efficiency > 99%, using PM041154. **[TSR SR 4.2.2.3]**

3.5.4 Variable Air Volume (VAV) Induction Terminal Boxes

Approximately 40 VAV induction terminal boxes are utilized in the SB supply ducts as shown in Figures HV III-2 through HV III-8. These units perform the following functions:

- All VAVs are induction type (i.e., air is drawn into the units from the ceiling plenum in which they are located) and is mixed with air entering from the supply duct before entering the diffuser.

- Temperature controls adjust the inlet and recirculating flow dampers, which change relative proportions and the total volumetric flow rate, to maintain outlet temperatures at required values.

- In certain VAVs electric heaters are provided which supplement the heat provided in the incoming air from the supplying AHUs.

A general description of this equipment is provided in the following section.

3.5.4.1 Description of Variable Air Volume Terminals

Figure HV G-3 contains a diagram showing the principal features of a typical VAV. The VAV is made up of three assemblies:

- An induction and mixing box in which the velocity of supply air entering at one end is used to induce an incoming flow of air from the outside ceiling plenum. Dampers in both the induced flow path and the main flow path can be adjusted to provide a desired temperature change. These dampers are operated through an adjustable and preset linkage by a pneumatic actuator.

- A heater section, located at the outlet of the induction box described above. This section contains an electric coil which can be used to heat the air leaving the induction and mixing section before it is transmitted to the outlet registers in the area ceiling.

- A terminal and control box which mounts on the side of the heater. This unit provides a termination point for incoming electric and pneumatic power supplies. It also contains the controls for the heater coil.

Thermocouples or pneumatically operated thermostats in the areas served by the VAVs are connected to the terminal and control boxes. Controllers in these boxes then adjust the damper solenoids and heater controls as required to provide the demanded temperature.

3.5.5 Dampers

3.5.5.1 General Use Air Dampers

Dampers are provided in air ducts as described in Section 3.2 and its accompanying figures. These units fulfill functions which include, isolation, flow control and back draft prevention. Figure HV G-7 illustrates typical construction of back draft and control or isolation dampers. The following features are common to dampers of these types:

- Configurations of parallel blades are located inside rectangular housings with flanges which provide for bolted connection to adjacent components and ducts.

- The blades of back draft dampers rotate round full length or stub axles welded to their upper edges so that the blades swing to a horizontal open position when forward airflow is present. A back draft causes the blades to drop to a vertical position when their lower edges meet stops and so effectively close the duct.

- A bracket bolted to the shaft of the top blade carries a balance weight which can be adjusted to provide operation at the desired reduction in forward flow. All blades are connected to a hinged bar to provide uniform movement of all blades.

- The blades of control and isolation dampers are usually arranged in pairs which open in opposite directions to provide symmetric flow patterns in their ducts. Operation can be either manual or by a pneumatic actuator.

- All ducts and blades are made of galvanized sheet steel.

3.5.5.2 Tornado Dampers

Tornado dampers, constructed to Design Basis Earthquake (DBE) or Design Basis Tornado (DBT) requirements, as applicable, and are installed at all HVAC inlet and exhaust openings in the WHB as shown in Figure HV G-8. **[DSA SC SSC 4.3.1]** Tornado dampers are also located at the HVAC exhaust air terminals in the three entrance airlocks in the CH area.

The overall configuration of the tornado dampers is similar to that of the multi-blade back draft dampers shown in Figure HV G-7. Dampers installed in outside air intakes open in the same direction as the normal airflow and close automatically to prevent reversal of flow (similar to a back draft damper).

Dampers installed in exhaust air openings open against the direction of normal airflow. Their blades are normally maintained in a partly open position by springs which hold the blades against stops. When the tornado pressure drop causes the exhaust flow rate to increase sufficiently, the back pressure on the partly open blades overcomes the spring tension and closes the blades. Figure HV G-8 shows layout and detail of the tornado damper in the WHB exhaust duct.

Design and construction was based on withstanding loads arising from tornados with the following characteristics: **[DSA SC SSC 4.3.1]**

- Maximum wind speed: 183 mph
- Translational velocity: 41 mph
- Tangential velocity: 124 mph
- Pressure drop: 0.50 psi
- Rate of Pressure Drop: 0.09 psi/sec
- Radius of maximum wind: 325 ft

The WHB tornado dampers were also designed to close in the event of a DBE (0.1g).

While the dampers were designed to withstand seismic loadings it was not a requirement that seismic and tornado events should be coincident.

The following features were included in the tornado damper's structural design:

- Dampers are provided with neoprene blade seals to minimize leakage
- Counterweights (in intake dampers) and springs (in exhaust dampers) which determine damper operating characteristics are field adjustable.
- Blade axles are mounted in relubricable ball bearings with externally accessible grease fittings.

Tornado dampers are provided at the inlet and exhaust HVAC openings to the TMF. These units are not designed for a seismic trip.

3.5.5.3 Fire Dampers

To meet the requirements of NFPA 90A fire dampers are installed in all HVAC ducts where they pass through walls with a fire rating of 2 hours or more.

Fire dampers are of the metal curtain type in which a fusible link maintains the damper in the open position. Melting of the fuse at a temperature of 160 F will allow the damper to close.

The following locations for fire dampers have been identified in the WHB:

Location	Service	Size
Air lock 107	supply	16" x10"
	return	18" x 9"
CH Battery Recharge Area (Room 103)	supply	32" x 26"
	return	60" x 26"
	supply	48" x 16"
	exhaust	80" x 36"
Corridor 114	return	12" x 12"
Overpack Personnel Change Room 109	exhaust	33" x 22"

The following locations for fire dampers have been identified in the SB:

Location	Service	Size
Computer Room (229)	Supply	40 x 20
Computer Room (229)	Supply	10 x 18
Computer Room (229)	Return	14 x 12
Computer Room (229)	Supply	10 x 6
Computer Room (229)	Return	10 x 6
Computer Room (229)	Return	8 x 6
Computer Room (229)	Supply	6 x 10
Vault	Return	6 x 6
CMR Viewing Area (240)	Supply	10 x 8

The following locations for fire dampers have been identified in the SB:

Location	Service	Size
Computer Room (229)	Supply	40 x 20
Computer Room (229)	Supply	10 x 18
Computer Room (229)	Return	14 x 12
Computer Room (229)	Supply	10 x 6
Computer Room (229)	Return	10 x 6
Computer Room (229)	Return	8 x 6
Computer Room (229)	Supply	6 x 10
Vault	Return	6 x 6
CMR Viewing Area (240)	Supply	10 x 8

In the Engineering Building fire dampers are located at the outlet of each exhaust fan.

In the Safety and Emergency Services Building a fire damper is located in the ventilation duct connecting to the second floor electrical room.

3.5.5.4 Room static pressures in the HV01 and HV02 subsystems are maintained by Pressure Differential Dampers (PDDs) and Constant Volume Air Terminal Units (CVATs) which are controlled by the Direct Digital Control (DDC) system.

3.5.6 Chilled Water Equipment

Refer to Chapter VII (CW02) for the chilled water equipment.

3.6 Instrumentation and Control

This section describes the design and operating features of the control and instrumentation equipment provided for the system HV00 subsystems described in Section 3.2.

As many of the control features are common to several subsystems cross references are used to avoid repetition.

Section 3.6.1 contains descriptions of specific instrument features which are in general use in HVAC systems throughout the plant, these include:

- Pneumatic Controllers (Section 3.6.1.1)
- Flow Measuring System (Section 3.6.2)
- Area Diff Press Monitoring/Transmission (Section 3.6.2.4)
- AHU and HEPA Filter Pressure Monitoring (Section 3.6.2.5)
- Tornado Damper Control System (Section 3.6.2.6)

Refer to Section 3.6 of each SDD HV00 subsystem chapters to obtain subsystem-specific I&C information.

3.6.1 Instrumentation Features in General Use

3.6.1.1 Pneumatic Control System

This pneumatic system is in general use in subsystems HV04, HV05, and HV06 (excluding Bldg. 486), for all major control functions. Figure HV G-10 provides a diagram showing a typical flow control application based on static pressure. The principal components consist of:

- Auto Manual Control Station (Section 3.6.1.2)
- Controller (Section 3.6.1.3)
- Control Actuators (Section 3.6.1.4)
- Other Control Components (Section 3.6.1.5)

These components are described in the sections designated above. A description of some specific applications is provided in Section 3.6.1.6.

3.6.1.2 Auto Manual Control Station

Each auto/manual control station consists of a 6" by 6" panel mounted faceplate with the controls and indicators illustrated in Figure HV G-9. These comprise:

- A central pointer which continuously displays the process signal under control.

- A red peripheral pointer which can be transferred by a "Valve/Reg" selector switch so as to indicate either the output of the controller or the control setpoint as determined by the thumbwheel (see last bullet below).

- A three position control transfer switch, "Auto/Seal/manual" which allows the controlled actuator to be transferred between automatic and direct manual control. The seal position provides the capability for bumpless switching between control modes.

- A thumbwheel which adjusts the output of a pneumatic regulator contained within the control station so as to provide a variable signal for either manual control or adjustment of the automatic control setpoint.

3.6.1.3 Pneumatic Controller

Construction:

A pneumatic controller generally mounts on a manifold block at the rear of each control station (they may also be mounted elsewhere within control cabinets where they perform functions not requiring operator adjustment).

The regulator which provides control signals to the controller is mounted within the station on the manifold block. The controller is made up of a stack of machined aluminum rings held together by six bolts. Overall dimensions are approx 4.5" dia and 8" high. Roll-edged diaphragms, which are clamped between the rings, serve both as gaskets and pressure sensors.

Operation:

The controller operates on a force balance principle with all forces acting along the axis of the instrument. The controller compares the measured variable flow (in Figure HV G-9) with a setpoint derived from the regulator in the control station. Air pressure is used to transmit these signals to a detector element made up of diaphragms fixed to a center post. Movement of the post in response to pressure differences across the diaphragms causes a nozzle seat to move and so provides throttling action in a pilot valve which controls the output pressure of the controller. Approximately .001" movement of the pilot nozzle seat changes the output pressure from 3 to 15 psi. Adjustments to needle valves in air passages within each controller provide adjustable internal proportional and integral control terms. The integral (or reset) control function can be disconnected by relocation of a feedback selector plate from "With manual bypass" to "Without manual bypass." This action disconnects the reset chamber (Pr) from the controller output.

3.6.1.4 Control Actuators

The 3 to 15 psi output from the controllers is transmitted to pneumatic actuators on valves, electrical switches, or fan inlet vane positioning mechanisms. The type of actuator used can be determined from the subsystem block diagrams contained in Section 3.2.

3.6.1.5 Other Control Components

In order to provide signal conditioning functions for the control systems pneumatic devices are provided which perform mathematical functions such as averaging, biasing and low value selection. Interfaces between these control systems and related instrumentation and electrical supply systems require pneumatic/current and current/pneumatic converters, also pneumatic trip relays which operate electrical contacts.

3.6.1.6 Control Loop Documentation

Specific components are listed in the bill of materials in the control panel layout drawings. These drawings also contain wiring and termination information.

3.6.1.7 Direct Digital Control System

The DDC system is in general use in subsystems HV01, HV02 (excluding Bldg. 412), and HV06 (Bldg. 486 only).

A digital controller and any required expansion modules are installed in the control panel for connection of input and output points associated with the exhaust fan, supply fan, temperature, pressure, and HEPA filter train monitoring and control, as appropriate.

The existing inlet vanes of exhaust fans are mechanically locked in the full open position and an adjustable speed drive (ASD) is provided for each fan, except for 41-B-807, Hot Cell AHU. The ASDs are networked to the controller network using a portal. Utilizing this digital interface permits all inputs and outputs to be communicated directly, thus eliminating redundant I/O and significantly increasing available information for use by the operators. A Hand/Off/Auto (HOA) switch is installed on the face of each ASD for local operator interaction. Existing drive status lights factory installed on the control panel are utilized as the local display. The ASD hand switch positions are monitored by the DDC to provide indication of the actual switch position. The "off" and "auto" switch positions is monitored directly by the DDC with the "on" position being a virtual point based on the condition of the other two inputs. The communications interface between the DDC system and the adjustable frequency drives (ASDs) is configured such that the ASDs can be controlled and monitored over the communication network.

The exhaust air system interacts with the makeup system in a pressure dependent manner making all exhaust airflow information unnecessary. Therefore, all equipment associated with the Kurz air monitoring system including the flow measuring station, flow straightener, transmitter, and all signal conditioning components are not used.

Manual Operation:

With the HOA switch in the "off" position, the ASD is off. With the HOA switch in the "on" position, the ASD starts and operates at a minimum speed of 15 Hz with the fan speed being manually set from the operator key pad on the front of the operating ASD.

When the HOA switch for exhaust fan is "off", software interlocks through the DDC shall cause inlet isolation dampers and discharge isolation dampers to spring return closed. When the HOA switch for exhaust fan is "on", software interlocks cause inlet isolation dampers and discharge isolation dampers to be powered open.

Automatic Operation:

The operator shall initiate operation from the control panel. The DDC shall automatically control the exhaust fans using a lead/backup control strategy. The operator shall also be able to configure the lead and backup exhaust fan. When initiated, the DDC shall first configure the HEPA filter trains as described in that section. Once the appropriate HEPA train isolation dampers have been commanded to open and after a 140 second delay has occurred (damper actuator rotation interval), the appropriate fans start.

During normal operation, if the lead exhaust fan fails, the backup exhaust fan starts. From the CMR or other computer connected to the DDC, the operator is able to switch lead/backup exhaust fan designation during normal operation.

These instruments are standard off-the-shelf instruments. Transmitter accuracy is ± 1 percent. Loop accuracy is ± 2 percent.

3.6.2 Flow Measuring Systems

Airflow measurement in HV02 (bldg. 412 only), HV03, and HV04 subsystems is with an array of electronic sensors that act on a principle similar to a hot wire anemometer. Several sensors are placed in a section of duct to measure the velocity similar to a Pitot traverse. These signals are converted electronically into an airflow signal for use by the flow control systems. The two types of flow measuring systems are the analog and the newer digital type, both by the same manufacturer.

3.6.2.1 Flow Measuring Element

The flow measuring assembly consists of an array of one to three parallel probes positioned in the duct at a location where there is a suitable velocity profile. Each probe contains three or four sensing elements. The positioning of the elements and probes is so arranged that an average air velocity can be determined and multiplied by the duct cross sectional area to find the flow rate. Figure HV G-11 provides a pictorial view of a typical probe containing four sensing elements positioned across a circular duct.

Each flow sensing element consists of a velocity sensor winding and an ambient temperature sensor compensating winding. This system is similar to the principle of a hot wire anemometer.

3.6.2.2 Analog Signal Processing

The signal from the velocity sensor must be processed by electronic circuits for conversion into a signal that can be used by the systems for display and control. The two types of flow measuring systems differ only in the way that the signals from the sensors are processed.

Figure HV G-12 contains a block diagram of the configuration of the analog and digital flow measuring and control equipment.

The analog electronic signal conditioning consoles contain power supplies and the following modules:

- Signal conditioner modules, which accept two wires from each sensor element in a duct, and linearize and amplify each incoming signal. They also average these signals and develop a 0 to 5 v total flow-rate signal for each duct.

- Signal generator which changes the conditioner module output to a 4 to 20 mA signal for use by the control systems.

3.6.2.3 Digital Signal Processing

The digital type signal processor contains all the hardware and software for signal linearization, amplification, and calibration. With this type of processor, all potentiometer adjustments associated with the analog system have been eliminated. Access for system set up is through the key pad located in the front of the unit. The unit is directly connected either to the HV01 digital control system or through a current to pneumatic transducer for the pneumatic control systems.

3.6.2.4 Area Differential Pressure Monitoring

Area differential pressure monitor/transmitter units located in the WHB and SB are used to control the pressure within the buildings at required values.

Figure HV G-13 illustrates the layout of a typical differential pressure monitor/transmitter unit. The unit is pneumatic in operation and contains the following features:

- Each unit is mounted on a wall rack and receives sample air lines from the outside atmosphere and from the area monitored. A common outside air header is used which serves a number of units. The outside air header is compensated for the effect of wind pressure by the use of an inverted U entry as shown in Figure HV G-13.

- A differential pressure transmitter compares the pressure of the area and outside air and modulates the incoming instrument air supply to provide an outlet air pressure proportional to their difference.

- A pressure regulator, with a pressure indicator mounted on it, supplies air to the unit at specified pressure. Root valves allow the transmitter, the indicator or the entire system to be serviced without impacting other units. Bleed valves allow the incoming sample lines to be blown down. Air lines and interconnecting tubing are ½" O.D. x .049".

- The output signal line connects to a pneumatic controller in the control panel provided for the fan whose operation will maintain the area pressure at its required value.

3.6.2.5 Control and Supply System for AHU Heater Coils

This section provides a description of the power supply and control circuits for the AHU heater coils in HV01 and HV02. This equipment is similar to that used in HV03, HV04 and elsewhere on the site. The heater coils are described in Section 3.5.1.4.

Figure HV G-14 contains a schematic diagram of the electrical power supply and control circuits for the electrical heater section of AHU 41-B-803. The design and mode of operation of this equipment is typical of that provided in other AHUs in subsystems HV01 to HV04.

The heating elements in this AHU are grouped in twelve Y connected heater circuits. These circuits are staged to provide heat output which is proportional to the temperature deviation at the controlling thermostat.

The 480 V, 3-phase, 60 cycle power is supplied to individual heater enclosures from Motor Control Centers (MCCs) and distribution panels. The incoming power line connects to a disconnect switch fitted with a shunt trip device. This switch supplies the twelve control contactors which control power supply to the individual heater coils.

The 120 V contactor operating coils are activated by two single phase step controllers which operate in a master and slave mode. Control power comes from a 480V/120V transformer located in the enclosure. The step controllers receive an input signal from a pneumatic/electric transducer located in the enclosure. The pneumatic input signal to this transducer comes from a pneumatic temperature transmitter which monitors the outlet temperature of the air leaving the AHU.

Ten of the heater coils are fully energized as their contactors are successively closed by signals from the master step controller. Two of the heater coils are supplied from their contactors by way of two slave stepping power controllers.

These devices provide a vernier control of heat output. These power controllers employ heavy duty solid state switchgear to control the 3 phase heater coils. They are conservatively rated and are mounted in oversized heat sinks.

Logic and control circuits in the master stepping controller and slave unit provide proportional controlling action. This is done by establishing a basic time interval (4 seconds) and energizing the heater for a percentage of each interval depending on the heat required. This is accomplished by switching the triacs in the power controllers at the direction of the logic circuits in the master stepping controller. A light emitting diode located on the cover of each step controller allows its operation to be monitored.

Protection devices include the following:

- The shunt trip in the main disconnect switch will trip the unit in the event of low airflow or excessive temperatures in the housing and coil assemblies.

- The shunt trip circuit includes an interlock with the AHU supply fan motor contactor which prevents closure of the disconnect switch if the supply fan is not in operation.

- All heater element supply lines are provided with fuses rated at 125% of rated current.

3.6.2.6 Tornado Damper Seismic Trip System

The tornado dampers are either spring loaded or counter weighted back-draft dampers that close due to the high velocity outward airflow caused by the tornado pressure differential. These dampers can also be closed by a signal from the Seismic Monitoring System (EM04).

Figure HV G-14 illustrates the operation of this system. A seismic switch and relays in system EM04 energize the twelve solenoid valves of the tornado dampers designated in Figure HV G-14. Operation of the solenoid valves admits air to the pneumatic actuators to close the dampers.

Additionally, the damper in the Station C (radiation effluent monitor) exhaust duct has a switch in the blade linkage that is closed when the damper closes. This switch energizes the relay which opens the trip circuits of the exhaust fans listed in Figure HV G-14.

De-energizing the relay will also shut off the air handling units by the action of the control circuit interlocks.

3.7 System Interfaces

This section describes the implementation of the primary and secondary interfaces listed in Appendix C.

3.7.1 Primary Interfaces

These interfaces relate to functions and services needed by the HVAC system from the following systems to satisfy system HV00 design requirements and criteria.

3.7.1.1 Compressed Air System (CA00)

The CA00 system provides air supply to the pneumatic control systems which operate the duct air dampers, chilled water control valves and fan vortex positioners contained in systems HV00 and CW02.

The interface between system CA00 and HV00 is at the supply valves on the branch lines from the CA00 main distribution air line. These valves are shown, along with the components they supply, on the CA00 Piping and Instrumentation diagrams (P&ID) listed in the WIPP drawing register.

In the case of the engineering and safety and emergency buildings the compressed air equipment was procured along with the HVAC equipment.

3.7.1.2 Plant Monitoring and Communication System (CM01)

System CM01 provides status, alarm and measurement information for HV00 subsystems as detailed in the following tables:

HV01	Table HV G-4	HV04	Table HV G-8
HV02	Table HV G-5	HV05	Table HV G-7
HV03	Table HV G-6		

The interface between the two systems is at the input terminals to the system CM01 Local Processing Units (LPUs) listed in these tables. Signal parameters at the interface for the different types of information transfer are as follows:

- Analog information is transmitted to the LPUs in the form of 4 to 20 ma current signals at a level in the range 5mv to 10V.

- Status signals are provided by the closure of contacts in circuits connected to terminals with 48 V potential in the LPUs. The resulting current is in the range 5 to 25 ma.

- Outgoing control signals are provided to system ED00 by the opening or closure of contacts on relays in the LPUs.

TABLE HV G-4: List of Active Points at HV01/CM01 Interface in the WHB

HEPA FILTER ASSEMBLIES

LPU	Number	Filter P.D. Measurement			Filter Clogged Alarm		
		Mod	**HEPA 1**	**HEPA 2**	**Mod**	**HEPA 1**	**HEPA 2**
804	41-B-834	AG5204	AG5206	AG5208	CG5203*	CG5205*	CG5207*
	41-B-979	AG5214	AG5216	AG5218	CG5213*	CG5215*	CG5217*
	41-B-814	AG5222	AG5224	AG5226	CG5221*	CG5223*	CG5225*
	41-B-815	AG5228	AG5230	AG5232	CG5227*	CG5229*	CG5231*
812	45-B-116	AG6301	AG6302	AG6303			
	45-B-117	AG6304	AG6305	AG6306			

AHU & EXHAUST FANS

LPU	Unit	Number	Meas	Fan Stopped	Low flow
804	AHU	41-B-812	AG5202 (static pres.)	CG5237*	CG5201*
	AHU	41-B-813	AG5212 (static pres.)	CG5238*	CG5211*
	AHU	41-B-861		CG6311	CG6301
	AHU	41-B-863		CG6312	CG6302
	Supply Fan	41-B-1007		CG6002	CG6001
	Exhaust Fan	41-B-816	AG5234 (static pres.)	CG5239*	CG5233*
	Exhaust Fan	41-B-817	AG5236 (static pres.)	CG5240*	CG5235*
	Exhaust Fan	41-B-835	AG5210 (flow)	CG5241	CG5209*
	Exhaust Fan	41-B-836	AG5220 (flow)	CG5242	CG5219*
821	Supply Fan	41-B-101		CG5151	
	Supply Fan	41-B-102		CG5152	

AREA HIGH DIFFERENTIAL PRESSURE ALARMS

Area	LPU	Alarm No	Area	LPU	Alarm No
ORR Room	804	AG5901*	Crane Maint RM		
CH Bay	804	AG5902*	Air Lock	821	AP0248

* against a point indicates alarm priority 2

TABLE HV G-5: List of Active Points at HV02/CM01 Interface in the WHB

HEPA FILTER ASSEMBLIES

LPU	Number	Filter P.D. Measurement			Filter Clogged Alarm		
		Mod	HEPA 1	HEPA 2	Mod	HEPA 1	HEPA 2
804	41-B-801	AG5124	AG5122	AG5120	CG5123	CG5121	CG5119
	41-B-802	AG5138	AG5136	AG5134	CG5137	CG5135	CG5133
	41-B-877A	AG5104	AG5106	AG5108	CG5103	CG5105	CG5107
	41-B-877B	AG5112	AG5114	AG5116	CG5111	CG5113	CG5115
	41-B-877C	AG5126	AG5128	AG5130	CG5125	CG5127	CG5129

AHU & EXHAUST FANS

LPU	Unit	Number	Meas	Fan Stopped	Low Flow
804	AHU	41-B-803	AG5102 (static pres.)	CG5143	CG5101
	AHU	41-B-804	AG5110 (static pres.)	CG5144	CG5109
	AHU	41-B-807	AG5802 (Hot Cell temp.)	CG5805	CG5801
	Exhaust Fan	41-B-805	AG5118 (static pres.)	CG5145	CG5117
	Exhaust Fan	41-B-806	AG5132 (static pres.)	CG5146	CG5131
	Exhaust Fan	41-B-878A+B	AG5140 (static pres.)	CG5139	
	Exhaust Fan	41-B-878A		CG5147	
	Exhaust Fan	41-B-878B		CG5147	
816	AHU	41-B-991	AU6602 (flow)	CU6603	CU6601
	AHU	41-B-992	AU6605 (flow)	CU6606	CU6604
	Exhaust Fan	41-B-993	AU6611 (flow)	CU6608	CU6607
	Exhaust Fan	41-B-994	AU6612 (flow)	CU6610	CU6609

TABLE HV G-6: List of Active Points at HV03/CM01 Interface in the WHB

Zone	Unit	Number	Function	LPU	Point No
1	AHU	45-B-101	stopped	812	CJ5102
	Exh Fan	45-B-102	stopped	812	CJ5102
2	AHU	45-B-112	stopped	812	CJ5302
	AHU	45-B-113	stopped	812	CJ5304
	Exh Fan	45-B-114	stopped	812	CJ5301
	Exh Fan	45-B-115	stopped	812	CJ5303
	HEPA	45-B-116	Mod filter clog	812	CG6305
			HEPA 1 filter clog	812	CG6306
			HEPA 2 filter clog	812	CG6307
	HEPA	45-B-117	Mod filter clog	812	CG6308
			HEPA 1 filter clog	812	CG6309
			HEPA 2 filter clog	812	CG6310
	Exh Fan	45-B-118	stopped	812	CG6303
	Exh Fan	45-B-119	stopped	812	CG6304
3	AHU	45-B-105	stopped	812	CJ5201
	Exh Fan	45-B-106	stopped	812	CJ5202
	Exh Fan	45-B-107	stopped	812	CJ5203
4	AHU	45-B-120	stopped	812	CJ5401
	Exh Fan	45-B-121	stopped	812	CJ5402
5	AHU	45-B-125	stopped	812	CJ5501
	Exh Fan	45-B-126	stopped	812	CJ5502
6	AHU	45-B-130	stopped	812	CJ5601
	AHU	45-B-131	stopped	812	CJ5603
	Exh Fan	45-B-136	stopped	812	CJ5602
	Exh Fan	45-B-137	stopped	812	CJ5604
Batt Room	Exh Fan	45-B-621	running	801	CJ5701
CMR	ALM-HVAC	damper	transfer CMR air supply command	812	DJ5605

INACTIVE POINTS AT HV03/CM01 INTERFACE

Zone 1 HVAC	shutdown command	812	DJ5611
Zone 2 HVAC	shutdown command	812	DJ5612
Zone 3 HVAC	shutdown command	812	DJ5613
Zone 4 HVAC	shutdown command	812	DJ5614
Zone 5 HVAC	shutdown command	812	DJ5615
Zone 6 HVAC	shutdown command	812	DJ5616

TABLE HV G-7: Active Air Temp Points at the HV05/CM00 Interface in the Water Pumphouse

LPU	Function	Point No
803	Pumphouse Lo-Lo air temp	CK5701
	Pumphouse Hi-Hi air temp	CK5702

TABLE HV G-8: List of Active Points at HV04/CM01 Interface in the WHB

HEPA FILTER ASSEMBLIES

LPU	Assembly	Filter P.D. Measurement			Filter Clogged Alarm		
	Number	Mod	HEPA 1	HEPA 2	Mod	HEPA 1	HEPA 2
805	41-B-883	AH6701	AH6702	AH6703	CH6706	CH6707	CH6708
	41-B-884	AH6704	AH6705	AH6706	CH6709	H6710	CH6711

AHU & EXHAUST FANS

LPU	Unit	Number	Flow Meas	Low Flow
805	AHU	41-B-870	CH6701	
	AHU		41-B-871	CH6702
	Exhaust Fan	41-B-881	AH6707	CH6712
	Exhaust Fan	41-B-882	AH6708	CH6713

AREA STATIC PRESSURE ALARMS

LPU	Area	Alarm No
805	Exhaust Equipment Room 101	CH6703
	Access Corridor Room 104	CH6704
	Filter Chamber Room 105	CH6705

3.7.1.3 Electrical Distribution System (ED00)

The system provides electrical power as required by HVAC equipment. The interface between systems ED00 and HV00 is at the output terminals of the switchgear, MCCs and distribution boards which supply HVAC equipment.

In the event of loss of the incoming power supply, backup power is provided to the CMR HVAC system (HV03, zone 6) from the subsystem ED09 diesel generators. This power is supplied from MCCs 45P-MCC04/3 fed from CB-2 in Sub 1 and 45P-MCC04/4 fed from CB-2 in the SB Substation.

3.7.1.4 Environmental Monitoring System (EM00)

In the event of a seismic event, of a magnitude that could impair the effectiveness of confinement in the WHB, signals from the seismic monitoring system, EM04, are utilized by system HV00 to trip the HVAC fans and close tornado dampers at the WHB boundaries.

The interface between system EM04 and HV00 is located at the output terminals on the east wall of the WHB. Cables from these terminals connect to the tornado damper solenoid valves located on the WHB inlet and exhaust ducts.

The HVAC seismic/ tornado damper operating system is described in Section 3.6.2.6.

3.7.1.5 Fire Protection System (FP00)

Smoke detectors provided by the FP00 system are located in HVAC ducts in the SB, the Engineering Building, the Safety and Emergency Building and Bldg. 412. Where smoke is detected these detectors operate interlocks in the power supplies of their related HVAC fans.

The interface between system FP00 and HV00 is at the output terminals of the FP00 panels which operate the interlocks.

3.7.1.6 General, Civil and Structural (GC00)

Interfaces between the HVAC equipment and system GC00 are at the mounting fixtures and hanger supports which locate the equipment in WIPP buildings. These arrangements are identified in the installation drawings listed in the WIPP Drawing Register.

3.7.1.7 Ventilation U/G (VU00)

The primary interface between the VU00 system and the HVAC system is functional. The exhaust airflow from the Waste Handling Tower is drawn into the Waste Shaft (WS) by the action of the main exhaust fans which vent the U/G facility.

3.7.1.8 Plant Communication System(PC00)
Plant Protection System (PP00)
Water Distribution System (WD00)

The above systems provide services important to the operation of HVAC equipment. The design features of these systems in buildings which accommodate system HV00 equipment are described in their SDDs.

There are no physical interfaces between these systems and system HV00 equipment. In the case of subsystem CW02 there is an interface with system WD00 at the supply valves in the water distribution system branch lines.

3.7.1.9 The interface between HV00 and WH00 is for the exhaust hood for the TRUDOCKs and for TRUPACT III. The air from both hood systems is exhausted to the battery exhaust fans.

3.7.2 Secondary Interfaces

Secondary interfaces relate to the provision of HVAC to other systems which require them to meet their design requirements and criteria.

These interfaces relate to the provision of acceptable ambient conditions and the confinement of contaminants. They are therefore functional rather than physical.

The indoor design conditions provided are those required in Section 2.1.2. Similarly the confinement provided is as required in Section 2.1.3.

4.0 OPERATION

4.1 Introduction

The operation of the surface Heating and Ventilating systems are described in terms of the separate buildings and facilities which they serve. (Refer to the WIPP Site Controlled Operating Procedures.)

Operation of the major chilled water system which serves the WHB and SB is described in Chapter VII. Operation of the CW02 systems which serve the engineering and safety and emergency buildings is described, along with the operation of the HVAC in those buildings, in the sections listed above.

In the case of the smaller HVAC systems in ancillary buildings such as the pumphouse, warehouse, auxiliary warehouse, etc, operating requirements are considered to be self evident or can be inferred from the descriptions developed elsewhere in this section.

As the HVAC systems are designed for continuous operation "normal operations" are limited to the activities required to bring standby units into operation or to transfer modes of operation from automatic to manual to accommodate interlocks which might otherwise limit desired changes in operating configuration.

The WHB Zone 2, consisting of the AHUs, HEPA filters and exhaust fans which supply the CH areas is operated using WP 04-HV1021, which maintains the confinement ventilation system for the CH BAY in an OPERABLE condition. An OPERABLE confinement ventilation system consists of the following elements:

- Exhaust fan 41-B-816 or 41-B-817 SHALL be IN-SERVICE; and
- CH BAY exhaust air SHALL flow through at least one stage of HEPA filters in either filter unit, 41-B-814 or 41-B-815. **[TSR LCO 3.2.1]**

WP 04-AD3001 specifies the daily verification that one CH Bay confinement ventilation system exhaust fan, 41-B-816 or 41-B-817, is IN-SERVICE. **[TSR SR 4.2.1.1]** CH BAY exhaust air is flowing from a HEPA filter unit to an exhaust fan. **[TSR SR 4.2.1.2]**

WHB Zone 4, consisting of the AHUs, HEPA filters, and exhaust fans which supply the RH areas, is operated using WP 04-HV1061 and the WHB RH Area Zone 4 HVAC, which maintains the Hot Cell Complex confinement ventilation system in an OPERABLE condition. An OPERABLE confinement ventilation system consists of the following elements:

- Exhaust fan 41-B-878A or 41-B-878B SHALL be IN-SERVICE;
- Exhaust air SHALL flow through two of the following filter units: 41-B-877A, 41-B-877B, or 41-B-877C. **[TSR LCO 3.2.2]**

WP 04-AD3001 specifies the daily verification that one Hot Cell Complex confinement ventilation system exhaust fan, 41-B-878A or 41-B-878B, is IN-SERVICE. **[TSR SR 4.2.2.1]** Hot Cell Complex exhaust air is flowing from at least two HEPA filter units to the exhaust fan. **[TSR SR 4.2.2.2]**

It is not possible to identify "infrequent operations" which are significantly different from "normal operations" so these two categories were combined under the heading of "normal operations."

Shutdown operations are generally brief and are described chiefly in terms of the initiating actions (interlocks frequently complete the shutdown). Also any significant checks required to ensure preservation of containment boundaries are included.

A set of specific precautions and limitations are provided along with each HVAC system operations section. Items identified are those which are specific to that equipment or system and should be taken into account by the operators when carrying out these procedures.

The degree of detail provided in each outline is sufficient to allow specific identification of all key steps in existing or new procedures. These outlines omit checking and administrative requirements, also omitted are actions related to the operation or mission of other systems not directly needed for the operation of HV00 equipment.

The procedures outlined are applicable to systems and equipment released for operation following the successful completion of any required acceptance tests. Also, it is assumed that all applicable calibration and maintenance procedures have been performed on a timely basis.

Refer to Section 4.0 of each SDD HV00 subsystem chapters to obtain subsystem-specific HVAC or CW02 subsystem operations requirements and conditions.

5.0 SYSTEM LIMITATIONS, SETPOINTS, AND PRECAUTIONS

5.1 Introduction

This section provides an account of the operating limits, setpoints, alarms, interlocks, and precautions which relate to the operation of the HVAC. Consideration is given to public safety, general personnel safety, equipment safety and performance, and overall system performance. The information presented here references and consolidates the descriptions provided separately for individual subsystems and items of equipment in Sections 3.0, 4.0, 6.0, and 7.0 where they relate to specific aspects of design, operation and maintenance.

As a result of the confinement function which they perform, certain HVAC components have conditions for maintaining operations. WP 04-AD3001 specifies the daily verification that one CH Bay confinement ventilation system exhaust fan, 41-B-816 or 41-B-817, is IN-SERVICE. **[TSR SR 4.2.1.1]** CH BAY exhaust air is flowing from a HEPA filter unit to an exhaust fan. **[TSR SR 4.2.1.2]** WP 04-AD3001 specifies the daily verification that one Hot Cell Complex confinement ventilation system exhaust fan, 41-B-878A or 41-B-878B, is IN-SERVICE. **[TSR SR 4.2.2.1]** Hot Cell Complex exhaust air is flowing from at least two HEPA filter units to the exhaust fan. **[TSR SR 4.2.2.2]**

The alarms and interlocks related to these components are described in Section 5.2.

The alarms and interlocks which monitor components are described in Section 5.3.

Precautions which should be observed by operating and maintenance personnel are described in Section 5.4.

5.2 Conditions for Maintaining Operations Limits and Alarms

The conditions for maintaining operations of the HVAC system are described in Section 3.3.2 of each chapter.

Refer to Section 5.0 of each SDD HV00 subsystem chapters to obtain subsystem-specific HVAC setpoint and alarm information.

5.3 System HV00 Alarms and Interlocks

A comprehensive system of alarms and interlocks are provided in the HVAC systems which serve the waste handling areas (HV01, HV02, HV03, and HV04). Alarm features in these subsystems are described in Section 5.3.1; interlocks are described in Section 5.3.2 below.

In conformance with commercial practice, less use is made of alarms and interlocks in HVAC subsystems which serve support facilities (HV05 and HV06). Alarms and interlocks in these systems are described along with their overall SDDs in Sections 3.2.5 and 3.2.6.

In the case of the chilled water systems alarms and interlocks are provided as part of the vendors integrated chiller units. The controls and interlocks of the chiller modules are described in Chapter VII.

5.3.1 HVAC Alarms in HV01, HV02, HV03, and HV04

Alarms on these subsystems are either displayed on the local control panel or in the DDC computer. These alarms also activate CMR alarms as described in Section 3.7.1.2.

5.3.2 System HV00 Interlocks

The following general operating features are provided by these interlocks:

- AHUs and exhaust fans provided to serve a common area are paired to form one or more trains, each consisting of an AHU and an exhaust fan.

- The AHU supply fan and exhaust fan in each train are interlocked so that under automatic control loss of either unit will cause its partner to trip. Time delay and flow switches allow startup of the train.

- When in automatic control a mechanical equipment room AHU can only be operated when either a CH area or an RH area HVAC train are in operation.

- The two CH trains are interlocked so that only one can operate at a time.

- The inlet and outlet dampers on the CH, RH and battery station area HEPA filters open when their associated exhaust fans start up and close when the fans shutdown.

- The inlet and outlet dampers at the hot cell exhaust fans open when their associated fans start up and close when they shutdown.

- Low flow interlocks operate in conjunction with the low flow alarms to shut down their associated fans.

5.4 Precautions

Operation of the HVAC systems requires electrical power (up to 480V supply), compressed air and exposure to rotating machinery. Technical personnel required to operate and maintain these systems must be trained in industry safety standards related to the operation of electrical, mechanical and instrumentation equipment.

There are no particular electrical or mechanical hazards unique to the design of system HV00 equipment.

The WHB contains a combination of high capacity air fans and an extensive system of sheet metal distribution ducts. This requires that attention be given to transient or steady state conditions which could result in duct deformation due to pressure differences between the duct internal air and the external area. Particular situations which require attention include the following:

- Only one of the main HVAC trains should be operated at a time in the CH and RH areas (interlocks provide this feature in the CH area).

- The main exhaust fans in the CH and RH trains should be started at a low flow rate and then brought up to speed in an area differential pressure control mode.

- The static pressure rise at the registers in the SB inlet ducts should not be allowed to exceed 2.0" wg.

As automatic reconfiguration of HVAC trains following fire detection is contingent on their operation in automatic mode, prolonged operation of any parts of these trains in manual mode should be avoided.

Operation of the chilled water system compressor units should take account of the vendor's instructions about the requirements for crank case heating and the permissible interval between restarts. These measures are intended to ensure adequate lubrication by minimizing both the amount of refrigerant in solution, and the presence of oil foaming.

6.0 OFF-NORMAL EVENTS AND RECOVERY PROCEDURES

6.1 Introduction

An off-normal event is defined as an abnormal system or plant condition, which could affect the safety of site or off-site personnel or could affect the integrity or proper functional operation of the system or plant.

In this SDD off-normal events are only considered significant when applicable to the HVAC systems of buildings directly connected with the waste handling process. These include the WHB and SB, the EFB and the Emergency Operations Center (EOC) Facility in the Safety and Emergency Building.

Following is a list of off-normal events:

- Loss of WHB differential pressure
- Inoperability of a WHB HVAC Train **[TSR LCO 3.2.1] [TSR LCO 3.2.2]**
- Release of radioactive particulates
- Loss of electrical power
- Loss of compressed air supply
- Fire
- Design Basis Earthquake/Tornado

In each case the impact of the casualty is described as is the indication provided to plant operators through alarms, instrumentation and any other observable consequences. Recovery procedures are outlined. (Refer to the WIPP Site Controlled Operating Procedures for abnormal events which deserve the Event and Recovery Scenario).

7.0 MAINTENANCE

In accordance with requirements contained in DOE Order 4330.4B, the maintenance program "....shall contain provisions sufficient to preserve, predict, or restore the availability, operability, and reliability of plant structures, systems and components important to safe and reliable operation of the ... facility." This is the guiding requirement and basis for the material provided herewith.

Due to the dependence of the site habitability and operations on the HVAC system, maintenance should be scheduled at times of site inactivity, if at all possible. Also, all HVAC maintenance activities must be performed in accordance and consistent with the requirements contained in the WIPP Site Safety Manual.

This section provides guidance for the preparation of procedures needed to implement the Maintenance Program. These procedures will be subject to an authorized approval and change control program.

7.1 Maintenance Approach

In general, all maintenance on HVAC equipment is carried out using "contact maintenance" techniques. It is not anticipated that radiation levels of a magnitude that would require remote maintenance would occur. Nevertheless before performing maintenance on HVAC equipment in the Waste Handling Area, Radiological Control should be contacted for their radiological evaluation and concurrence.

A graded approach to maintenance should be utilized, in which the detail and resources expended on maintenance functions correspond to the importance of specific facility requirements such as safe operation, reliability, environmental compliance, programmatic mission, safeguards and security. The most essential and costliest items should receive the most maintenance attention followed by less attention to less essential equipment. This graded approach should take account of the following order of preference:

- Clean, adjust, rework or repair equipment in place. Where feasible this provides for maintenance without shutdown of the system or component.

- Remove the subject unit from service and replace by either a redundant installed unit or a spare. Clean, service, repair, and requalify the removed unit and either return to service or use as a spare.

- Remove the subject unit, rework or repair, requalify and return to service.

Two types of maintenance activity are outlined in the following sections. These are corrective maintenance, and preventive maintenance.

7.2 Corrective Maintenance

Corrective maintenance is carried out either to correct a failure or to avoid an impending failure. Presence of a failure would be indicated by alarms at local control panels as discussed in Section 3.6 or by CMR alarms as described in Section 3.7.1.2. Prediction of impending failure could arise from either predictive maintenance or in-service inspection checks. The purpose of corrective maintenance is to restore the component or system to a condition suitable to perform its required functions in a reliable manner.

Maintenance on HVAC equipment is performed in conformance with the preferences listed in the previous section, and with the component/system de-energized. All the principal waste handling areas are served by redundant HVAC equipment so that maintenance can generally be carried out without interrupting waste handling activities.

Corrective maintenance should be carried out in accordance with the manufacturer's recommendations as described in their operation and maintenance (O&M) manuals. Where it is necessary that equipment be dismantled and removed the exit routes are described in Section 3.4.

7.3 Preventive Maintenance

The preventive maintenance program described in this section is based on current industrial practice for high availability facilities.

The scope of preventive maintenance on HVAC equipment will cover the following disciplines and their designated performance areas:

- Mechanical (cleanliness, corrosion, lubrication, alignment, bearing operation, belt drive tension and wear, fastener torque)

- Electrical (cleanliness, insulation resistance, motor current, contactor and relay contact status, overheating, terminal torque)

- Instrument (calibration, control panel alarm, indicator light, switch and instrument operation)

All major components should be evaluated on the basis of the graded approach described in Section 7.1. Arising from this review a schedule for periodic preventive maintenance by the applicable disciplines will be setup. This review should take account of the recommendations of specific manufacturers for the scope and frequency of maintenance activities for their equipment. It should be noted that manufacturers will not utilize the graded approach which is application specific. Preventive maintenance will be performed more frequently on critical items than on others in less demanding applications.

Table HV G-9 provides a general summary of the frequency of maintenance recommended for the different categories of equipment which makeup system HV00. As an equipment maintenance history is accumulated, the scope and frequency of the preventive maintenance program should be reviewed and where appropriate modified to ensure optimum performance and resource utilization.

7.3.1 Outline of HVAC Equipment Preventive Maintenance Requirements

This section provides an outline of the contents of the maintenance procedures required for the HVAC components listed in Table HV G-9. The content of these outlines is generic and is intended to provide a basis for the preparation of maintenance procedures for specific manufacturer's equipment.

Administrative and verification actions have been omitted, as have actions required to restore the system to operation following the completion of maintenance. Where maintenance is specific to the design of the equipment attention is directed to the manufacturers' O&M manuals).

TABLE HV G-9: Guideline for Frequency of HVAC Maintenance Activities

Equipment	**Preventive Maintenance**		
	Mech	Elect	Instr
Air Handling Units	6m, 3m	12m	
Exhaust Fans	6m, 3m	6m	
Flow meters		24m	6m
HVAC Control Panels		24m	12m
AHU Heater Control panel		24m	12m
HEPA Filters	as needed		6m
VAV Terminal Boxes			2m
Isolation Dampers	12m		
Tornado Dampers	12m, 60m		
Fire Dampers	24m		
Water Chillers	6m		
Chilled Water Pumps	6m		
Heat Pump/Condenser Modules			
Infrared fire detectors			24m

(Refer to WIPP Site Controlled Operating Procedures for maintenance and inspection procedures as they apply to the following HVAC equipment and devices).

- Air Handling Units
- Exhaust Fans
- Flow Meters
- HVAC Control Panels
- AHU Electric Heater Coils
- HEPA Filter Assemblies
- Variable Air Volume (VAV) Terminal Boxes
- Isolation Dampers
- Tornado Dampers
- Fire Dampers
- Water Chillers
- Chilled Water Pumps
- Heat Pumps/Condensing Units
- Smoke Detectors

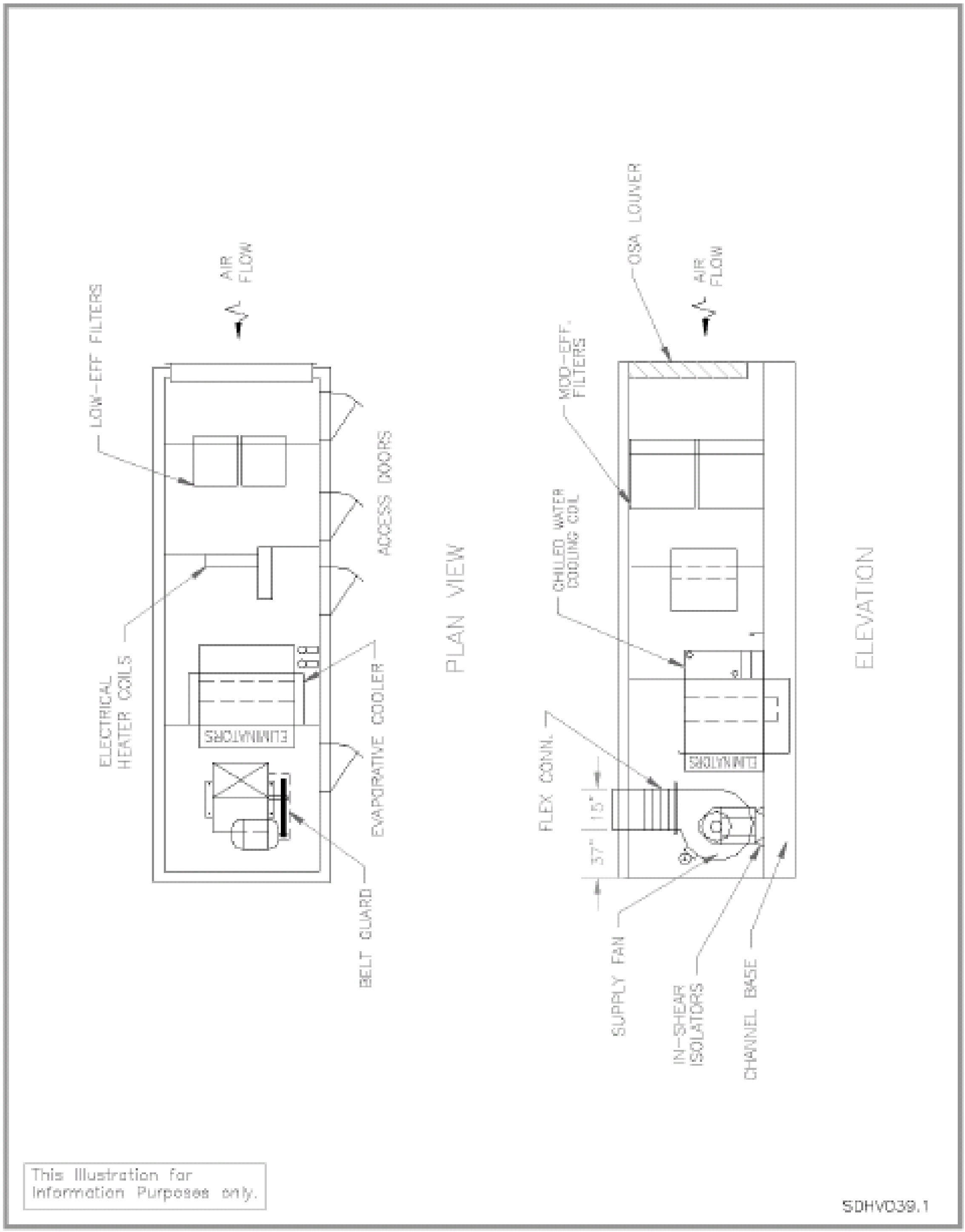


FIGURE HV G-1: Air Handling Units Plan and Elevation

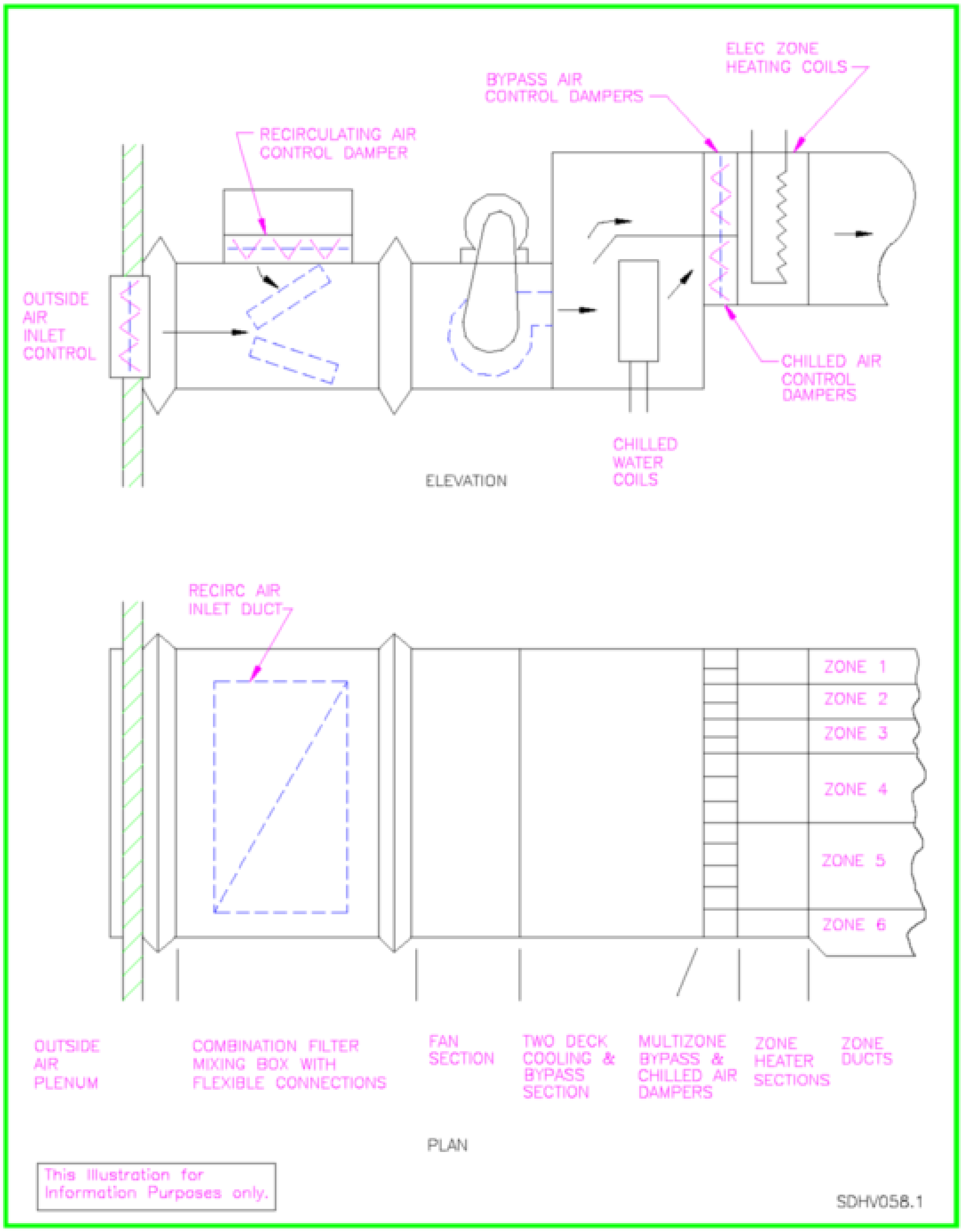


FIGURE HV G-2: Air Handling Unit Plan and Elevation

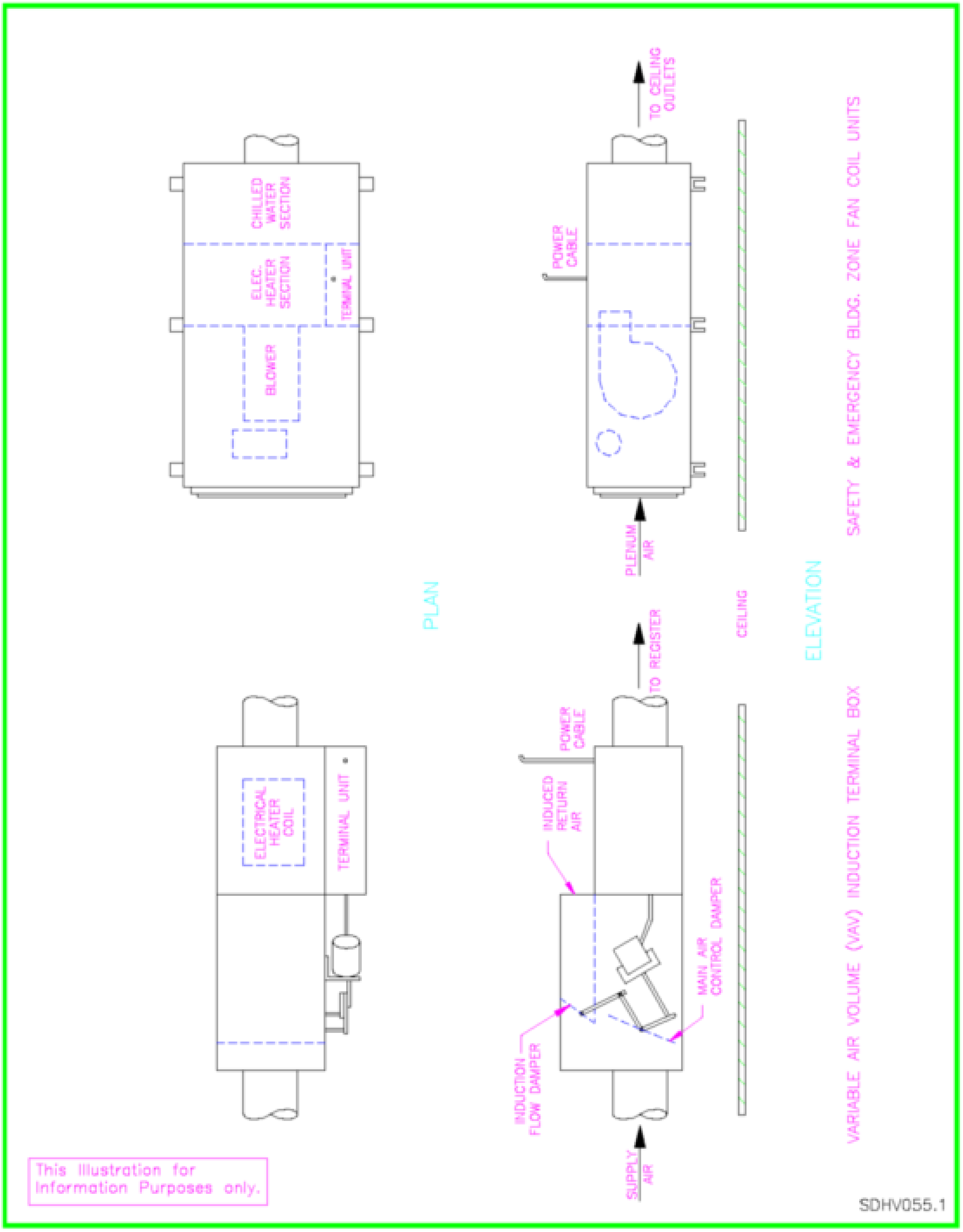


FIGURE HV G-3: HV04 & HV05 Ceiling Air Handling & Terminal Units

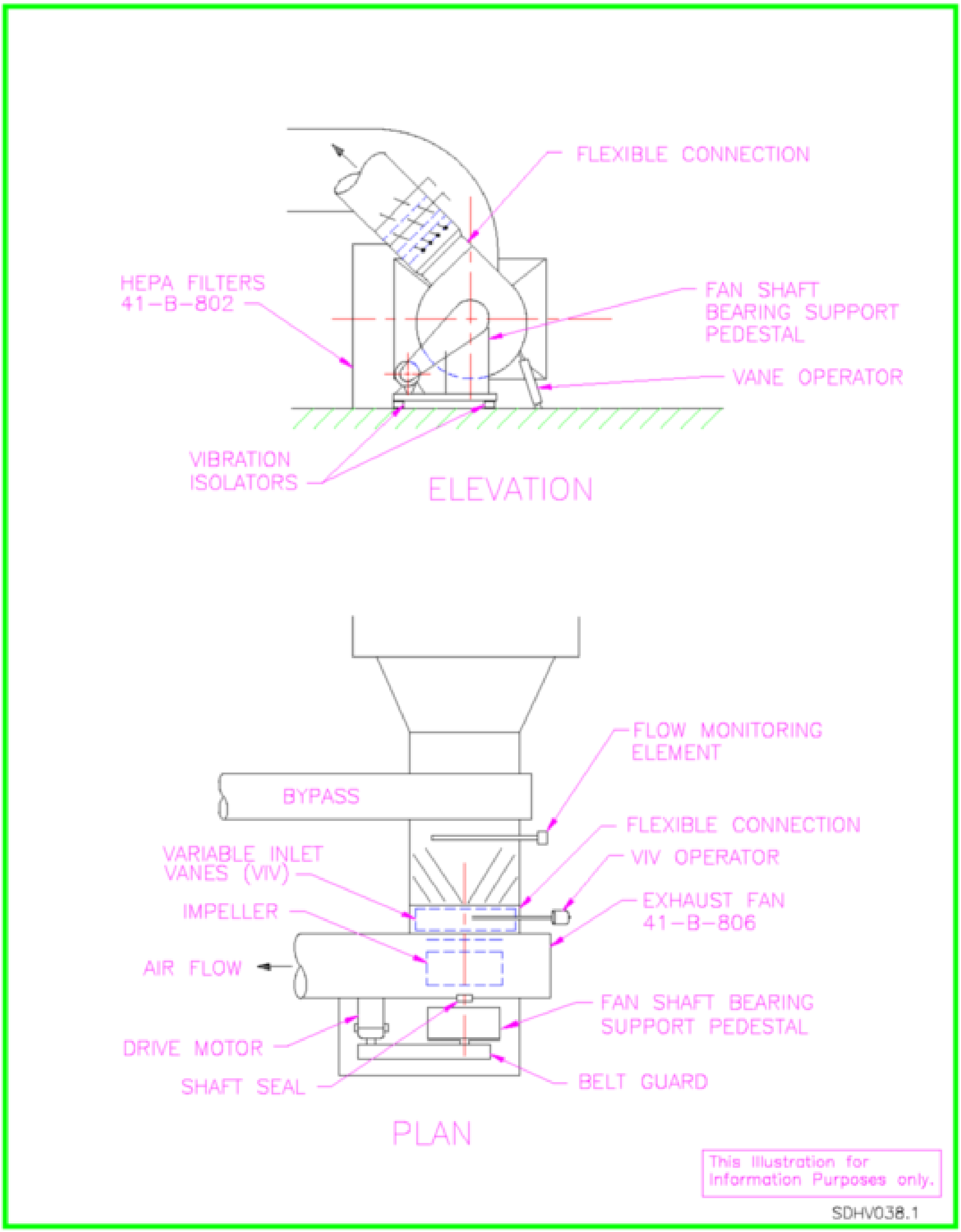
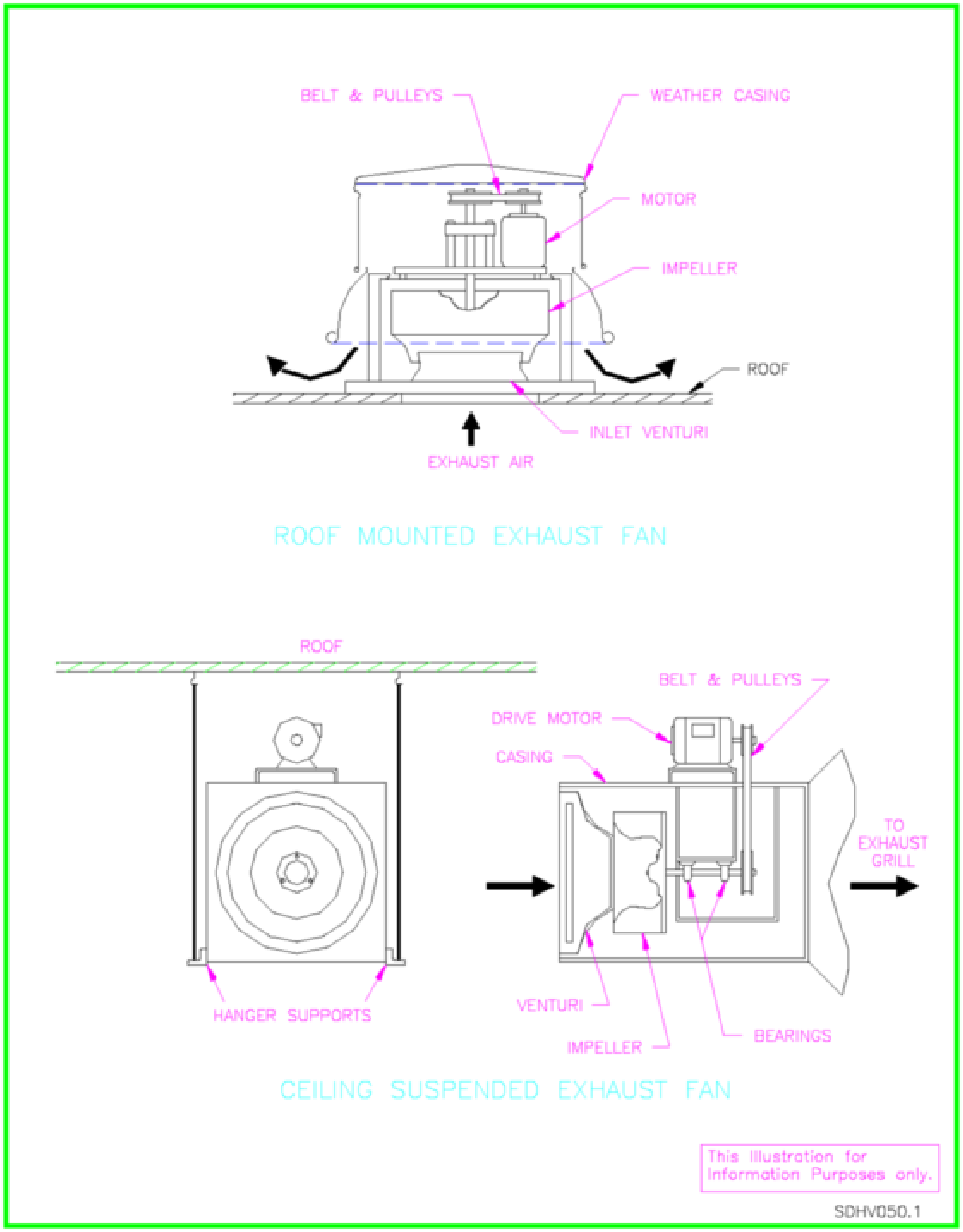


FIGURE HV G-4: Layout of Exhaust Fan



FIGURES HV G-5: HV05 and HV06 Roof and Ceiling Mounted Exhaust Fans

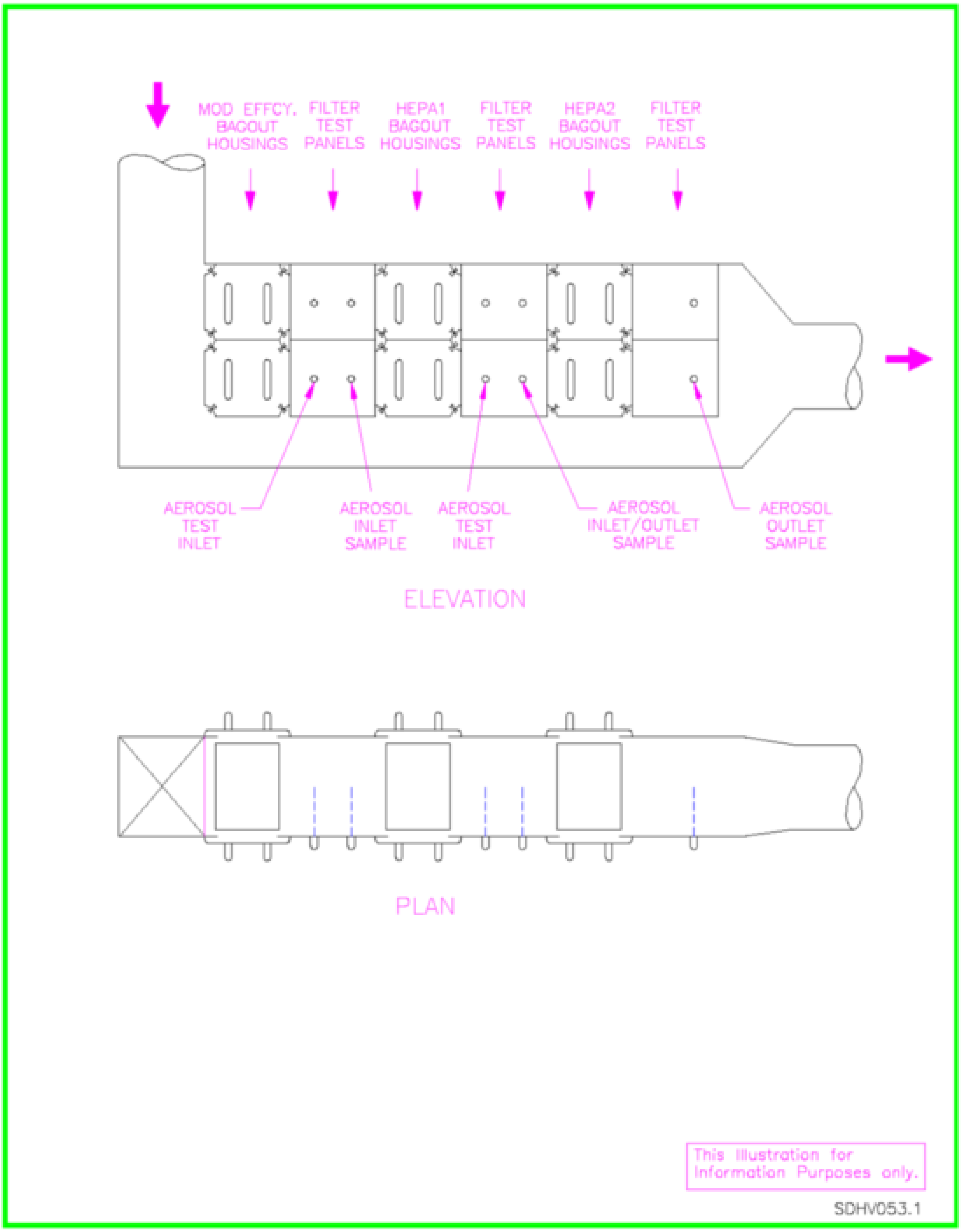


FIGURE HV G-6: Filter Assemblies Layout

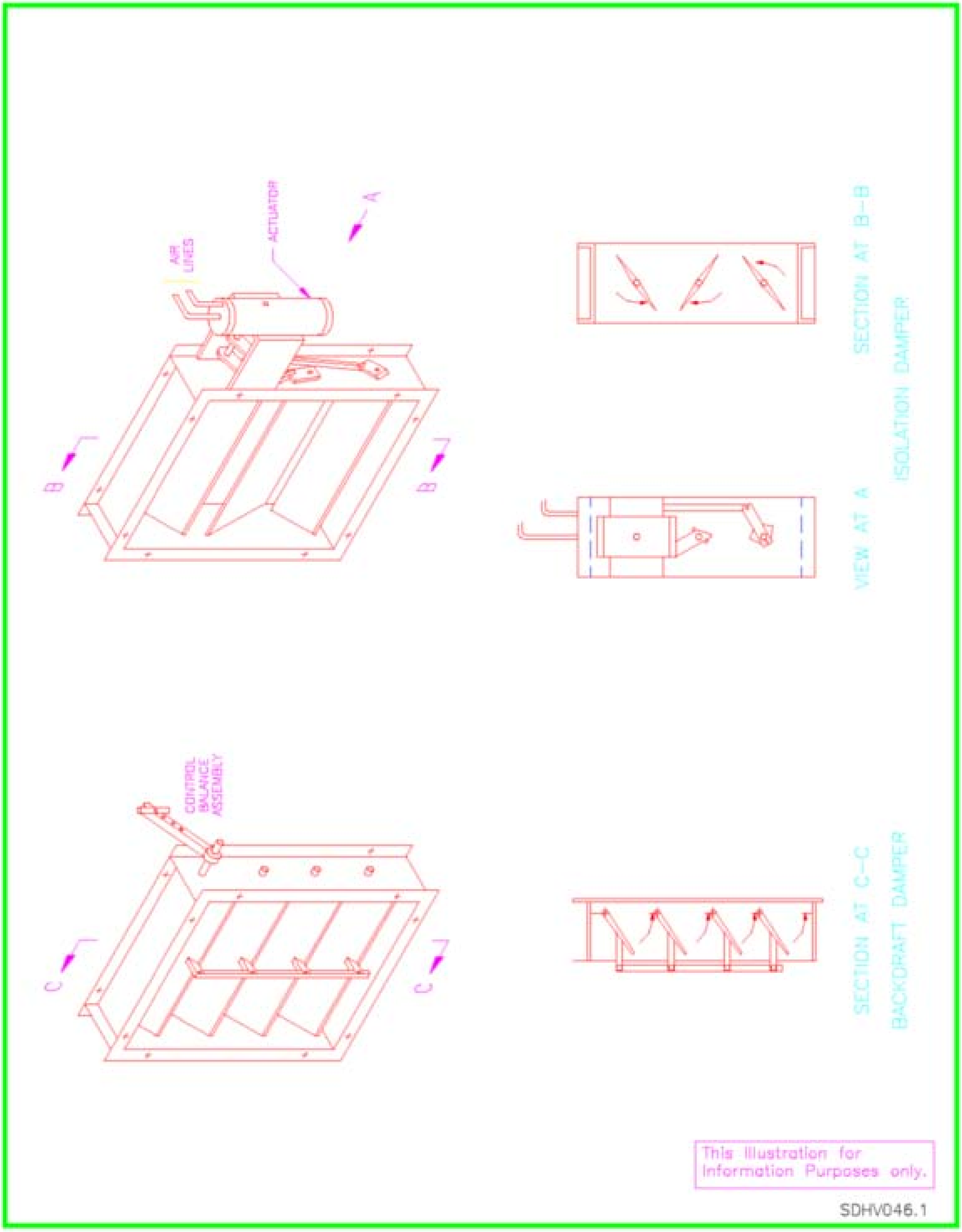


FIGURE HV G-7: HVAC Duct Dampers for Back Draft & Isolation Operation

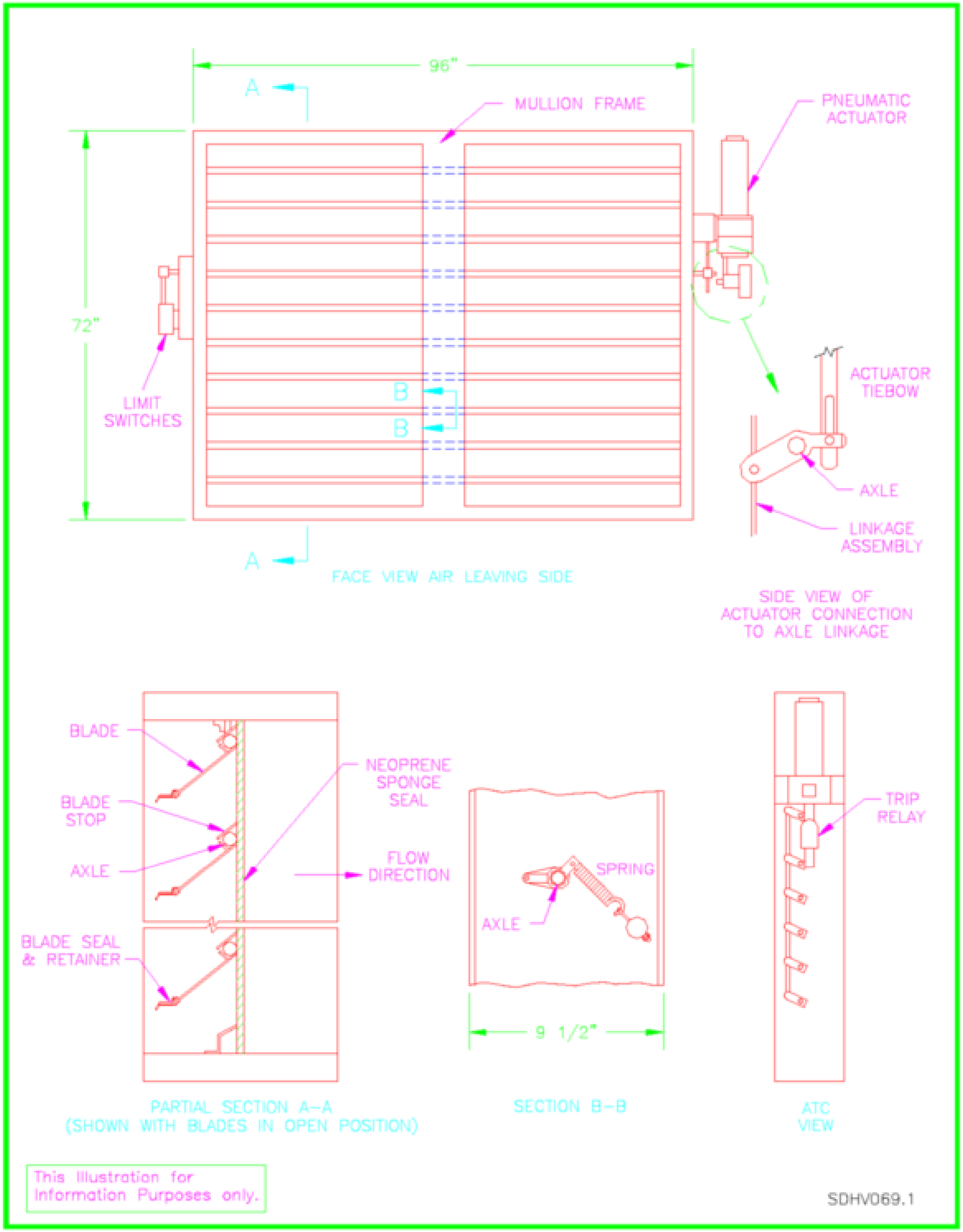


FIGURE HV G-8: WHB Exhaust Duct Tornado Damper Layout and Detail

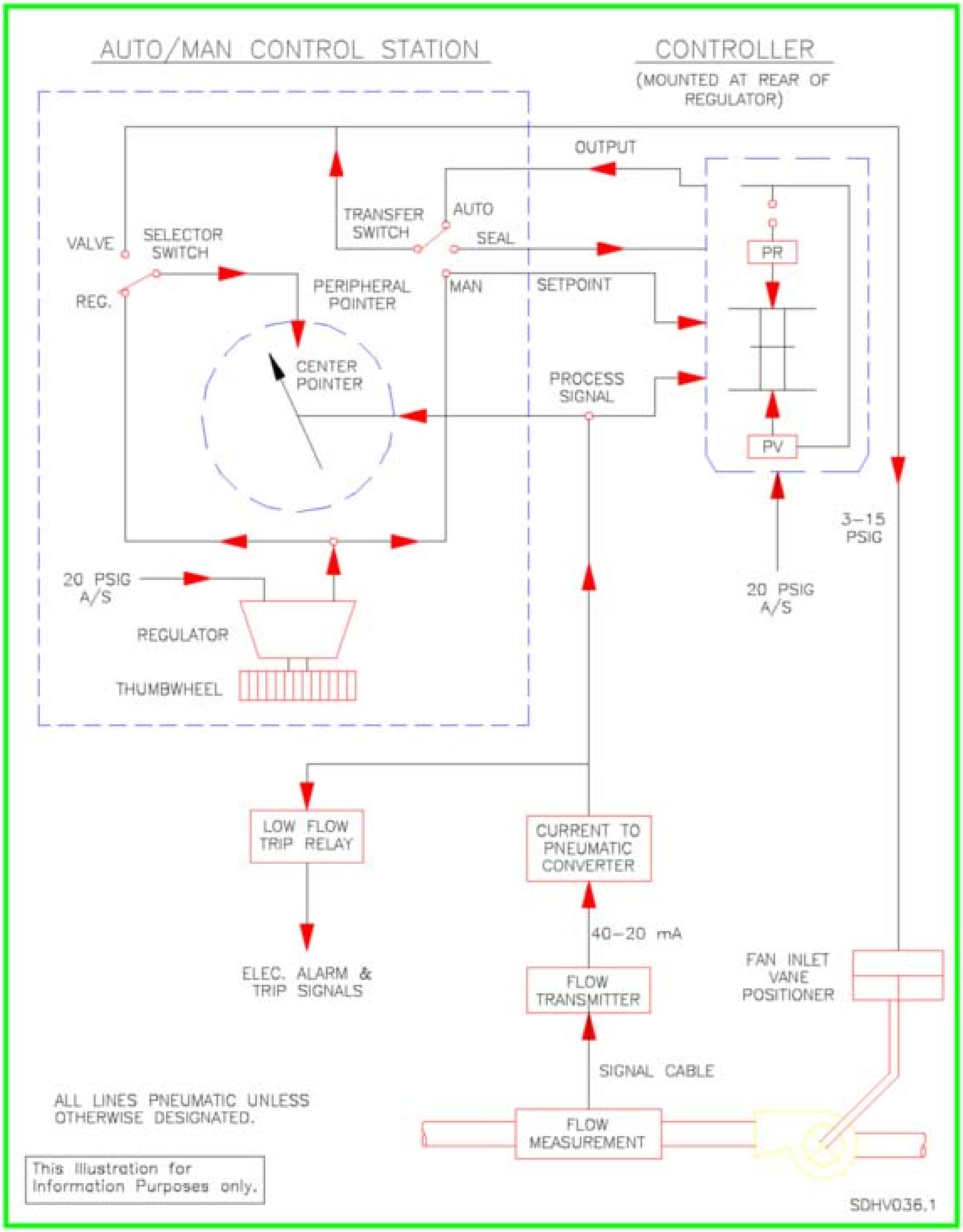


FIGURE HV G-9: Pneumatic HVAC Flow Control Block Diagram

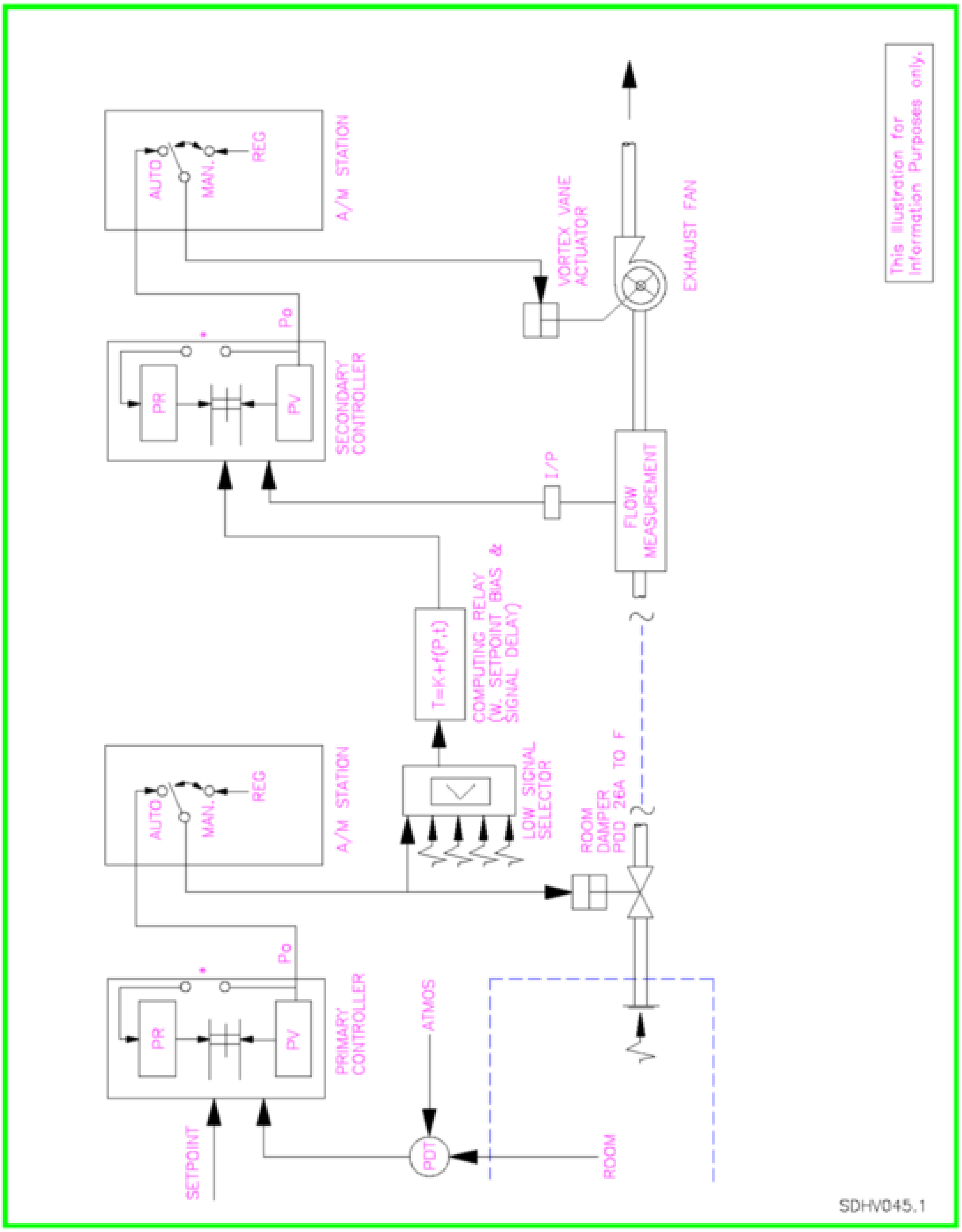


FIGURE HV G-10: Pneumatic HVAC Exhaust Fan Flow Control Block Diagram

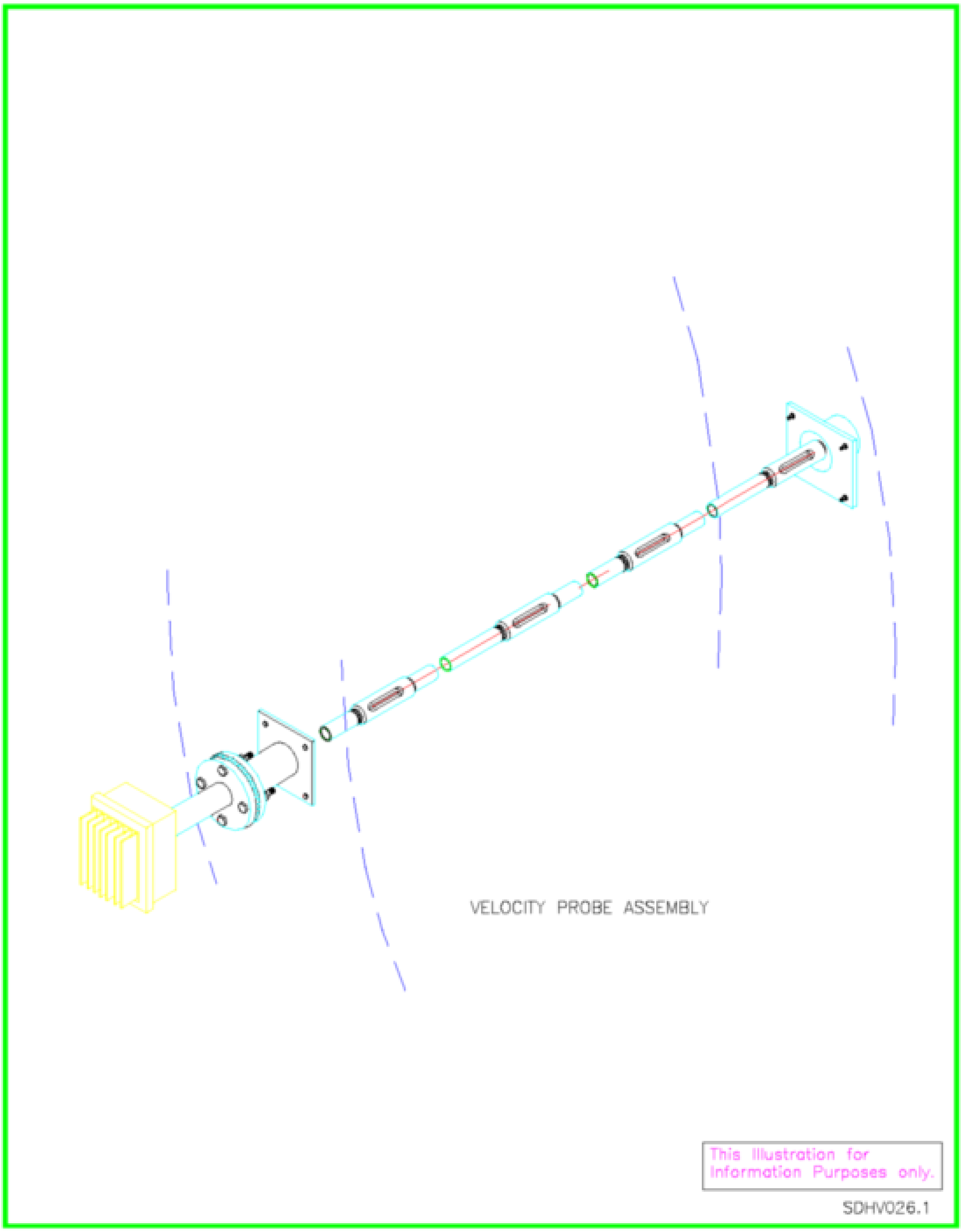


FIGURE HV G-11: Velocity Probe Assembly

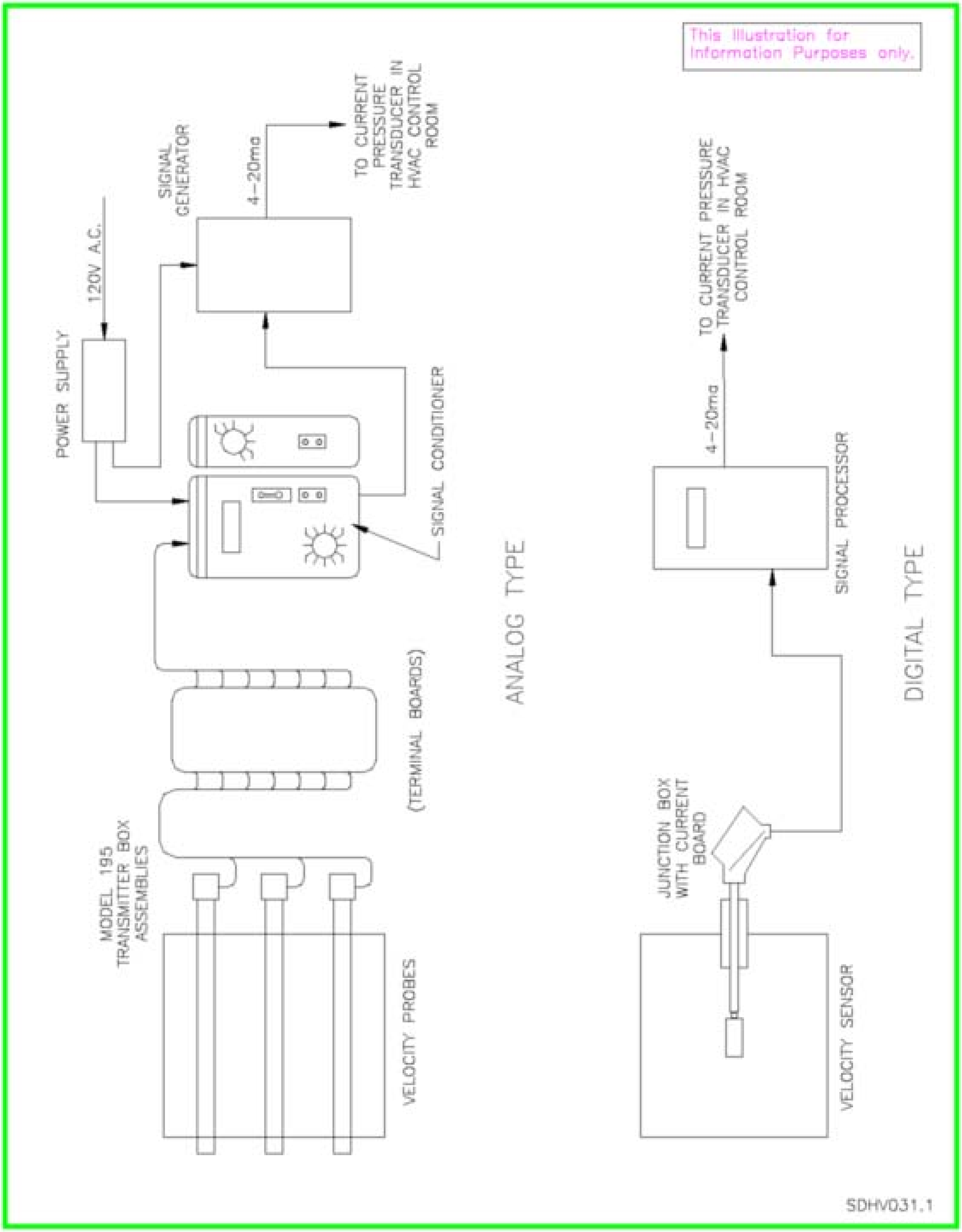


FIGURE HV G-12: HVAC Duct Flow Monitoring System Block Diagrams

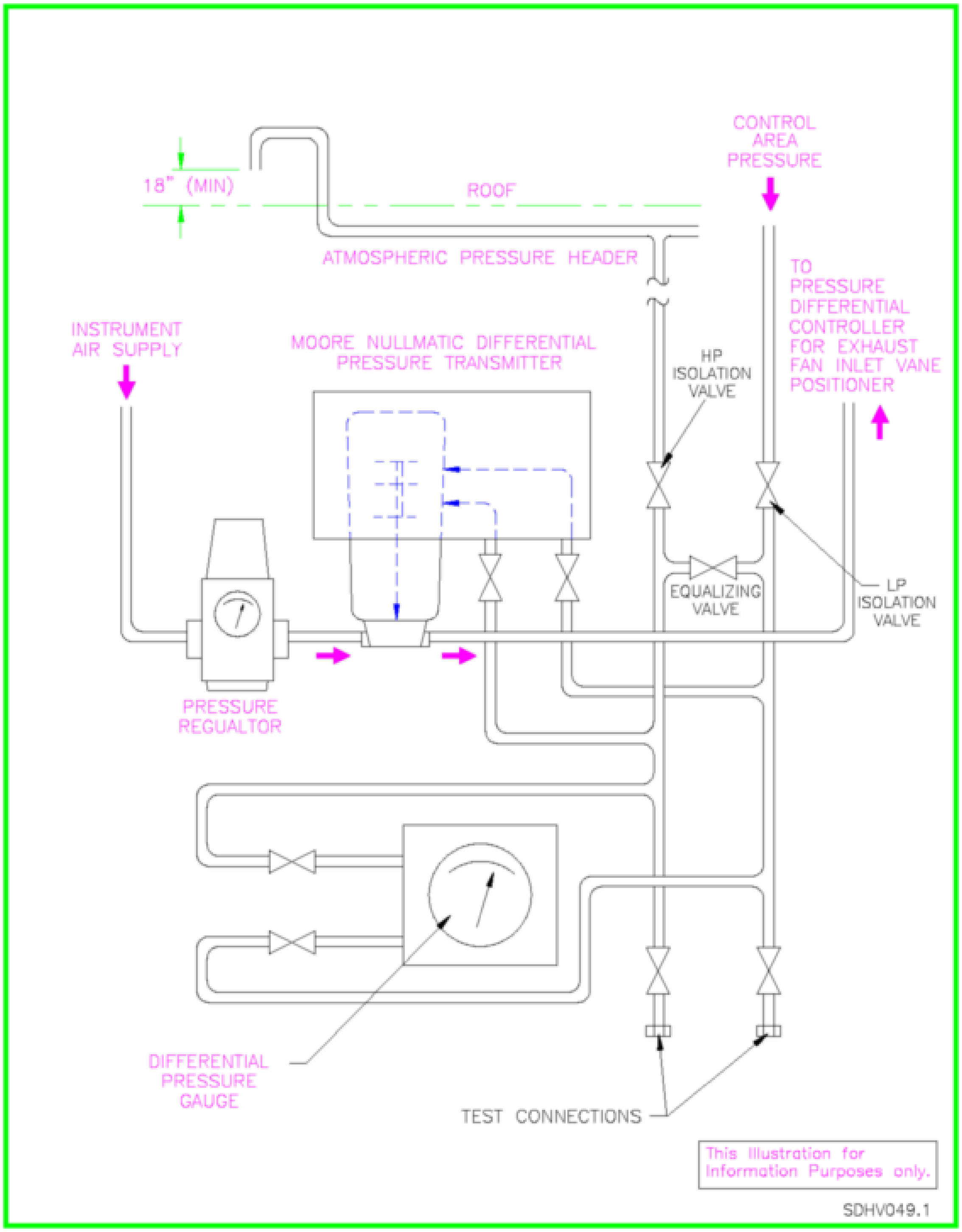


FIGURE HV G-13: Area Differential Pressure Monitor and Transmitter Unit

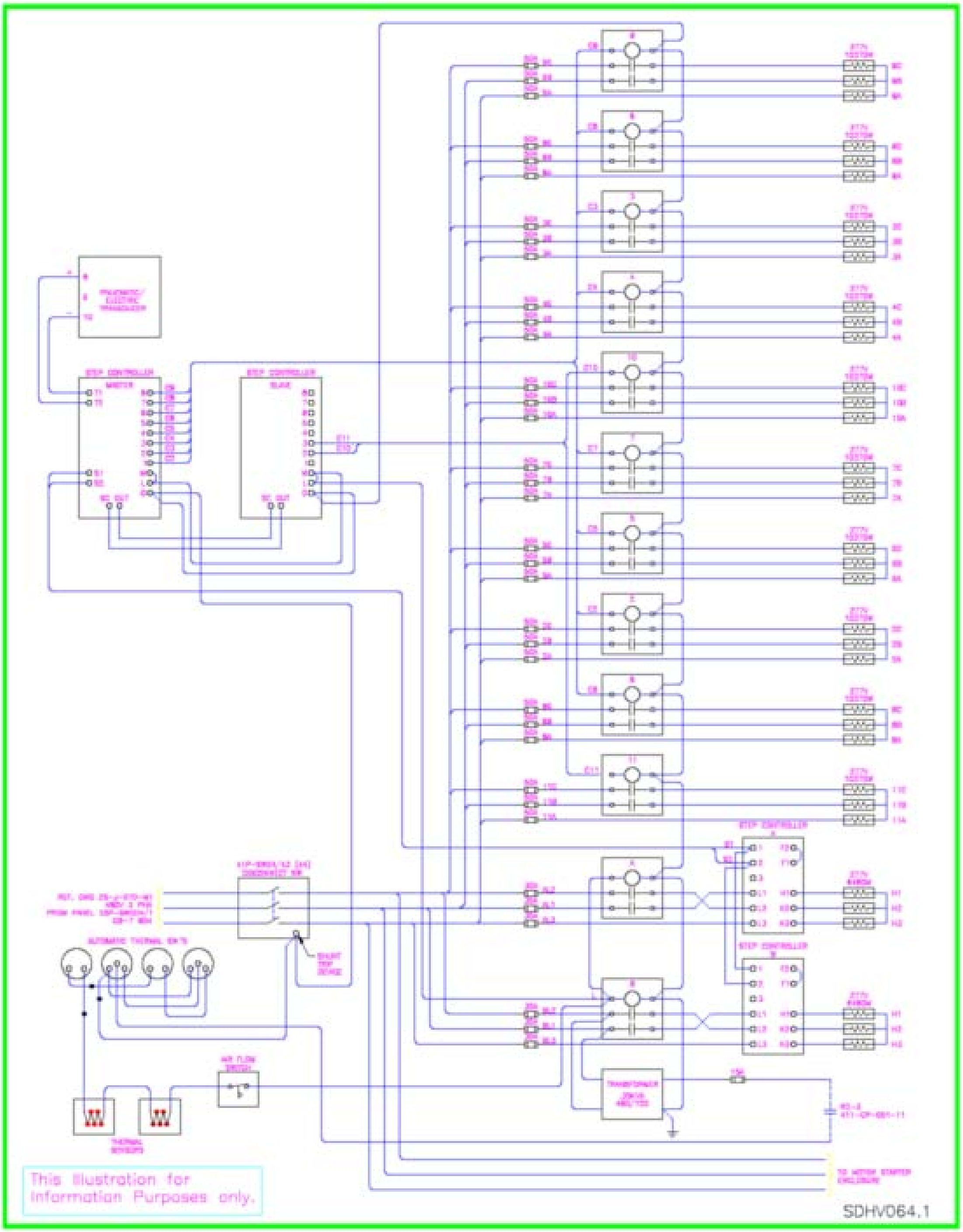


FIGURE HV G-14: AHU Electrical Heater Coil Control Circuits

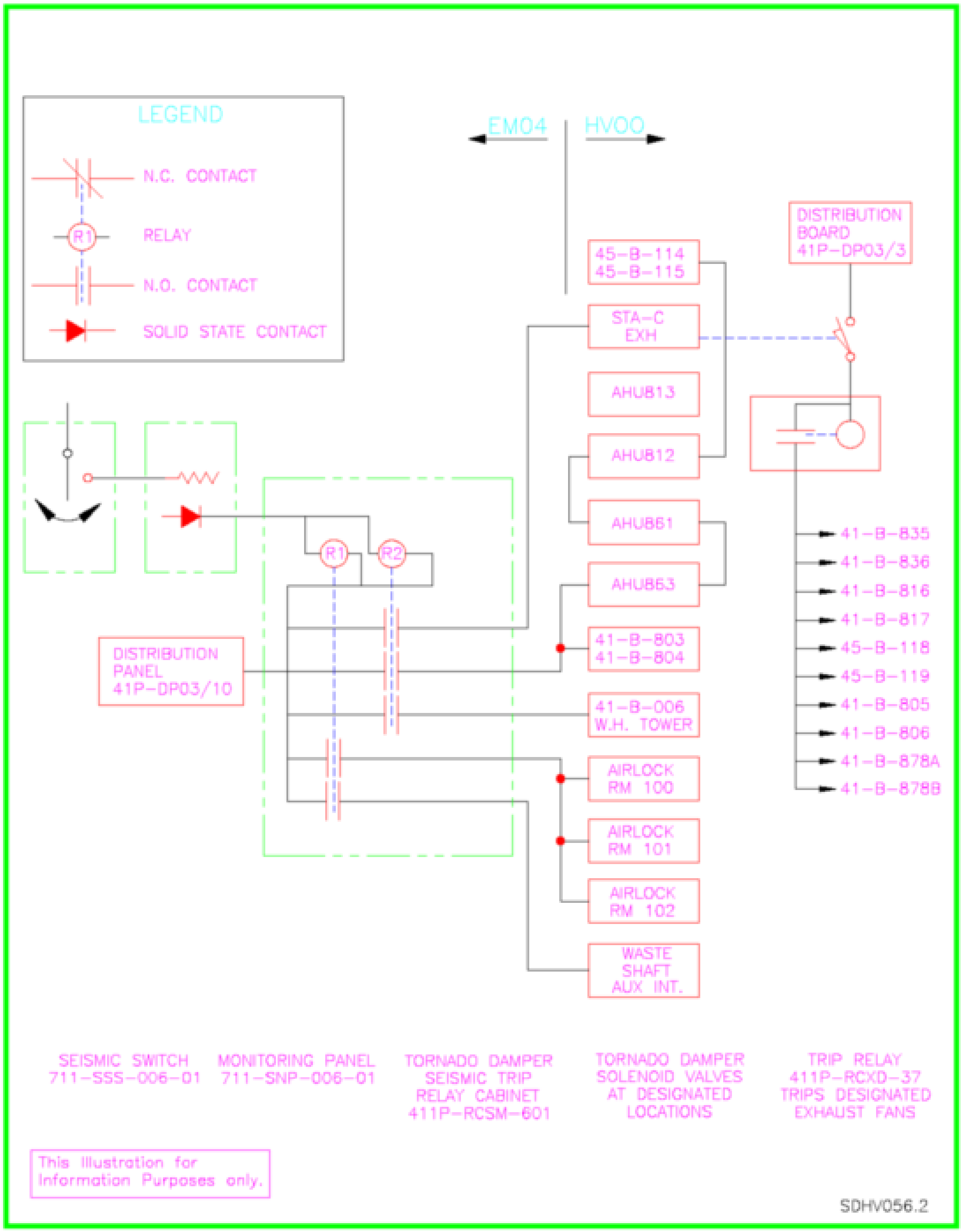


FIGURE HV G-15: Tornado Damper Seismic Trip System Block Diagram

Chapter I
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Chapter I

Subsystem HV01, Waste Handling Building CH Area HVAC

1.0 PRIMARY FUNCTIONS

Refer to Section 1.0 of Chapter G for the primary functions.

2.0 DESIGN REQUIREMENTS

2.1 General

Refer to Section 2.1 of Chapter G for the general design requirements.

2.1.1 Outdoor Design Conditions

Refer to Section 2.1.1 of Chapter G for the outdoor design conditions.

2.1.2 Indoor Design Conditions

The HV01 system shall be designed for indoor design temperatures as follows:

Indoor Design Temperatures (EF)

Winter (Min)	Summer (Max)	Space
40	80	(HV01) WHB CH waste area

Any space considered "Occupied Space" may be subject to indoor temperature conditions of:

Winter (Min)	Summer (Max)	Space
65	80	(HV01) WHB CH waste area

2.1.3 Ventilation

Refer to Section 2.1.3 of Chapter G for the general ventilation requirements.

2.2 Subsystem General Requirements

2.2.1 Subsystem HV01

2.2.1.1 Temperature Requirements

The design temperature requirements for the WHB CH waste area shall be in accordance with Sections 2.1.1 and 2.1.2. The temperature tolerance, in areas controlled for temperature, shall be ± 5˚ F.

2.2.1.2 Ambient Pressures

The ambient pressures in the areas and rooms in the WHB CH waste area shall be from +0.10 inch w.g. to -2.0 inch w.g. for maintaining the preferred directions of airflow.

2.2.1.3 The WHB CH waste area HVAC system shall be designed to:

a. provide a single exhaust point to facilitate monitoring of exhaust air from the WHB and the SB laboratories.

b. maintain pressure differentials in various areas within the CH waste area to cause migratory airflow from areas with less potential for radiological release to areas with higher potential for radiological release.

c. provide exhaust for battery recharge area.

d. provide environmental control for personnel comfort and satisfactory equipment operation.

2.2.1.4 Fan Capacity

The HVAC system for the CH area shall be designed as a minimum to have two 50% capacity supply air units and two 50% capacity exhaust fan and filter units.

2.2.1.5 Loss of Power

During loss of offsite power, supply and exhaust fans shall be capable of being manually switched to backup power. For freeze protection of equipment, some unit heaters shall also be capable of being manually switched to backup power.

2.2.1.6 Battery Recharge Exhaust

A separate exhaust system shall be provided for the battery recharging area. Air shall be discharged through HEPA filters to the stack. The exhaust system shall have pre-filters, two stages of HEPA filters, and exhaust fans of non-sparking construction.

2.2.1.7 Hoist Tower HVAC System

Outside air shall be filtered before being supplied to the hoist tower. A unit heater and an evaporative cooling unit shall be provided. Air supplied to the hoist tower shall be exhausted through the WS. See SDD VU00 for a detailed statement of this requirement.

2.2.1.8 Mechanical Room HVAC System

The HVAC systems for the Mechanical Room shall be designed for 100% outside air. The room shall be maintained slightly below atmospheric pressure. Outside air shall be filtered before being discharged into the areas. Local unit heaters and/or duct heaters shall provide heating during winter months for equipment requirements and freeze protection.

2.2.1.9 HEPA Filter Units

HEPA filter units are provided in system HV01 to filter the exhaust air from the CH waste areas and the mechanical room. The units house two stages of HEPA banks preceded by roughing filters. The efficiency specified for the bank is the average of all HEPA filters within one bank. A periodic surveillance is performed to evaluate the condition of the installed filters. All HEPA filter units shall be located in the negative pressure section of the exhaust ducts.

CH BAY exhaust air SHALL flow through at least one stage of HEPA filters in either filter unit 41-B-814 or 41-B-815 with > 99% efficiency.
[TSR LCO 3.2.1] Annually, one stage of HEPA filters in unit 41-B-814 and 41-B-815 is verified to have an efficiency of >99% using PM041154, In Place Testing of HEPA Filter Units. **[TSR SR 4.2.1.3]**

If HEPA filter replacement is required, a corrective work package will be used to change the filter.

2.3 Operational Requirements

Refer to Section 2.3 of Chapter G for the general operational requirements.

2.3.1 Subsystem HV01

2.3.1.1 The WHB CH waste area HVAC system is required to function as a dynamic confinement ventilation system.

The design shall ensure the ability to maintain desired airflow characteristics to minimize the spread of airborne radioactive materials in the building and the ability to maintain a negative pressure within the building to mitigate against a potential radiological release to the outside environment.

The WHB CH waste are HVAC system is operated using WP 04-HV1021, Waste Handling Building Zone 2 HVAC, which maintains the confinement ventilation system for the CH BAY in an OPERABLE condition. An OPERABLE confinement ventilation system consists of the following elements:

- Exhaust fan 41-B-816 or 41-B-817 SHALL be IN-SERVICE; and
- CH BAY exhaust air SHALL flow through at least one stage of high efficiency particulate air (HEPA) filters in either filter unit, 41-B-814 or 41-B-815. **[TSR LCO 3.2.1]**

2.3.1.2 The system shall be designed to provide the required confinement capability under all credible circumstances.

2.3.1.3 Air handling systems shall be provided to mitigate a radiological release during normal waste handling operations (e.g., TRUPACT opening). The system design complies with ALARA policies in accordance with the requirements of 10 CFR 835 and the guidance of DOE Radiological Control Manual DOE/EH-0256T.

2.3.1.4 Backup power supplies shall be provided, as necessary, for those parts of the system which are critical to ensuring the functions during a loss of offsite power.

2.3.1.5 Adequate monitoring and alarm capabilities shall be provided as necessary. Essential operating parameters including: fan operating status, filter bank pressure drops, and static pressure differentials in critical areas shall be monitored, indicated and alarmed locally and/or in the CMR, as designated.

2.3.1.6 Appropriate control devices required in response to off-normal status of essential operating parameters shall be provided accordingly.

2.3.1.7 Airflow rates at selected significant points shall be monitored.

2.3.1.8 Tornado protection dampers, designed to close automatically from the effects of a tornado, shall be provided at all supply and exhaust air openings in the walls and roof of the WHB. **[DSA SC SSC 4.3.1]**

2.4 Structural

Refer to Section 2.4 of Chapter G for the structural requirements.

2.5 General Arrangement and Essential Features

2.5.1 Subsystem HV01

2.5.1.1 The major components of subsystem HV01 include:

- Supply air handling unit containing: filters, evaporative coolers (abandoned in place), chilled water coils, electric heaters, and supply fans
- Ductwork
- Exhaust HEPA filter units
- Exhaust fans
- Central exhaust stack
- Unit heaters
- Tornado dampers
- Controls and instruments

2.5.1.2 All the exhaust fans and HEPA units and all the supply air handling units shall be located in the Mechanical Room.

2.6 Maintenance

Refer to Section 2.6 of Chapter G for other essential features and feature specifications.

2.7 In-Service Inspections

Refer to Section 2.7 of Chapter G for the general in-service inspection requirements.

2.8 Instrumentation and Control

Refer to Section 2.8 of Chapter G for the general I&C requirements.

2.9 Interfacing Systems

2.9.1 General

Refer to Section 2.9.1 of Chapter G for the general interfacing system requirements.

2.9.2 Primary Interface

Refer to Section 2.9.2 of Chapter G for the primary interface general information and Appendix C-1 for primary interface requirements.

2.9.3 Secondary Interfaces

Refer to Section 2.9.3 of Chapter G for the secondary interface general information and Appendix C-2 for secondary interface requirements.

2.10 Quality Assurance

Refer to Section 2.10 of Chapter G for the quality assurance requirements.

2.11 Codes and Standards

Refer to Section 2.11 of Chapter G for codes and standards.

2.12 Reliability Assurance

2.12.1 General

2.12.2 Subsystem HV01

2.12.2.1 In the event of malfunction of an active component, the HVAC system HV01 shall be designed to have the capability of isolating the failed component and permitting the system to operate on the standby train.

2.12.2.2 The HVAC system HV01 (CH TRU area) and HV02 (RH TRU area) shall be independent such that one system may be operating normally when the other is outside the normal operating range.

3.0 DESIGN DESCRIPTION

3.1 Summary Description

Refer to Section 3.1 of Chapter G for the summary description.

The HVAC system is designed to provide heating, ventilating and air conditioning as required for operation under both the normal and abnormal conditions described in Chapter G of this SDD. The following design features are provided:

- The differential pressure between the WHB and the outside atmosphere is maintained sub atmospheric. Also, any release of contamination within these areas is mitigated by HEPA filters assemblies. Airflow to these filter assemblies through ducts that connect areas in which any likelihood of contamination increases progressively.

- In the event of the DBE, provision is made to stop supply and exhaust fans and close all intake and exhaust ducts.

- In the event of the DBT, the tornado dampers in the WHB exhaust and supply ducts will close.

Figure HV I-1 contains a block diagram which illustrates the principal components of the HVAC in the surface waste handling areas. This figure also shows the location and interconnection of these components.

3.2 Detailed System Description

3.2.1 HV01 WHB CH Area HVAC

This system is divided into the following three zones:

- The CH waste area located on the first floor of the west half of the WHB contains the following rooms:

  - Shielded storage area (Room 118)
  - Inventory and preparation area (Room 103)
  - Cage loading area (Room 120)
  - Site generated waste room (Room 112)
  - Personnel access corridor (Room 114)
  - Small equipment decon room (Room 111)
  - Air locks (Rooms 100, 101, 102, 106, 107, 110 and 113)
  - Change room (Room 109)
  - TP-III room (Room 108)
  - Stairway (Room 105)

- The Mechanical Equipment Room, located on the second floor of the WHB, which consists of the following rooms:

  - Room 208 (supply air room)
  - Room 200 (exhaust air room)

- The Waste Hoist Tower, located between the RH and the CH areas, which consists of the following rooms:

  - Hoist room (Room 800)
  - Hoist deflector sheave room (Room 600)
  - Elevator lobby area (Room 115)

3.2.2 CH Area System Description

The HVAC system for the CH area is illustrated in Figure HV I-2. The principal components consist of two air handling units, four HEPA filter units, and their four associated exhaust fans. This equipment can be operated independently from other HVAC systems. Operating status is monitored in the Central Monitoring System (CMS).

The system is designed to operate so that all areas which may contain waste are maintained at a sub atmospheric pressure. Room static differential pressures are listed in Appendix C-1. These conditions may be achieved by the use of a single Air Handling Unit (AHU), and one exhaust fan. The remaining units provide standby capacity when not used to meet ventilation requirements.

The following sections describe design features of this subsystem.

3.2.3 CH Area Air Supply

Air is supplied to the CH Area from the air handling units. These units are drawn through types with filters, chilled water cooling coil, electric heating coil, and an evaporative cooler that is not in use. Temperature control is from a temperature transmitter in the Inventory and Preparation Area (room 103) that controls the cooling coil and heater in sequence. Airflow is maintained at a constant rate by varying the speed of the fan. An electronic sensor in the supply duct supplies a signal that controls the speed of the fan.

There are two modes for the AHU to get air. Once-through brings in 100% outside air into the building. The other mode is recirculation mode. This mode reuses conditioned air from inside the building for the AHU. This allows the existing AHU to heat and cool more efficiently.

3.2.4 Pressure Control

The exhaust flow rate from each room is varied by the PDD to maintain the necessary room static pressure. As the room differential pressure varies, the PDD increases or decreases the exhaust flow rate to satisfy the controller setpoint. The pressure differential signal is processed through the control modules via proportional integral-derivative control blocks in the controller module software. The controller module adjusts the exhaust fan flow rate based on the combined demand for exhaust flow from each PDD control signal. This is true for all cases except Room 116 (Cage Loading Room) where the supply airflow is controlled by a PDD with similar principals.

3.2.5 HVAC in the Battery Recharge Area

The battery recharge area located on the north side of the CH Bay has a separate exhaust system provided for the removal of hydrogen generated when battery charging is in progress. The exhaust system for the battery recharge area consists of two HEPA Filter assemblies and two exhaust fans. One exhaust fan and filter is on standby status.

Flow sensors are installed in the discharge ducts of the fans. These signals are processed by the DDC system to maintain a constant flow rate. The battery charging exhaust fans do not have inlet vortex vanes for flow control. Adjustable speed drives (ASD) have been installed for flow control.

The CH Bay is at higher pressure than the battery exhaust duct. Any potential contamination from TP-III will stay in the duct and not contaminate the CH Bay, if the duct stays negative to Bay. The intake registers for the battery exhaust fans had dampers added so the air going into the duct could be regulated. If the air flow is increased into the duct from the TP-III fan or the TP-II fans, the damper will close, keeping the duct pressure below the CH Bay. The damper is controlled by a pressure transmitter (PT) that monitors the pressures of both the Bay and the duct. A Proportional Integral Derivative Block from the Direct Digital Control (DDC) system reads the pressure and then calculates how much the damper needs to be opened.

The battery exhaust system duct configuration handling the exhaust from the TRUDOCKS was not changed. The intake registers from the old battery exhaust hood had 18" x 18" control dampers added. It is still the same intake registers and duct. The other change was adding the TP-III exhaust system to the battery exhaust system.

With the TP-III fan off, the battery exhaust system's operation is unchanged. The system operates as it did before, with one TRUDOCK fan running, both TRUDOCK fans running, or neither TRUDOCK fans running. With the TP-III fan running, the system still pulls the same amount of air. The difference is the air comes from the TP-III and not the CH Bay.

When the TP-III fan starts, the isolation damper and a backdraft damper in Room 108 opens. One of the control dampers in the battery exhaust system closes. The other control damper starts regulating the duct pressure to keep a constant duct pressure. This prevents the battery exhaust system from being over loaded when all three fans are running. This will help the battery exhaust fans maintain their flow rates when the fans for TP-III and TRUDOCKS are started and stopped. The constant pressure in the battery exhaust duct will also help the TP-III system keep a constant flow rate.

If there is any radioactive contamination, it would be contained within the exhaust hood system and drawn through an industrial grade HEPA prefilter which is in the overhead in Room 108. From there, the effluent is directly discharged into the WHB controlled exhaust system, which provides a second nuclear grade HEPA filtration before being discharged out of the WHB.

The control dampers keep any air from the TP-III system from mixing with the CH Bay air when the fan is running. The isolation damper and a backdraft damper prevent the air in the two rooms from mixing when the TP-III fan is stopped. The battery exhaust fans and the TP-III fan are interlocked. If the battery exhaust fan stops, the TP-III fan along with the TRUDOCK fans will also stop. At that time, the isolation damper will close and prevent any air between the two rooms from mixing. The control logic found in the DDC system controls the fan, monitors the PTs, and regulates the dampers. The fan speed is set with the logic. It is currently set to a fixes speed. However, if needed, the logic could also support varying the fan speed in the future. If the duct pressure gets to high, there is a safety in the logic to stop the fan, protecting the system. If for any reason the fan stops anytime, the isolation damper between Room 108 and the CH Bay will close. As previously stated, there are interlocks with the battery exhaust fans and the TP-III fan. If the battery exhaust fans stop, the TP-III will also stop.

Duct pressure for the TP-III is controlled by a pressure transmitter and the isolation damper. By keeping the pressure constant in the duct, the flow is helped to stay at the 100 feet per minute (fpm). Flow rate is kept constant with help from the regulated control of the control damper in the CH Bay. By keeping both the TP-III duct pressure and the battery exhaust duct constant, the flow for the vent hood will stay constant. The startup test will show that with the TP-III fan running, by starting and stopping the TRUDOCK fans, the battery exhaust duct pressure will stay constant.

3.2.6 Interlocks

The DDC system contains software based interlocks that ensure proper operation of the system and to avoid equipment failures resulting from incorrect operation. These may be summarized as follows:

- Permissive interlocks and latching relays prevent the simultaneous operation of two exhaust fans or two supply fans. This constraint maybe removed by switching the HOA switch to 'HAND' providing additional ventilation capacity as required by operations.

- An AHU supply fan can only be started if the corresponding exhaust fan is operating.

- The isolation dampers in the inlet and outlet ducts of the HEPA filters are automatically opened when their respective exhaust fans are started. When the fans are de-energized the dampers are closed.

- If either AHU trips automatically due to a malfunction, the corresponding exhaust fan will also be tripped.

- Electrical heaters in the AHU can only be energized when their supply fans are running. Stopping the supply fan will de-energize the heater.

- Travel stops in the air actuators for the room PDDs prevent them from closing completely. This avoids the development of potentially damaging negative pressures in the ducts under certain plant conditions.

3.2.7 Mechanical Equipment Room

3.2.7.1 General Arrangement

HVAC for the Mechanical Equipment Room is shown in Figure HV I-3. Two 100% capacity draw through air handling units draw air through seismic/tornado dampers and louvers in the WHB south wall. Outside air is drawn through a prefilter bank, a (Moderate) MOD efficiency filter section, an electric heating coil, a chilled water cooling coil and an evaporative cooling section (not in use). The chilled water supply valve and the duct heater receive a control signal via the DDC control module from a temperature sensor in Room 200.

Room 208 is maintained at a positive static pressure. Airflow from Room 208 to Room 200 through transfer louvers. Air is drawn from Room 200 through registers in the inlet of RH area HEPA filter assemblies and CH area HEPA filter assemblies.

Five unit heaters supply additional heat in Rooms 200 and 208.

3.2.8 Waste Hoist Tower Area HVAC

Outdoor air is drawn into the hoist tower by the negative pressure created by the U/G Ventilation System (VU00). Relative to HV01, the ventilation system has two modes of operation. Normally, air is drawn through the louver, filters, and the evaporative cooler section to be supplied to the Hoist Tower Rooms. The HVAC for the Waste Hoist Tower Area is illustrated in Figure HV I-4.

3.3 System Performance Characteristics

3.3.1 General

This section provides a description of the system performance characteristics under the various normal and infrequent operating modes and off-normal operating conditions.

Figure HV I-1 shows the layout and interconnection of HV01 and HV02 HVAC trains discussed in this section.

3.3.2 Normal Operation

During normal operation, the subsystems HV01 and HV02 supply properly conditioned air to normally occupied areas of the WHB, ALARA compliance is achieved by providing control of pressure differentials in areas/rooms within the WHB, ensure airflow is confined to the prescribed flow path and pattern, and providing for continuous filtration of exhaust air. These provisions mitigate against radiological releases in the exhaust airstream from the WHB. The exhaust airstream is designed to collect the various exhaust streams into a single discharge point.

During all plant operational modes, Station C provides radiation monitoring for air streams for HV01 as well as HV02 and Zone 2 of HV03.

3.3.2.1 During normal plant operation, a single HVAC train will sustain temperatures, differential pressures, and heating and cooling demand. However, an additional train may be required due to operational configuration.

3.3.2.2 Static pressure control is provided by PDDs installed in the exhaust air duct near room exhaust registers.

3.3.2.3 During normal operation, continuous filtration of exhaust air from the CH Waste Handling Area is provided by the HEPA filter assembly in the HVAC train in operation. All exhaust air is passed to the outside atmosphere through Station C (effluent monitor) or is returned back to the AHU to use the conditioned air again.

The CH Ventilation system has a once through and recirculation mode. In once through mode the AHU uses 100% outside air. Dampers at the exhaust fans control the air so that 100% of the air is exhausted out of the building through Station C. Using the recirculation mode, the damper between the exhaust fan and the exhaust duct is closed to let only a small amount of air out of the building. Another damper at the exhaust fan regulates how much air is returned back into the building. This damper is split into two parts, as an 80/20. The 80% opening, or split, of the damper controls most of the air and is used as a coarse adjustment. The 20% split of the damper is used as a fine adjustment. The 20% split is controlled by a Proportional, Integral, Derivative (PID) loop in the DDC. The 80% split is controlled by another PID, but it will only move the damper if the 20% split is less than a minimum set point or greater than a maximum set point. This reduces the amount of movement the 80% split does and allows the 20% split to do most of the controlling for room pressure. Room 200 and 208 are used as a plenum to return the air back to the AHU. A pressure transmitter in Room 200 sends a signal to the DDC that controls the amount of air that the split damps let into Room 200. Two control dampers on the AHU control the intake of the AHU. One damper configuration supplies only outside air. The other configuration supplies return air for the AHU. The CMRO can change from once-through to recirculation back to once-through remotely by using the CMS.

3.3.2.4 Air from the CH battery recharge area is exhausted through one of two smaller HEPA filter/exhaust fan trains provided for that area. This exhaust air is discharged into the single exhaust stack Station C (effluent monitor).

3.3.2.5 Exhaust air from the Mechanical Equipment Area is drawn through registers in the CH or RH area exhaust ducts in Room 200. It is then filtered and exhausted along with CH area air as previously described. The Mechanical Equipment Room is maintained at a pressure slightly below atmospheric pressure by the CH area exhaust fans.

3.3.3 Off-Normal Operation

If a malfunction occurs in a CH area HVAC train both the supply and the exhaust fans in that train will trip. The HVAC system standby train for that area can then be started up. This will ensure that the specified negative pressure can be maintained in areas where waste is being handled.

3.3.3.1 In the event of a tornado, the tornado damper located in the WHB common exhaust duct will close. The exhaust fans, interlocked with the damper, will trip. As a consequence, the corresponding AHU fans will trip also.

3.3.3.2 Following the occurrence of a seismic event, the systems response is the same as described above.

3.3.3.3 The design intent is that each exhaust fan operate to draw air through the HEPA filter to which it is directly connected. If the rare circumstance occurs that this is not possible, a "crossover duct" can be used to allow an exhaust fan to draw air through the opposite filter. This realignment option is programmed in the DDC system and requires no manual configuration of dampers. The realignment option is initiated by the operator at the DDC host computer.

3.3.4 Conditions for Maintaining Operations

Mode compliance conditions are met when the following HVAC subsystem HV01 operating conditions are maintained. These are:

a. Ability to maintain differential pressure

The room-specific differential pressures shall be maintained below the maximum values listed below.

Room	Differential Pressure Inches Water Gage
CH Receiving Bay	-0.02
Room 108	-0.02

b. Ability to maintain exhaust filtration

The HEPA filter differential pressure is continuously displayed in the CMR and is accessible through the DDC system computer interface. A filter pressure differential of three inches of water indicates that filter replacement is recommended.

3.4 Heating Ventilating and Air Conditioning System Arrangement

3.4.1 Layout of subsystem HV01 (CH area HVAC)

All major components of system HV01 CH area HVAC are located in the Mechanical Equipment Room. Figure HV I-5 describes the layout of the two rooms which make up this area:

- Room 208 (supply air room) contains four AHUs. Air enters the AHUs through outside louvers in the south wall of the building or return louvers in Room 208. Overhead steel ducts carry the processed air to distribution ducting in the WHB.

- Air that is discharged from the exhaust fan recirculation dampers flow through the double door openings between Room 200 and 208 to supply air the for AHU when the system is set to recirculation.

- Room 200 (Exhaust Air Room) contains the four HV01 HEPA filter assemblies along with their exhaust fans and dampers. Air enters the HEPA filter assemblies from the first floor exhaust ducts. The exhaust fans deliver air from the HEPA filter assemblies to an overhead 6' by 8' duct that discharges to the outdoors. A separation of 22' between large HEPA filter assemblies provides room for removing and bagging the filter units. A 5' wide ramp connects the floor of room 200 to the airlock which connects to the service hoist in the Waste Hoist Tower.

Subsystem HV01 Control cabinets are located in rooms 200 and 208 as shown in Figure HV I-5.

3.5 Component Design Description

Refer to Section 3.5 of Chapter G for typical HVAC component design descriptions. Special purpose tornado dampers and fire dampers for the WHB CH area are described in Section 3.5.5 of Chapter G.

The location, function and Appendix data references for the AHUs in the Waste Handling areas are listed in Table HV I-1.

TABLE HV I-1: Summary of AHUs in Subsystems HV01, HV02, and HV03

Sub-System	**AHU Number**	**Location**	**Area Serviced**
HV01	41-B-861, 41-B-863	WHB Room 208	Mech Equip Rm
	41-B-812, 41-B-813		CH Waste Areas
	41-B-869	Hoist Room	W H Tower

3.6 Instrumentation and Control

The WHB CH Area HVAC system is controlled and monitored by a microprocessor based digital control system. All control functions and signal processing are contained in programmed control modules. Input signals such as pressure, flow, temperature, and alarms are processed through the module and converted to electronic output control and parametric signals. Traditional use of pneumatic and electric devices such as controllers, timers, relays, and switches are minimized. Alarm horns and illuminated windows are not used. Required signals and alarms are transmitted from the control module to the CMS. Operating and programming instructions are contained in manufacturer's published manuals. Normal Operating Procedures approved in accordance with site policy are available for operators to operate the HVAC system.

3.6.1 Subsystem HV01 I&C Equipment

Supervision of subsystem HV01 is carried out from separate equipment panels that perform the following functions:

- Control of CH area HVAC equipment
- Control of room pressure in the CH area
- Control of the Waste Hoist tower HVAC

3.6.2 CH Area HVAC Control Panels

Five HVAC equipment control panels contain the DDC modules that control the fans, AHUs, and dampers that serve the CH area and the mechanical equipment room.

3.6.3 Control Panels (411-CP-052-13 and 411-CP-052-14)

DDC modules for the CH Bay exhaust fans and AHUs are housed in these panels. Features provided by this panel include the following:

- Control modules and I/O point expanders for the DDC system
- HOA switches and indicator lights showing fan status
- Transformers, terminal strips, relays, transformer, and transducers
- HEPA filter bank exchange logic.

3.6.4 Control Panel (411-CP-052-15)

This panel contains the DDC modules for the exhaust fans and HEPA filter assemblies that vent the forklift battery recharge area.

3.6.5 Control Panel (411CP-063-16)

This panel contains the control modules for the AHUs which supply the Mechanical room.

3.6.6 CH Area Static Pressure Control (411-CP-059-20)

This panel contains the DDC module and I/O point expander and the logic that controls the CH recirculation.

3.6.7 Waste Hoist Tower HVAC Control Panels

Control Panel 411-CP-060-18 (pneumatic) located on the East wall of the hoist wire deflector sheave room contains HVAC control equipment for AHU and the evaporative cooler. The functions performed by this panel are outlined in Section 3.2.8. Figure HV I-4, contains block diagrams of the control systems supervised from this panel. Figure HV I-6 shows the layout of instruments on the panel. The following features are provided on this panel:

- Two differential pressure indicators which monitor the pressure drop across each of the two filters in the filter housing.
- Three alarm displays which are activated by high pressure drops across the two filters and by low flow in the supply fan.
- Alarm Test and acknowledge pushbuttons.
- A flow meter for the supply fan.
- Two pairs of red (running) and green (stopped) indicator lights which display the operating status of the evaporative cooler pump and of the supply fan.

3.7 System Interfaces

Refer to Appendix C of Chapter VIII and Section 3.7 of Chapter G for primary and secondary interface information.

4.0 OPERATION

4.1 Operation of the WHB HVAC System

To facilitate operations, subsystem HV01 which supplies the WHB has been divided into the following 2 zones which are illustrated in Figure HV I-7.

- WHB Zone 1 consists of the AHUs which supply the mechanical equipment room.
- WHB Zone 2 consists of the AHUs, HEPA filters and exhaust fans which supply the Contact Handling (CH) areas.

Refer to WIPP Site Controlled Operating Procedures for HV01. The subject procedures are based on the Zone 1 and Zone 2 breakdown identified herein. Note that WHB Zone 3, which covers the waste tower, has not been included. This is because ventilation airflow through the waste hoist tower is established by the operation of the system VU00 main fans (Refer to SDD VU00). Air is drawn into the tower through AHU 41-B-1006. When the main VU00 fans are inoperative, supply fan 41-B-1007 will be switched on at panel 411-CP-060-18, as needed.

The WHB CH waste area HVAC system is operated using WP 04-HV1021, Waste Handling Building Zone 2 HVAC, which maintains the confinement ventilation system for the CH BAY in an OPERABLE condition. An OPERABLE confinement ventilation system consists of the following elements:

- Exhaust fan 41-B-816 or 41-B-817 SHALL be IN-SERVICE; and
- CH BAY exhaust air SHALL flow through at least one stage of high efficiency particulate air (HEPA) filters in either filter unit 41-B-814 or 41-B-815. **[TSR LCO 3.2.1]**

WP 04-AD3001, Facility Mode Compliance specifies the daily verification that one CH Bay confinement ventilation system exhaust fan, 41-B-816 or 41-B-817 is IN-SERVICE. **[TSR SR 4.2.1.1]** The CH BAY exhaust air is flowing from a HEPA filter unit to an exhaust fan. **[TSR SR 4.2.1.2]**

4.1.1 References

Detailed descriptions of CH area (including the mechanical room) HVAC system is contained in Section 3.2.

Figure HV I-2 provides a block diagram of the WHB Zone 2 system.

Figure HV I-3 provides a block diagram of the WHB Zone 1 system.

Figure HV I-5 shows the layout of WHB Zones 1, 2 and 4 control panels in the mechanical equipment room and its annex.

5.0 SYSTEM LIMITATIONS, SETPOINTS, AND PRECAUTIONS

5.1 Introduction

Refer to Chapter G for general requirements associated with system limitations, setpoints, and precautions.

5.2 Operability Conditions

Maintaining operability of the HVAC system is determined by the following performance indicators:

5.2.1 Negative pressure in CH Waste Handling Areas of the WHB

5.2.1.1 Differential Pressure Measurement in the CH Area

The area pressure controller setpoints and the design basis alarm setpoints related to this event are as listed below.

Area	Controller Setpoint	Alarm Setpoint	Minimum Negative Differential Pressure (DP)
CH Area	-0.11" wg	-0.02" wg	-0.01" wg
Room 108	-0.11" wg	-0.02" wg	-0.01" wg

The alarm function for static pressure is not resident in the DDC system; it is programmed in the CMS. Two alarms have been programmed. The first alarm is initiated the instant that the setpoint is exceeded and is disengaged the instant that the static pressure is restored; a second alarm is activated if the setpoint has been exceeded for a specified length of time. Due to pressure changes outside the envelope of the building from wind effects, the reference pressure is not constant over even a small amount of time. The analog output to the CMS is time averaged to minimize nuisance alarms generated by the CMS. Instantaneous transitions below the setpoint will not trigger an alarm on the CMS unless the transition is maintained below the setpoint. The time averaging logic within the DDC will allow the output indication to the CMS to trigger an alarm when the signal is maintained below the setpoint.

5.2.2 Deterioration of WHB HVAC Exhaust Filtration

The capability for filtration of exhaust air from the surface waste handling facility is determined by the performance of the HVAC system components. Alarms which identify deterioration in the performance of individual components are as follows:

5.2.2.1 HEPA Filter Assemblies

A differential pressure transmitter is installed for each prefilter and HEPA filter. The alarm function is processed through the DDC system, indicated at the host computer and transmitted to the CMS. Alarm setpoints are as follows:

Moderate Efficiency Filter	1" wg
HEPA 1 filter	3" wg
HEPA 2 filter	3" wg

5.2.2.2 AHU Supply and Exhaust Fans

Airflow rates for all AHU supply and exhaust fans are processed through the DDC system. Low-flow alarms are in the control system software, indicated in the host computer and transmitted to the CMS. Setpoints for the HV01 low-flow alarms are defined in Section 5.3.1.4.

Activation of a low flow alarm automatically shuts down the operating ventilation train, and the condition is indicated in the CMS.

5.3 HVAC System Setpoints

Design Basis differential pressure limits and nominal values for rooms in the WHB are listed in Appendix B-1. Room differential pressure setpoints are presented in Section 5.2.1.1.

Setpoints, including filter pressure alarms, are programmed in the DDC system. There is no single device that can be referenced for these settings. Adjustment of setpoints is accomplished through the DDC system; individuals must have a password that will allow access to the program. Setpoint access and modifications are performed in accordance with WIPP Site Controlled Operating Procedures.

5.3.1 Subsystem HV01 Setpoints

5.3.1.1 WHB Zone 1 (Mechanical Equipment Room)

The cooling setpoint is intended to be 76˚ F, and the heating setpoint is intended to be 72˚ F. All controller functions such as dead band, PID, and differential are adjusted through the DDC system.

5.3.1.2 WHB Zone 2 (CH Area)

- CH Area AHUs

Flow control is from the DDC system and should be set between 13,000 and 21,000 cfm.

The cooling setpoint is intended to be 76˚ F, and the heating setpoint is intended to be 72˚ F. All controller functions such as dead band, proportional/integral, and differential are adjusted through the DDC system.

- CH Area Exhaust Fans

The flow control signal is from the DDC system and is a combination of the supply flow rate and the room pressure control signal, acting to increase the flow rate as a demand signal. Room differential setpoints are as follows:

Area	Setpoint
Shielded Storage Room	-0.15" wg
Contact Handling Area	-0.11" wg
Site Generated Waste Room	-0.03" wg
Small Equipment Decon Room	-0.15" wg
TP-III Room	-0.11" wg

- Battery Charging Area Exhaust Fans

The flow rate should not be set lower than 2,000 cfm. 2,500 cfm is the design value. Flow control is from the DDC system and is a simple control loop.

- CH Area Unit Heaters

Four electrical fan heaters are located on the south wall of the CH bay. These units have local thermostats that can be set as needed.

5.3.1.3 WHB Zone 3 (Waste Hoist Tower)

The only HVAC automatic control in the Waste Hoist Tower is that for temperature switch in the inlet to the AHU

5.3.1.4 HV01 Alarms

The HV01 alarms are included in the DDC system through the alarm software and are presented in the CMR via the CMS.

Eleven AHU supply and exhaust fans are provided with low-flow alarms which operate at the setpoint values in cfm listed below.

Air Handling Units	Alarm Point	Exhaust Fans	Alarm Point
Mechanical Room Air Handling Unit	1,100 cfm	CH Area Exhaust Fans	8,200cfm
CH Area Air Handling Unit	9,375 cfm	Battery Charging Area Exhaust Fans	1,250cfm

The low and moderate efficiency filters on all AHUs are provided with high differential pressure alarms activated at setpoints of 0.5" and 1.0" wg respectively.
The HEPA Stage 1, HEPA Stage 2, and the exhaust moderate efficiency filters are provided with high differential pressure alarms in the DDC system activated at setpoints of 3", 3", and 1" wg respectively. These alarms are also transmitted to the CMR via the CMS.

Room static pressure alarms are independently derived in both the DDC system and in the CMS. The CMS alarms are derived directly from the static pressure signal by the CMS software. There is no alarm signal transmitted from the DDC to the CMS.

Refer to Section 5.3 of Chapter G for the general information regarding HVAC system interlocks and HVAC/Chilled Water system precautions.

6.0 OFF-NORMAL EVENTS AND RECOVERY PROCEDURES

6.1 Introduction

An off-normal event is defined as an abnormal system or plant condition, which could affect the safety of site or off-site personnel or could affect the integrity or proper functional operation of the system or plant.

In this SDD off-normal events are only considered significant when applicable to the HVAC systems of buildings directly connected with the waste handling process. These include the WHB and the SB, the EFB and the EOC facility in the Safety and Emergency Building.

The following list of off-normal events that effect HV01:

- Loss of WHB differential pressure
- Inoperability of a WHB HVAC Train **[TSR LCO 3.2.1]** **[TSR LCO 3.2.2]**

- Release of radioactive particulates
- Loss of Electrical Power
- Loss of compressed air supply
- Fire
- Design Basis Earthquake
- Design Basis Tornado

7.0 MAINTENANCE

Refer to Section 7.0 of Chapter G which presents maintenance requirements for HVAC equipment.

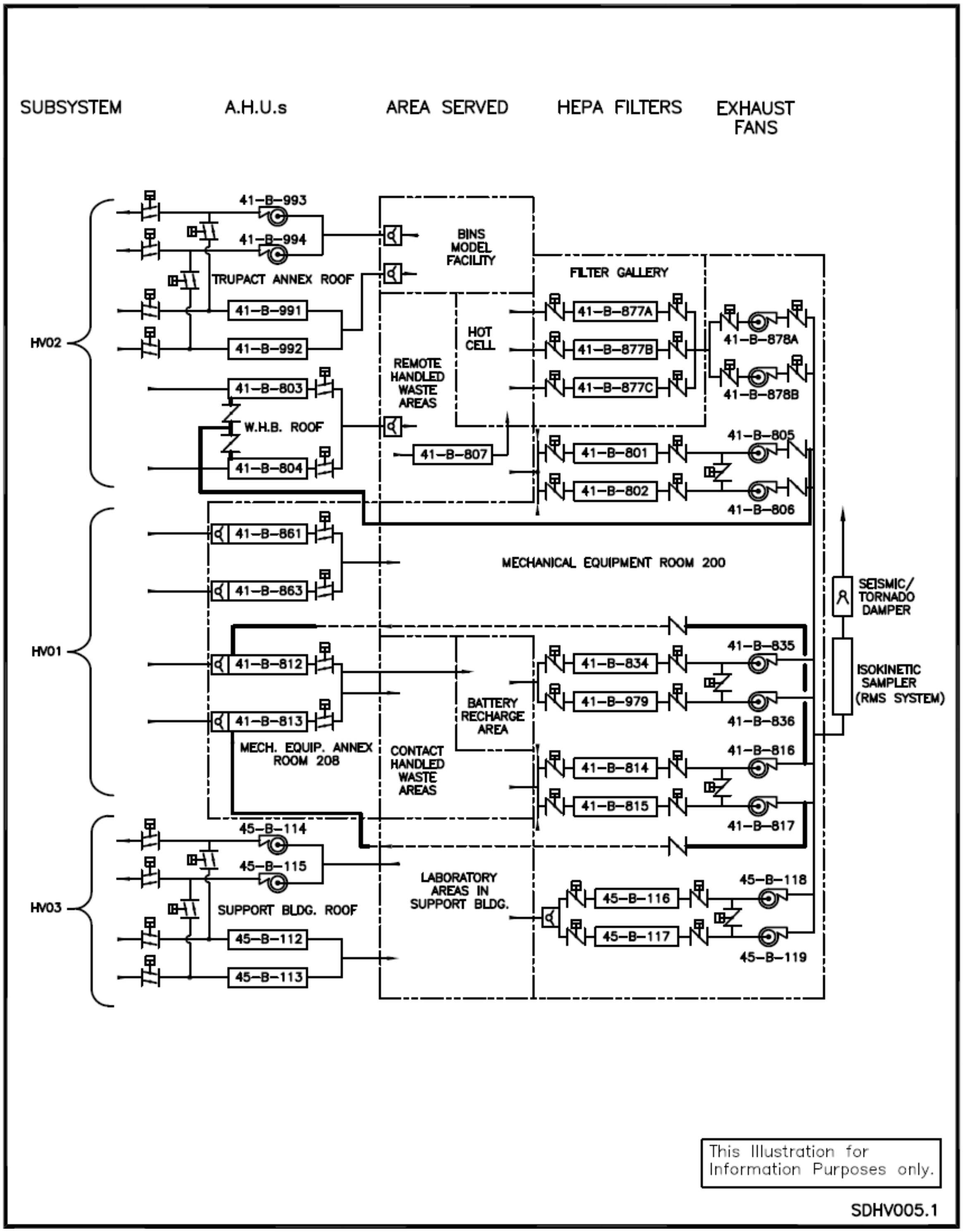

FIGURE HV I-1: HVAC Equipment Configuration in Surface Waste Handling Facility

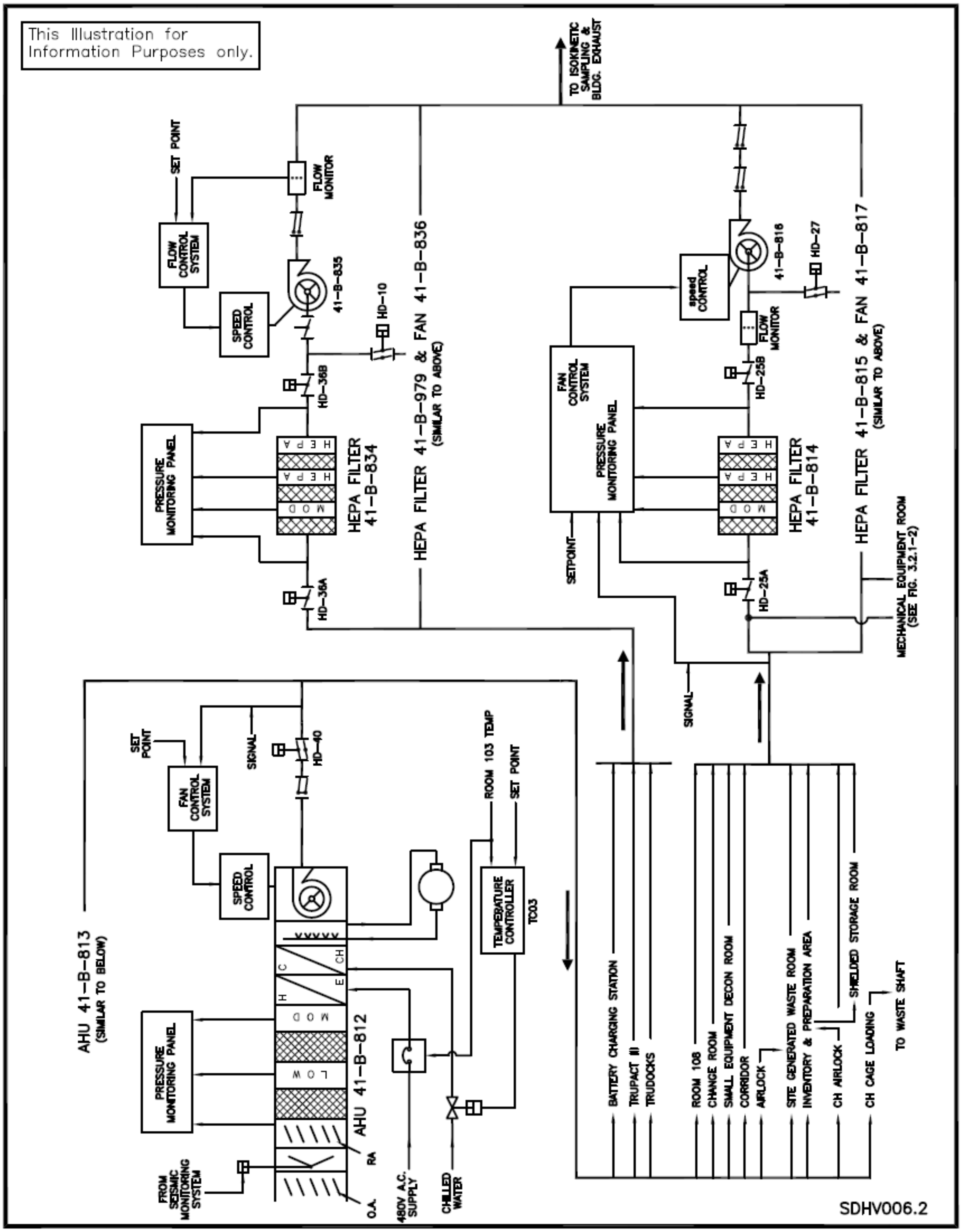

FIGURE HV I-2: Subsystem HV01 CH Area HVAC Block Diagram

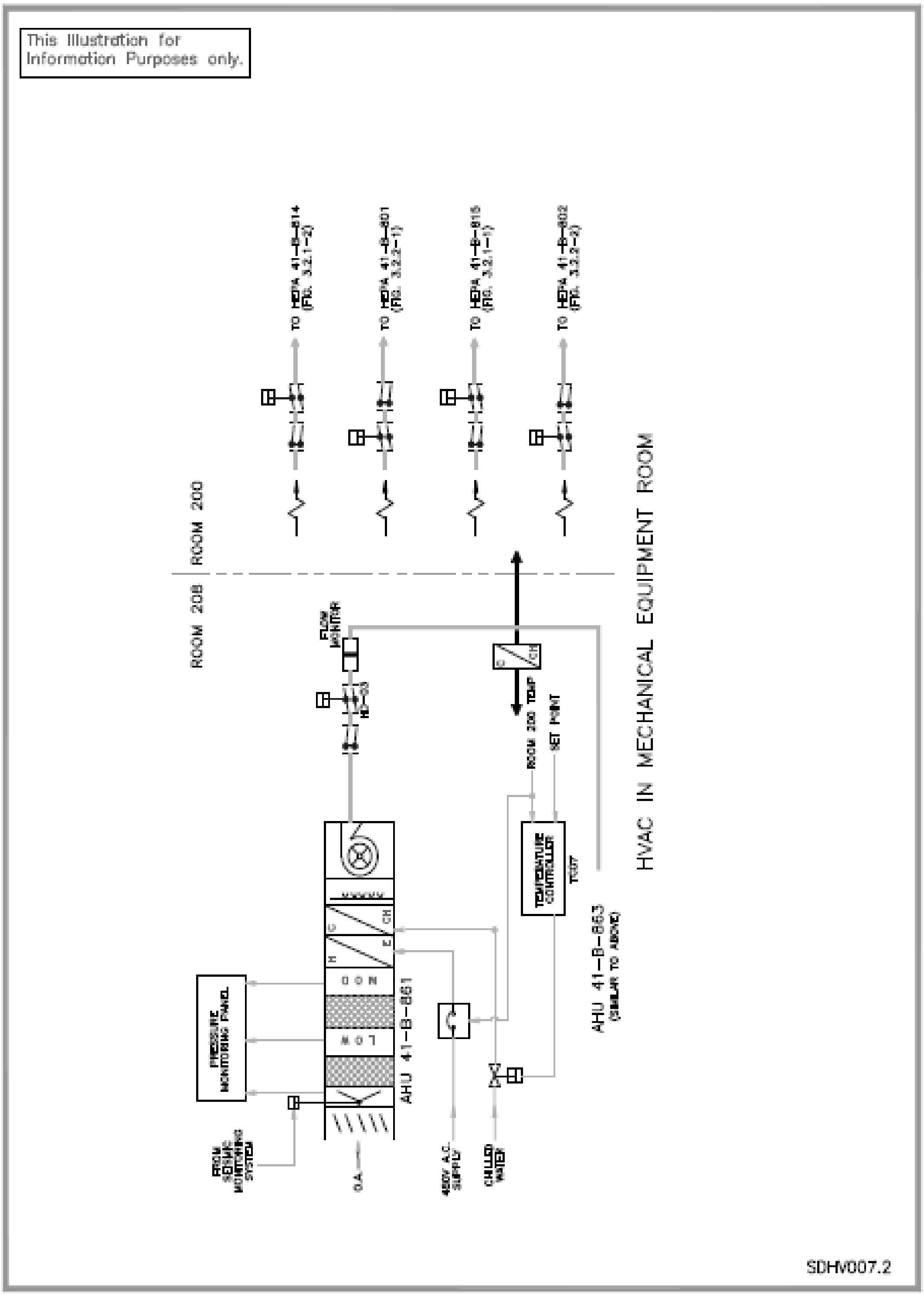

FIGURE HV I-3: HVAC in Mechanical Equipment Room & Overpack Enclosure

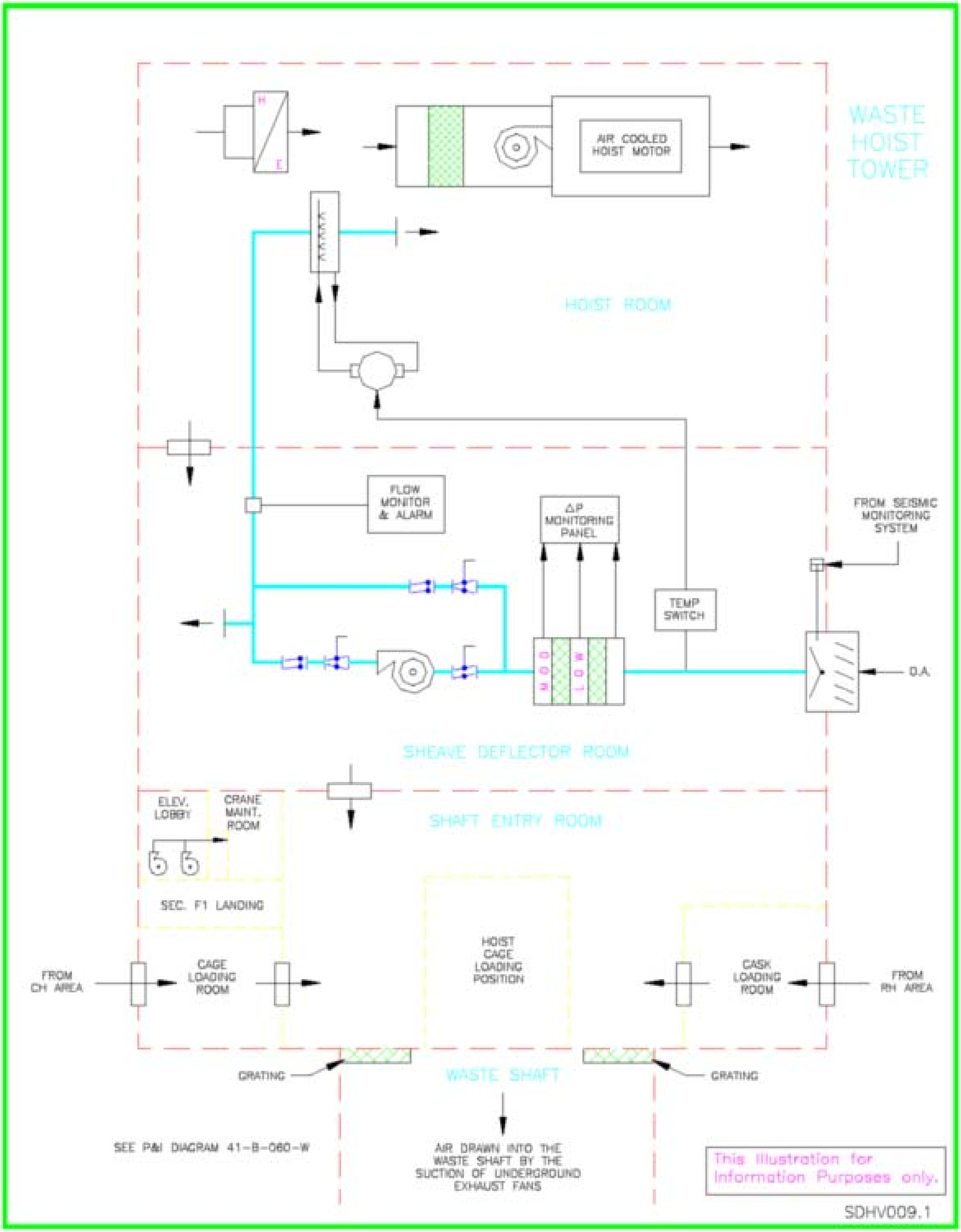

FIGURE HV I-4: Subsystem HV01 Waste Hoist Tower HVAC Block Diagram

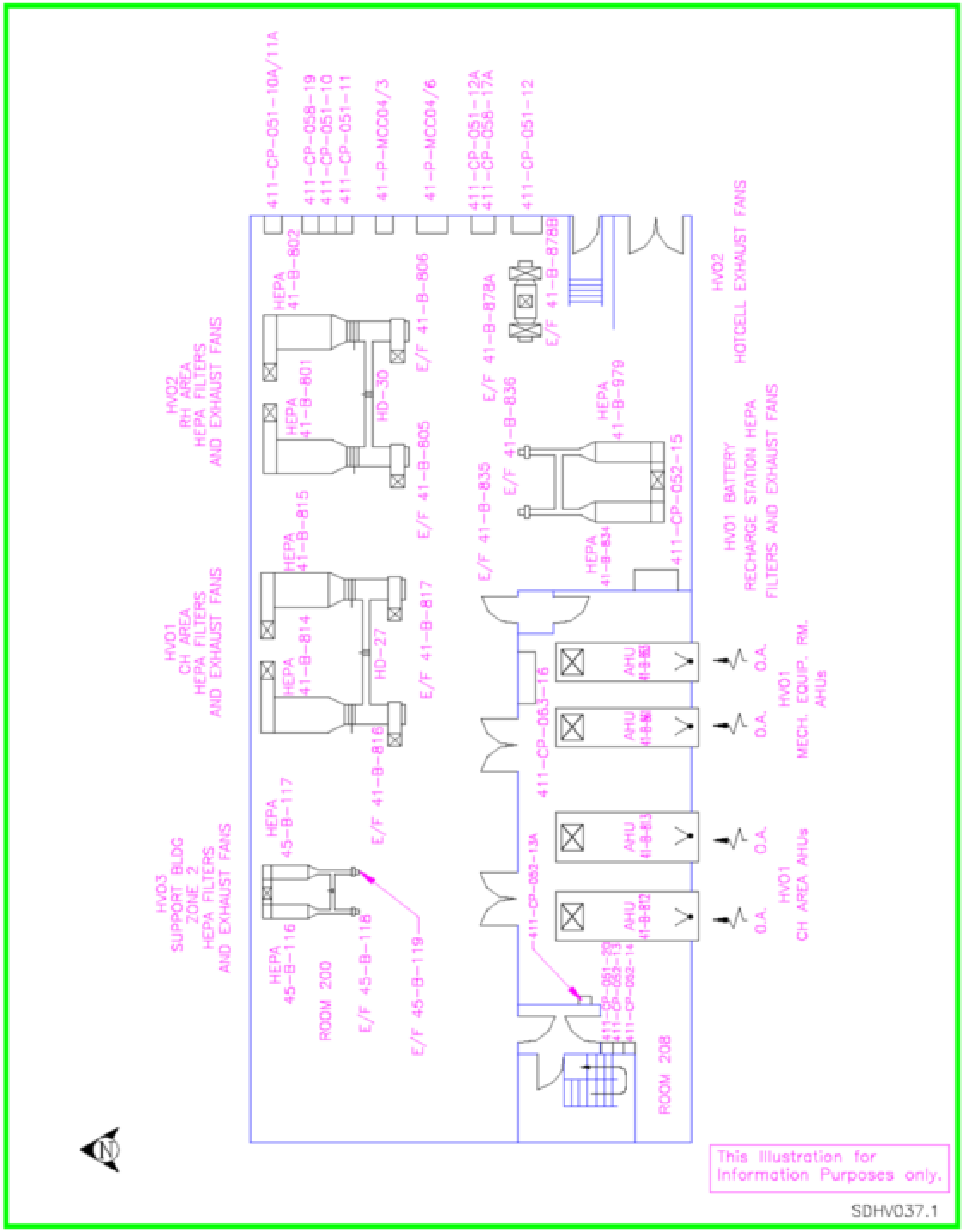

FIGURE HV I-5: Layout of HV01, HV02 & HV03 Components in the Mechanical Equipment Room

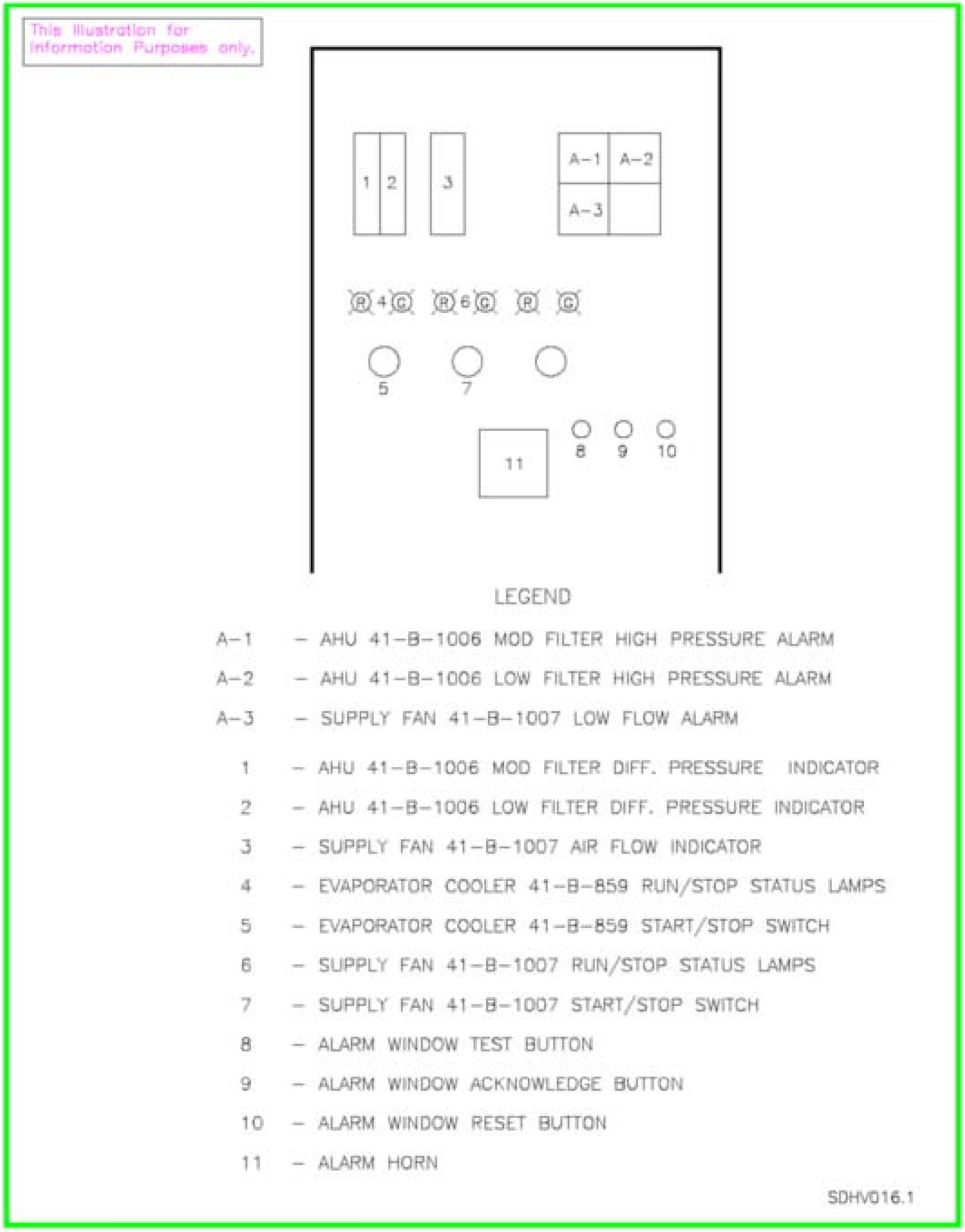

FIGURE HV I-6: Hoist Room HVAC Control Panel 411-CP-060-18 Layout

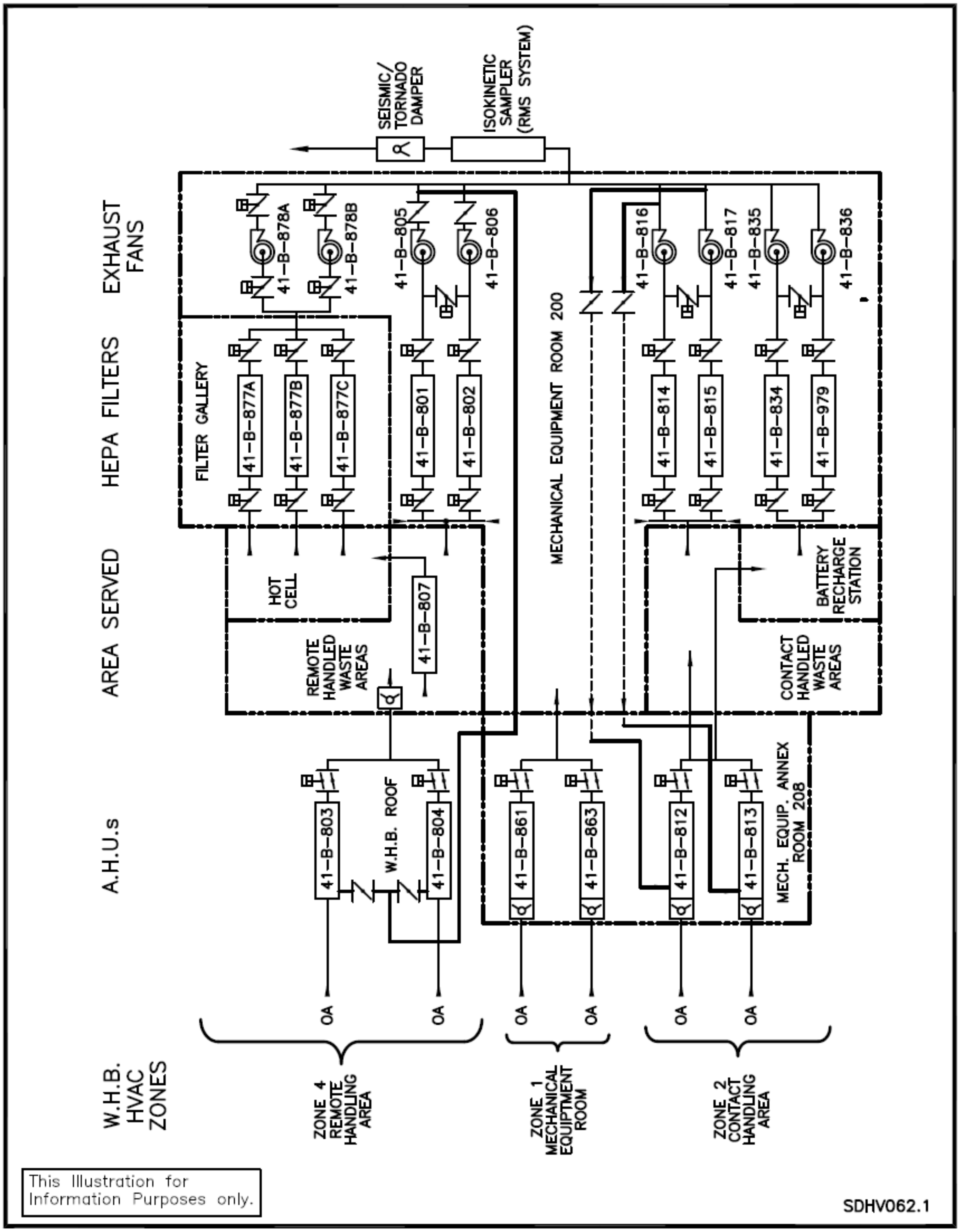

FIGURE HV I-7: Operating Zones in WHB HVAC Systems

Chapter II

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Chapter II

<u>Subsystem HV02, Waste Handling Building RH Area HVAC</u>

1.0 PRIMARY FUNCTIONS

Refer to Section 1.0 of Chapter G for the Primary Functions.

2.0 DESIGN REQUIREMENTS

2.1 General

Refer to Section 2.1 of Chapter G for the general design requirements.

2.1.1 Outdoor Design Conditions

Refer to Section 2.1.1 of Chapter G for the outdoor design conditions.

2.1.2 Indoor Design Conditions

The HV02 system shall be designed for indoor design temperatures, with the exception of the hot cell, as follows:

Indoor Design Temperatures (˚ F)

Winter (Min)	Summer (Max)	Space (HV02) WHB
40	95	RH waste area
65	80	TMF
N/a	104	Hot Cell

2.1.3 Ventilation

Refer to Section 2.1.3 of Chapter G for the general ventilation requirements.

2.2 Subsystem General Requirements

2.2.1 Subsystem HV02

The design temperature requirements for the WHB Remote Handled (RH) waste area and the TMF shall be in accordance with Sections 2.1.1 and 2.1.2.

2.2.2 To ensure that air flow is from the cask receiving and loading room areas to the Hot Cell, an exhaust fan arrangement shall be designed to draw air via ducts from the cask receiving and loading room areas into the Hot Cell.

2.2.3 When the supply air temperature to the Hot Cell from the cask receiving area is too high to provide an adequate hot cell environment, means shall be provided to cool the inlet air stream to maintain the Hot Cell temperature below the maximum allowable.

2.2.4 Air from the Hot Cell shall be exhausted via dedicated pre-filters and HEPA filters before being discharged through the exhaust stack.

Hot Cell Complex Filter units 41-B-877A and 41-B-877B and 41-B-877C SHALL have one stage of HEPA filters with >99% efficiency. **[TSR LCO 3.2.2]** Annually, one stage of HEPA filters in units 41-B-877A and 41-B-877B and 41-B-877C is verified to have an efficiency > 99%, using PM041154, In Place Testing of HEPA Filter Units. **[TSR SR 4.2.2.3]** If HEPA filter replacement is required, a corrective work package will be used to change the filter.

Two 100% capacity exhaust fans shall be provided.

WHB Zone 4, consisting of the AHUs, HEPA filters, and exhaust fans which supply the Remote Handling (RH) areas, is operated using WP 04-HV101, WHB RH Area Zone 4 HVAC, which maintains the Hot Cell Complex confinement ventilation system in an OPERABLE condition. An OPERABLE confinement ventilation system consists of the following elements:

- Exhaust fan 41-B-878A or 41-B-878B SHALL be IN-SERVICE; and
- Exhaust air SHALL flow through two of the following filter units: 41-B-877A, 41-B-877B, 41-B-877C. **[TSR LCO 3.2.2]**

2.2.5 The TMF shall be maintained at a positive pressure relative to atmosphere.

2.3 Operational Requirements

Refer to Section 2.3 of Chapter G for the general operational requirements.

The WHB RH waste area HVAC system shall meet the same operational requirements as prescribed in Section 2.3.1 of Chapter I for the WHB CH area.

2.4 Structural

Refer to Section 2.4 of Chapter G for the structural requirements.

2.5 General Arrangement and Essential Features

Subsystem HV02 will contain the same types of major components as are listed above in Section 2.5.1.1 of Chapter I for the WHB CH area, except for those required for the TMF. The TMF has all equipment referenced except for the HEPA filter.

2.5.1 All the exhaust fans and HEPA units shall be located in the Mechanical Room, with the exception of the hot cell HEPA filters which shall be located in a separate room near the Hot Cell. The location of HEPA filters for the Hot Cell shall be as close to the wall of the hot cell as practical, so that the duct from the Hot Cell will be as short as possible.

2.5.2 Other Essential Features and Feature Specifications

Refer to Section 2.5 of Chapter G for other essential features and feature specifications.

2.6 Maintenance

Refer to Section 2.6 of Chapter G for the general maintenance requirements.

2.7 In-Service Inspections

Refer to Section 2.7 of Chapter G for the general in-service inspection requirements.

2.8 Instrumentation and Control

Refer to Section 2.8 of Chapter G for the general I&C requirements.

2.9 Interfacing Systems

2.9.1 General

Refer to Section 2.9.1 of Chapter G for the general interfacing system requirements.

2.9.2 Primary Interface

Refer to Section 2.9.2 of Chapter G for the primary interface general information and Appendix C-1 for primary interface requirements.

2.9.3 Secondary Interfaces

Refer to Section 2.9.3 of Chapter G for the secondary interface general information and Appendix C-2 for secondary interface requirements.

2.10 Quality Assurance

Refer to Section 2.10 of Chapter G for the quality assurance requirements.

2.11 Codes and Standards

Refer to Section 2.11 of Chapter G for codes and standards.

2.12 Reliability Assurance

2.12.1 General

For the design of HV02, the Hot Cell shall have two 100% capacity exhaust fans and three 50% capacity HEPA filter units.

3.0 DESIGN DESCRIPTION

3.1 Summary Description

Refer to Section 3.1 of Chapter G for the summary description.

The HVAC in the RH area of the WHB is identical to that described in Section 3.1 of Chapter 1 for the CH portion of the WHB.

3.2 Detailed System Description

This subsystem provides HVAC for the following two areas:

- The RH area located on the first and second floor of the east half of the WHB and containing the following rooms:

  - Cask receiving area (Room 104)
  - Transfer Cell (Room 79)
  - Air locks (Rooms 77, 121, 129, and 202)
  - Cask unloading area (Room 126)
  - Access aisle (Room 122)
  - Hot cell (Room 124)
  - Filter gallery (Room 123)
  - Operating gallery (Room 211)
  - Waste hoist power room/operator station (Room 204)
  - Cask loading room (Room 120)
  - Vestibule (Room 144)
  - Stairway (Room 119)
  - Crane maintenance room (Room 402)
  - Manipulator repair room (Room 209)
  - Service room (Room 87)

The arrangement of these areas within the WHB is shown in Figures HV II-1 and II-2.

- The TMF which is located in Building 412 located at the west end of Building 411. The HVAC system for this facility is also designated Subsystem HV02, although it is completely separate from the RH area HVAC system.

3.2.1 RH Waste HVAC System

The HVAC system for the RH area is illustrated in Figure HV II-3. The principal components consist of three air handling units (one of these is dedicated for the Hot Cell); five HEPA filter units; and four exhaust fans. This equipment can be operated independently from the rest of the facility and its operating status is monitored by the CMS for presentation in the CMR.

The system is designed to operate so that all areas which may contain waste are maintained at a negative pressure to the outside atmosphere. Room static differential pressures are listed in Appendix B-1.

During normal operation these conditions may be achieved by the use of one RH HVAC train and one Hot Cell HVAC train as follows:

- The RH train consists of one AHU and one HEPA filter assembly with an associated exhaust fan.

- The Hot Cell HVAC train consists of an AHU and two HEPA filters units selected from the three available, with up to two exhaust fans.

The units not in use shall provide standby capacity when not used to meet ventilation requirements. The following sections describe design features of this subsystem.

3.2.1.1 Air Supply

The AHUs draw air through an inlet plenum from either outside air or recirculated air, a pre-filter bank, a Moderate efficiency filter section, an evaporative cooler (that is not in use), an electrical heating coil, and a chilled-water cooling coil. The chilled water control valve and the AHU electric heater is controlled through the DDC system based on a temperature sensor in the RH Bay (Room 104) that controls the cooling coil and heater in sequence.

The system is designed to operate so that all areas which may contain an open waste container are maintained a sub-atmospheric pressure. Room operating pressures are listed in Appendix B-1. These conditions may be achieved by the use a single Air Handling Units (AHU), and one exhaust fan.

Any remaining units provide standby capacity when not used to meet ventilation requirements. Air flow is maintained by adjustable speed drives (ASDs) which control the fans by way of static pressure sensors located in the ductwork.

These AHUs are located at the east end of the WHB roof. Each AHU is connected through a back draft damper and a switchable automatic or manually operated isolation damper to the supply duct which has a tornado damper in the supply duct wall penetration. The tornado damper is also commanded closed by the Seismic Monitoring System (System EM00) upon detection of a seismic event.

3.2.1.2 Air Distribution

In all RH rooms, with the exception of the Hot Cell, room static pressure is maintained by PDDs and CVATs which are controlled by a DDC system described below.

Pressure differential transmitters in these rooms send differential pressure signals to the DDC. The DDC then positions the PDDs and CVAT units to vary the exhaust and supply flow rate to maintain room pressure at the setpoint.

The hot cell exhaust fans draw air from the cask receiving room into the hot cell; cask receiving room air then becomes supply air for the hot cell. The duct that carries the air to the hot cell has a damper arrangement that allows air to flow directly from the cask receiving room or through an AHU with a chilled water cooling coil. The air handler fan is necessary to overcome the additional air pressure drop from the cooling coil. The AHU fan, chilled water coil, and damper realignment are controlled based on a temperature sensor located in the hot cell. The static pressure in the hot cell is maintained by control of the hot cell exhaust fans through the ASDs. Under normal hot cell operating conditions, the hot cell AHU will be unnecessary and both AHU dampers will remain closed while an exhaust fan will maintain necessary room pressure.

3.2.1.3 Exhaust Air

All RH exhaust air except the hot cell is drawn through HEPA filter assemblies located in the mechanical equipment room.

The ASDs on the RH exhaust fans are controlled as described in the previous section. The air is either recirculated back to the AHU by duct or discharged f into the exhaust header in the mechanical equipment room. It is then discharged to atmosphere and is monitored by the Station C effluent monitor (provided by system RM00). The recirculation system uses a split damper similar to the CH recirculation system, to control the amount of air returned to the AHUs. A pressure transmitter in the duct will open the dampers if the pressure is getting too low in the duct. If the pressure gets too high in the duct the dampers will close down reducing the pressure in the duct. The extra air is then discharged through the exhaust header.

Air flow from the hot cell is by either of two exhaust fans drawing air through two of three filter units. Hot cell differential pressure is maintained at a value of -0.4 to -1" water gauge by the DDC system that controls the exhaust fans.

All hot cell HEPA filter assemblies and exhaust fans have electrically operated isolation dampers located at both inlet and outlet ducts.

3.2.1.4 RH Area interlocks

The DDC system contains software based interlocks that ensure proper operation of the system and to avoid equipment failures resulting from incorrect operation. The drawings for the logic for the DDC can be found in the Engineering File Room. These may be summarized as follows:

- Permissive interlocks and latching relays prevent the simultaneous operation of two exhaust fans or two supply fans. This constraint may be removed by switching the HOA switch to "HAND" providing additional ventilation capacity as required by operations.

- If an AHU supply fan trips due to a malfunction its corresponding exhaust fan will also be tripped.

- If an exhaust fan is de-energized, its related AHU supply fan will be shut down.

- When either AHU is running, a low duct static pressure signal from the sensor in the supply duct will cause the related AHU supply fan to trip.

- When either exhaust fan is running, a low duct static pressure signal from pressure sensors in the exhaust duct will cause that fan to trip.

- If an automatic trip of AHU occurs due to a malfunction its corresponding exhaust fan will also be tripped.

- When the control mode selector switch for the hot cell AHU is in "AUTO," a high temperature permissive signal can start the AHU and supply conditioned air to the hot cell.

- The DDC can be configured such that any combination of hot cell AHU damper arrangements can be accomplished, depending upon operational needs.

- The isolation dampers on each side of HEPA filter assemblies, are automatically opened when the exhaust fan connected to each filter is energized. When the fan is de-energized the dampers are closed.

- The selection of the hot cell HEPA filters alignment is manual.

- Discharge dampers from the RH AHUs open automatically when the supply fans are started and close when they are de-energized. Electrical heaters in these AHUs can only be energized when their supply fans are running.

- A signal from the DDC operates the chilled water valve.

- An actuation of the tornado damper will cause fan motor(s) to stop.

3.2.2 TRUPACT Maintenance Facility HVAC System

The HVAC system for the TMF is illustrated in Figure HV II-4. The principal components consist of two air handling units; and two exhaust/return fans. All units are mounted outdoors on the roof of the TMF Building Annex.

The system is designed for normal operation in the recirculation mode with one AHU and one exhaust/return fan in operation.

The TMF is maintained at a pressure of +0.05" water gauge.

The following sections describe design features of this subsystem.

3.2.2.1 Air Supply

The outside air ducts to the AHUs contain two position dampers that are set for minimum make up air or for 100% outdoor air.

Tornado dampers without a seismic interlock are installed in the supply and return duct penetrations in the TMF wall.

3.2.2.2 Flow distribution within the TRUPACT Maintenance Facility

The incoming air duct is connected to air supply registers with flow controlled by manually operated dampers.

Exhaust air is collected in a single outlet duct which leaves the facility by way of a tornado damper.

3.2.2.3 Exhaust air from the TRUPACT Maintenance Facility

The exhaust air flow rate is varied by way of fan inlet vanes to maintain a constant positive pressure in the TMF.

A smoke detector is located in the outlet duct to transfer operation from recirculating mode to exhaust mode if/when smoke is detected.

3.2.2.4 TRUPACT Maintenance Facility HVAC Interlocks

Interlocking in the TMF between the AHUs and their related exhaust fans is similar to that illustrated in Figure HV II-4 for area equipment. The principal features of these interlocks may be summarized as follows:

- An AHU supply fan can only be started if the corresponding exhaust fan is operating.
- If an exhaust fan is de-energized (for any reason) its related AHU supply fan will be shut down.
- When either AHU is running, a low flow signal will cause the related AHU supply fan to trip.
- A low flow signal from the flow control system in the exhaust fan outlet duct will cause that fan to shut down.
- Discharge dampers from the AHUs open automatically when the fans are energized and close when they are de-energized. Electrical heaters in these AHUs can only be energized when their supply fans are running.
- Solenoid operated valves in the control air to the chilled water valves on the AHUs are open when each AHU is started. This allows the controller signal to reach the valve operator.

3.2.3 Service Room Facility HVAC System

The principal components of the Service Room consist of the fume hood, a pressure differential damper, and a constant volume air terminal unit.

As the Service Room HVAC is part of the general RH area HVAC, it is designed for normal operation to be coincident with the general RH area HVAC normal operation.

The Service Room is maintained at a pressure of -0.10" water gauge.

The following sections describe design features of this subsystem.

3.2.3.1 Air Supply

Air is supplied via a duct which comes from main RH area supply.

3.2.3.2 Flow Distribution within the Service Room Facility

The incoming air duct is connected to a DDC controlled VAV box to ensure proper air flow to the Service Room.

Exhaust air is collected in a single outlet duct which leaves the facility by way of the fume hood.

3.2.3.3 Exhaust air from the Service Room Facility

The exhaust air flow rate is constant utilizing fume hood face and/or bypass by way of a venturi type PDD.

3.2.3.4 Service Room Facility HVAC Interlocks

- The supply and exhaust of the service room is tied directly to main supply and exhaust of the RH area. There are no interlocks within the service room that will shut down the RH area HVAC.
- The high differential alarm is disabled when Service Room door is open.

3.3 System Performance Characteristics

3.3.1 General

This section provides a description of the system performance characteristics under the various normal and infrequent operating modes and off-normal operating conditions.

3.3.2 Subsystems HV02

Figure HV I-1 shows the layout and interconnection of HV01 and HV02 HVAC trains discussed in this section.

3.3.2.1 Normal Operation

During normal operation, system HV02 shall supply properly conditioned air to normally occupied areas, provide control of pressure differentials in areas/rooms to ensure airflows are confined to the prescribed flow paths and pattern, and provide for continuous filtration of exhaust air to limit the radioactive contamination in the exhaust airstream from the WHB for ALARA compliance. The exhaust airstream is continuously monitored by the Radiation Monitoring System (RMS) at Station C.

During normal plant operation, a single HVAC train may be utilized to sustain temperatures and differential pressures, however an additional train may be required due to operational configuration.

Air is drawn into the RH area hot cell either directly from the cask receiving and loading room or from an AHU which also draws air from that room. This AHU is brought into operation if the hot cell exhaust air temperature exceeds a value of 90 F. Operation of this system is described in Sections 3.2.1.2 and 3.2.1.3.

Static pressure control is provided by PDDs installed in the exhaust air duct near room exhaust registers and CVAT units in the supply duct. Pressure signals from these units provide an overall control of supply and exhaust air flow to and from these areas.

The hot cell differential pressure is regulated by control of the hot cell exhaust fan flow rate.

During normal operation, continuous filtration of exhaust air from the RH area is separately provided for each area by the HEPA filter assembly in the HVAC train in operation. All exhaust air is passed to the outside atmosphere through Station C (effluent monitor) in the WHB.

Exhaust airflow from the hot cell is filtered through two of three HEPA filter assemblies. One of two exhaust fans draws air through the HEPA assemblies in operation and forces it to the outside atmosphere through Station C (effluent monitor). The third HEPA filter assembly and the second exhaust fan fulfill a standby function.

An OPERABLE Hot Cell Complex confinement ventilation system consists of the following elements:

- Exhaust fan 41-B-878A or 41-B-878B SHALL be IN-SERVICE; and
- Exhaust air SHALL flow through two of the following filter units: 41-B-877A, 41-B-877B, 41-B-877C. **[TSR LCO 3.2.2]**

3.3.2.2 Off-Normal Operation

If a malfunction occurs in RH area HVAC train both the supply and the exhaust fans in that train will trip when the fans are in "auto." The HVAC system standby train for that area can then be started up. This will ensure that the specified negative pressure can be maintained in areas where waste is being handled.

The Hot Cell has one AHU and two exhaust fans; all three units are 100% capacity. The Hot Cell is exhausted through two of three HEPA filter assemblies, each with a 50% flow capacity. One exhaust fan and one HEPA assembly serve as standby units. The Hot Cell AHU is interlocked with the exhaust fans so that the AHU will trip automatically when the corresponding exhaust fans are stopped. In the event of a single active component failure, sufficient exhaust capacity is available to maintain the design pressure differential between the Hot Cell and the surroundings.

In the event of a tornado, the tornado damper located in the WHB common exhaust duct will close. The exhaust fans, interlocked with the damper, will trip. As a consequence, the corresponding AHU fans will also trip.

Following the occurrence of a seismic event, the system's response is the same as described above.

The design intent is that each exhaust fan operates to draw air through the HEPA filter to which it is directly connected. If the rare circumstance occurs that this is not possible, a "crossover duct" can be used to allow an exhaust fan to draw air through the opposite filter. This realignment option is programmed in the DDC system and requires no manual configuration of dampers. The realignment option is initiated by the operator at the DDC host computer.

3.3.3 Conditions for Maintaining Operations

There are two conditions for differential pressure as a mode compliance indicator associated with HVAC systems HV01 and HV02.

Principle system performance characteristics are:

a. Ability to maintain differential pressure

System operational performance shall be capable of maintaining RH area differential pressures as listed for the following rooms:

Room	**Differential Pressure** (Inches Water Gage)
RH Receiving Bay	Positive relative to the CH Bay
Hot Cell	No greater than -0.05 relative to RH Bay

b. Ability for exhaust filtration

Systems shall be capable of monitoring HEPA filter differential pressure and shall be capable of giving alarm when principle pressure exceeds 3 inches of water.

3.4 Heating Ventilating and Air Conditioning System Arrangement

3.4.1 Layout of HV02 Area HVAC Equipment

The layout of the HV02 RH area HVAC equipment and the TMF HVAC equipment has been discussed in previous sections and is illustrated accordingly in Figure HV II-5 and Figure HV II-6.

3.5 Component Design Description

Refer to Section 3.5 of Chapter G for typical HVAC component design descriptions. Special purpose tornado dampers and fire dampers for the WHB RH area are described in Section 3.5.5 of Chapter G.

TABLE HV II-1: Summary of AHUs in Subsystem HV02

AHU Number	Location	Area Served
41-B-803, 41-B-804	WHB Roof	RH Waste Areas
41-B-807	WHB RH Area East	Hot Cell
41-B-991, 41-B-992	TMF Annex Roof	TMF

3.6 Instrumentation and Control

3.6.1 Subsystem HV02 I and C Equipment

The monitoring and control of subsystem HV02 is carried out from individual equipment panels which are assigned to the RH area HVAC and the TMF. The WHB RH Area HVAC system is controlled and monitored by a microprocessor based digital control system. All control functions and signal processing are contained in programmed control modules. Input signal such as pressure, flow, temperature, and alarms are processed through the modules and converted to electronic output control and parametric signals.

3.6.2 RH area HVAC Control Panels

Four adjacent HVAC equipment control panels located on the east wall of the mechanical equipment room (#200) control all major items of RH Area HVAC equipment. The equipment controlled by each panel is listed in Table HV II-2 below.

TABLE HV II-2: Scope and Description of HV02 Panels

Panel Number	Equipment Controlled		
	AHU	**Exh Fan**	**HEPA Filter**
411-CP-051-10	41-B-803	41-B-805	41-B-801
411-CP-051-11	41-B-804	41-B-806	41-B-802
411-CP-051-12	-	41-B-878A 41-B-878B	41-B-877A 41-B-877B 41-B-877C
411-CP-058-17	41-B-807	-	-
411-CP-058-19	Pressure Control in RH Rooms		
411-CP-066-01	41-B-991 41-B-992	41-B-993 41-B-994	NA

3.6.2.1 Control Panel Features

Control panels contain combinations of the following features for operation of the ventilation systems. Each panel is designed specifically for the application.

- Red (running) and green (stopped) indicator lights which display fan status
- Three position hand switches, "HAND/OFF/AUTO" for controlling fans
- Control (UUC) modules and I/O point expanders for the DDC system
- Transformers, terminal strips, relays, and transducers

3.6.2.2 RH Area Static Pressure Control Equipment

The control panel for room static pressure contains only the UUC module(s) and ancillary equipment for control of the static pressure in the individual rooms in the RH area.

3.6.2.3 TRUPACT Maintenance Facility HVAC Control Panel

The HVAC in this building is controlled from a panel located in a room in its North West corner. See Figure HV II-7. Features provided on it include the following:

- Four differential pressure indicators which monitor the pressure drop across each of the two filters in the AHUs
- Temperature indicators for chilled water outlet temperature, outlet temperature from each AHU, and the room temperature in the TMF
- Four alarm display windows which are activated by low flow in the AHUs and exhaust/return fans
- Alarm test, acknowledge and reset pushbuttons
- Air flow indicators for the exhaust/return fans
- Four pneumatic auto/manual stations for controlling air flow in the AHUs and exhaust/ return fans
- A static pressure indicator for the indoor static pressure
- A pneumatic auto/manual station for setting the static pressure in the building by adjusting the flow demand signal
- A pneumatic auto/manual station which controls the electrical heater coil and chilled water sections
- Four, three position hand switches, "AUTO/ON/OFF" for controlling the two Exhaust/Return fans and the two AHU supply fans. Red (running) and green (stopped) status lights are located above each switch
- Two, three position switches control the evaporator cooler sections in the AHU. Red (running) and green (stopped) status lights are located above each switch
- Selector switches to operate the inlet and vent dampers in each of the two HVAC trains to change mode from exhaust flow to recirculation flow

The panel houses the pressure regulator, controllers, pneumatic circuits, relays and alarm modules required for the functioning of this control system.

3.6.2.4 Subsystem HV02 Flowmeter Configuration

All HV02 flowmeters are the Electronic Velocity Array (EVA) type. Panel location and sensor and probe arrangements for these instruments are described in Table HV II-3.

TABLE HV II-3: Flowmeter Configuration in Subsystem HV02

Panel No	**Flow Measured**	**Probe s**	**Element s**	**Flow Ind Pnl**
411-CP-006-01A	AHU 41-B-991 AHU 41-B-992			411-CP-066-01

3.7 System Interfaces

Refer to Appendix C of Chapter VIII and Section 3.7 of Chapter G for primary and secondary interface information.

4.0 OPERATION

WHB Zone 4, consisting of the AHUs, HEPA filters, and exhaust fans which supply the Remote Handling (RH) areas, is operated using WP 04-HV1061, WHB RH Area Zone 4 HVAC, which maintains the Hot Cell Complex confinement ventilation system in an OPERABLE condition. An OPERABLE confinement ventilation system consists of the following elements:

- Exhaust fan 41-B-878A or 41-B-878B SHALL be IN-SERVICE; and
- Exhaust air SHALL flow through two of the following filter units: 41-B-877A, 41-B-877B, 41-B-877C. **[TSR LCO 3.2.2]**

WP 04-AD3001, Facility Mode Compliance, specifies the daily verification that one Hot Cell Complex confinement ventilation system exhaust fan, 41-B-878A or 41-B-878B, is IN-SERVICE. **[TSR SR 4.2.2.1]** Hot Cell Complex exhaust air is flowing from at least two HEPA filter units to the exhaust fan. **[TSR SR 4.2.2.2]**

4.1 Operation of the TRUPACT Maintenance Facility HVAC

Operation of one of the two HVAC trains in the TMF is sufficient to meet normal air conditioning requirements. The second train provides backup.

Refer to WIPP Controlled Operating Procedures for the controlled TMF operations sequences and prerequisites.

5.0 SYSTEM LIMITATIONS, SETPOINTS, AND PRECAUTIONS

Refer to Chapter G for general requirements associated with system limitation, setpoints, and precautions.

5.1 HVAC System Setpoints

Setpoints are defined in terms of the controlled HVAC equipment in the different subsystems. The equipment which provides HVAC to particular areas in each subsystem is described in Section 3.2. The design basis temperature limits are listed in Section 2.1.2. Design Basis differential pressure limits and nominal values for rooms in the WHB are listed in Appendix B-1.

5.2 Subsystem HV02 Setpoints

5.2.1 WHB Zone 4 (RH Area)

5.2.1.1 AHUs

Airflow rate shall be a maximum of 18,500 cfm for each AHU.

Temperature setpoints are listed for guidance only:

- Cooling setpoint of 76˚ F
- Heating setpoint of 72˚ F

5.2.1.2 Exhaust Fans

TABLE HV II-4: Room Static Pressure Setpoints

Area	Setpoint
Manipulator Repair Room	-0.15" wg
Filter Gallery Room	-0.15" wg
Cask Loading Room	-0.20" wg
Service Room	-0.10" wg
Transfer Cell	-0.30" wg
Cask Receiving Room	-0.00" wg
Hot Cell	-0.7" wg

The alarm functions for static pressure are not resident in the DDC system; it is programmed in the CMS. Two alarms have been programmed. This first alarm is initiated the instant that the setpoint is exceeded, and is disengaged the instant that the static pressure is restored. A second alarm is activated if the setpoint has been exceeded for a specified length of time. Since the room static pressure is transmitted to the CMS without electronic filtration or time averaging, the static pressure indication is instantaneous. Alarms of short duration do not necessarily indicate system failure. The second alarm is established at a higher priority. The Cask Receiving Room (RH Bay) setpoint is relative to CH Bay. All other RH room setpoints are relative to Cask Receiving Room (RH Bay).

5.2.1.3 Independent Room Pressure Controllers

The operating Gallery (room 211) has a nominal differential pressure setpoint of -0.10" wg.

5.2.1.4 Exhaust Fans (from Hot Cell)

The room static differential pressure setpoint shall be maintained at -0.7" wg.

5.3 AHUs

Supply air flow of approximately 4,800 cfm shall be maintained for each fan in each case.

Temperature setpoints are:

- Cooling setpoint of 76˚ F
- Heating setpoint of 72˚ F

5.3.1 Exhaust Fans

The TMF room static pressure shall be maintained at +0.05" w.g.

5.4 HV02 Alarms

TABLE HV II-5: Typical Low Flow Alarms

Air Handling Units	Alarm Point	Exhaust Fans	Alarm Point
TMF	2,400 cfm		
		TMF	70 cfm

TABLE HV II-6: Typical Differential Pressure Alarms

Area	Controller Setpoint	Alarm Setpoint	Minimum Negative DP
Cask Receiving Area	0.0" wg	0.0" wg	0.0" wg
Hot Cell	-0.7" wg	-0.05" wg	-0.03" wg
Service Room	-0.10" wg	-0.01" wg	0.0" wg

The low and Moderate efficiency filters on the AHUs have high differential pressure alarms which have setpoints of 0.5" and 1.0" wg respectively.

The HEPA filters and pre-filters in all HEPA filter assemblies have high differential pressure alarms activated at setpoints of 3" and 1.0" wg respectively.

6.0 OFF-NORMAL EVENTS AND RECOVERY PROCEDURES

The following list of off-normal events applies to the WHB RH area HVAC systems. Refer to Section 6.0 of Chapter G for a discussion of the off-normal events and the associated recovery procedures.

- Loss of WHB differential pressure
- Inoperability of a WHB HVAC Train **[TSR LCO 3.2.1] [TSR LCO 3.2.2]**
- Release of radioactive particulates
- Loss of Electrical Power
- Loss of compressed air supply
- Fire
- Design Basis Earthquake
- Design Basis Tornado

7.0 MAINTENANCE

Refer to Section 7.0 of Chapter G which presents maintenance requirements for HVAC equipment.

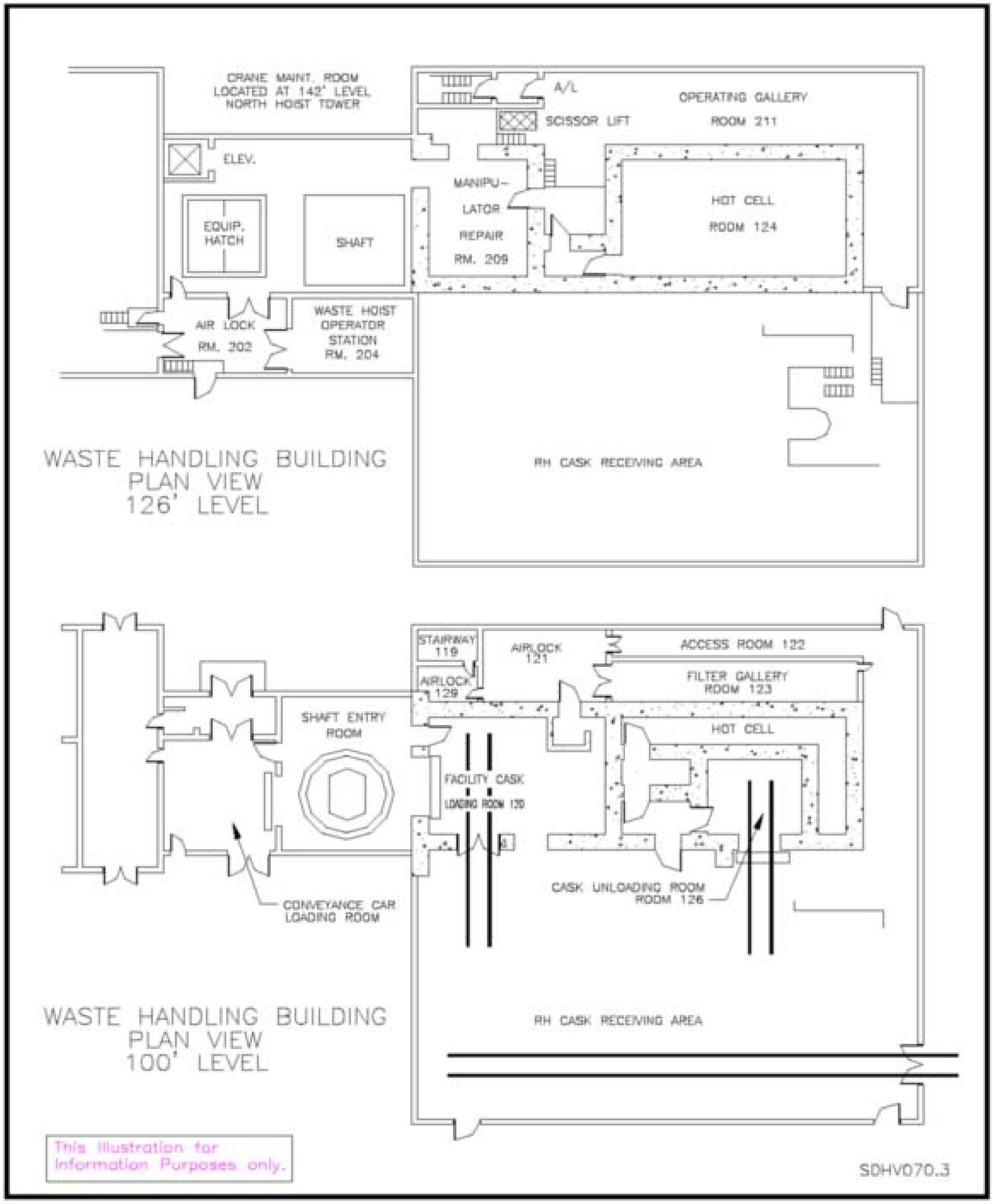

FIGURE HV II-1: Location of RH Areas Served by HV02 HVAC

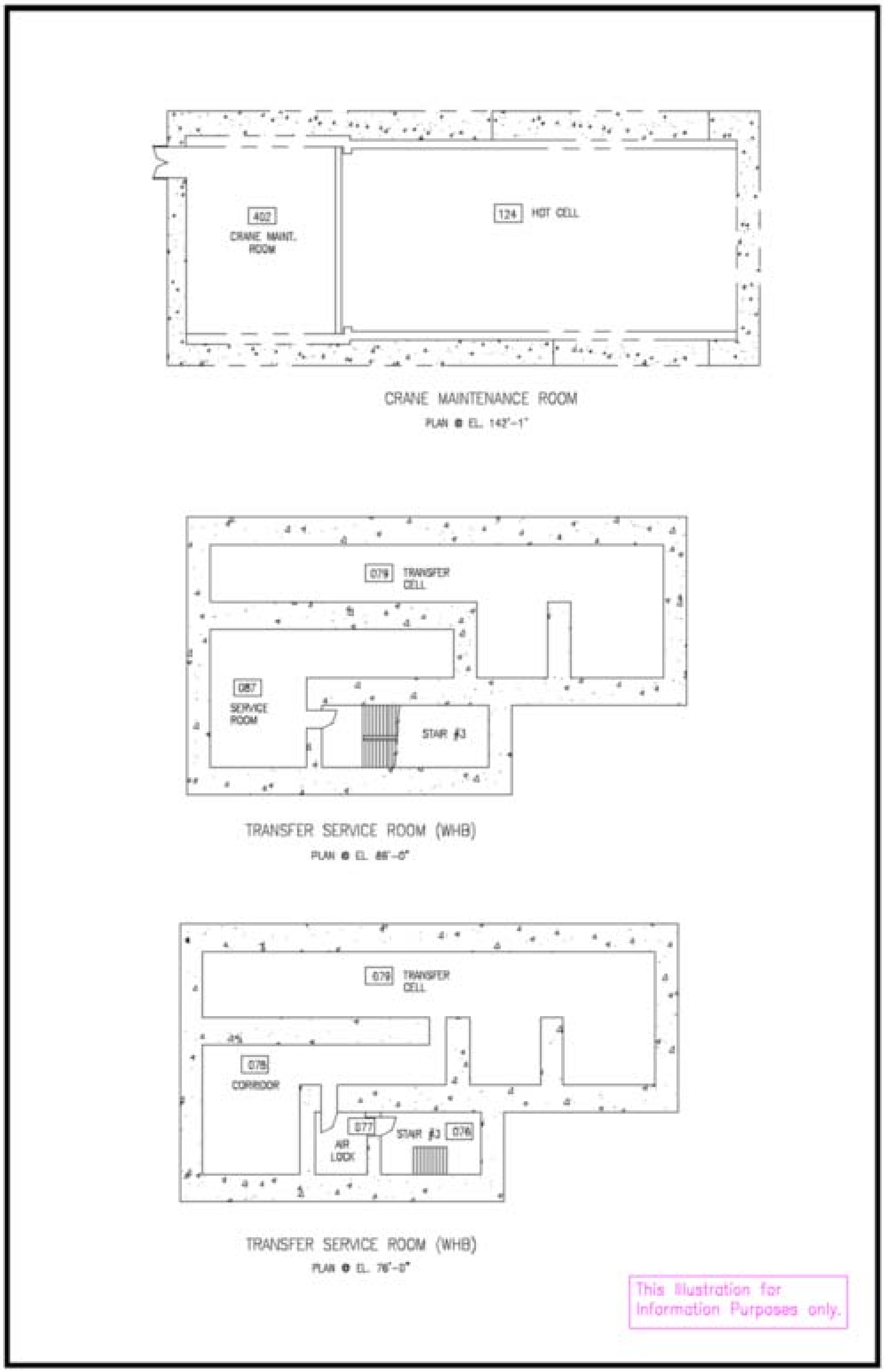

FIGURE HV II-2: Location of RH Areas Served by HV02 HVAC (Cont'd)

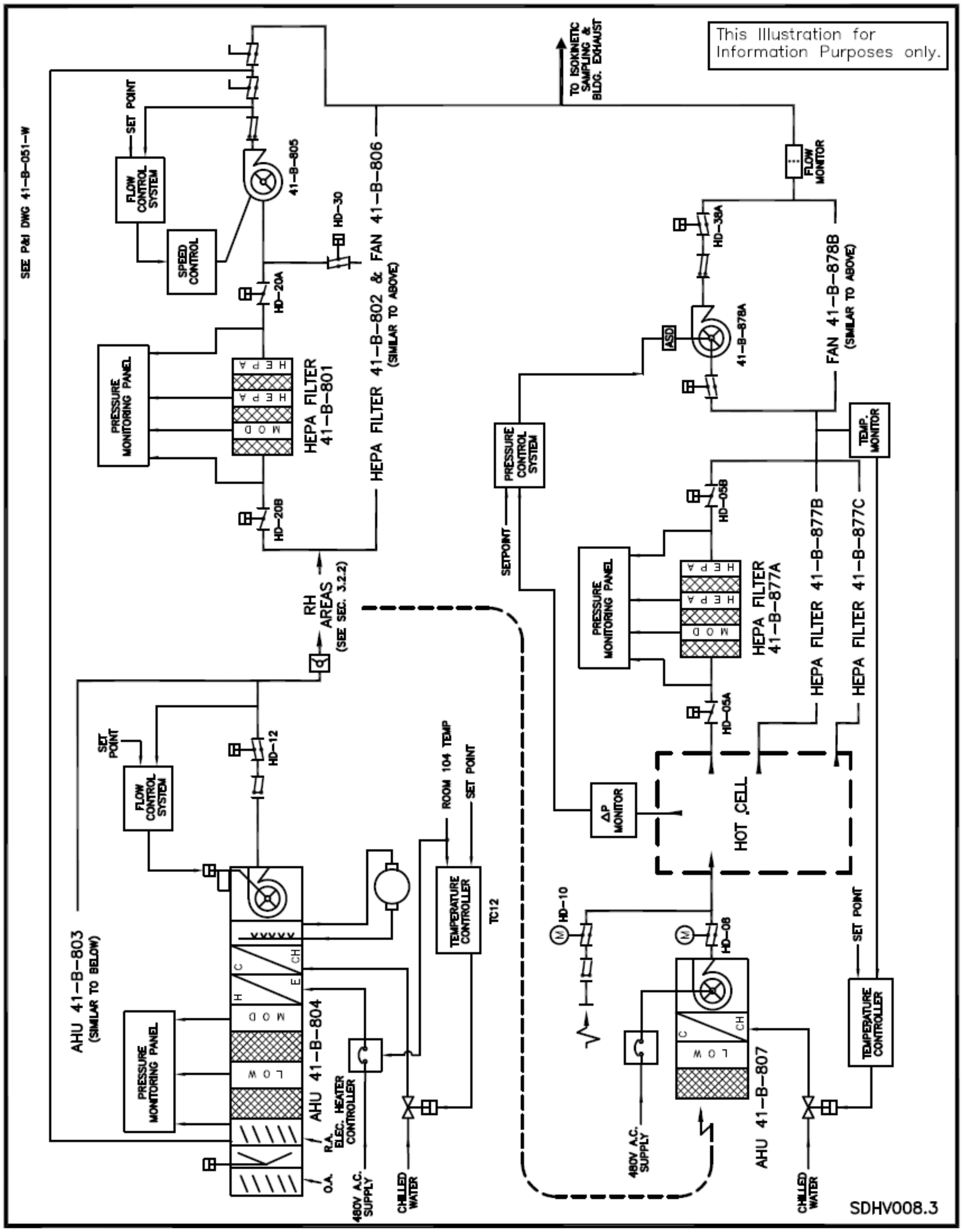

FIGURE HV II-3: Subsystem HV02 RH Areas Block Diagram

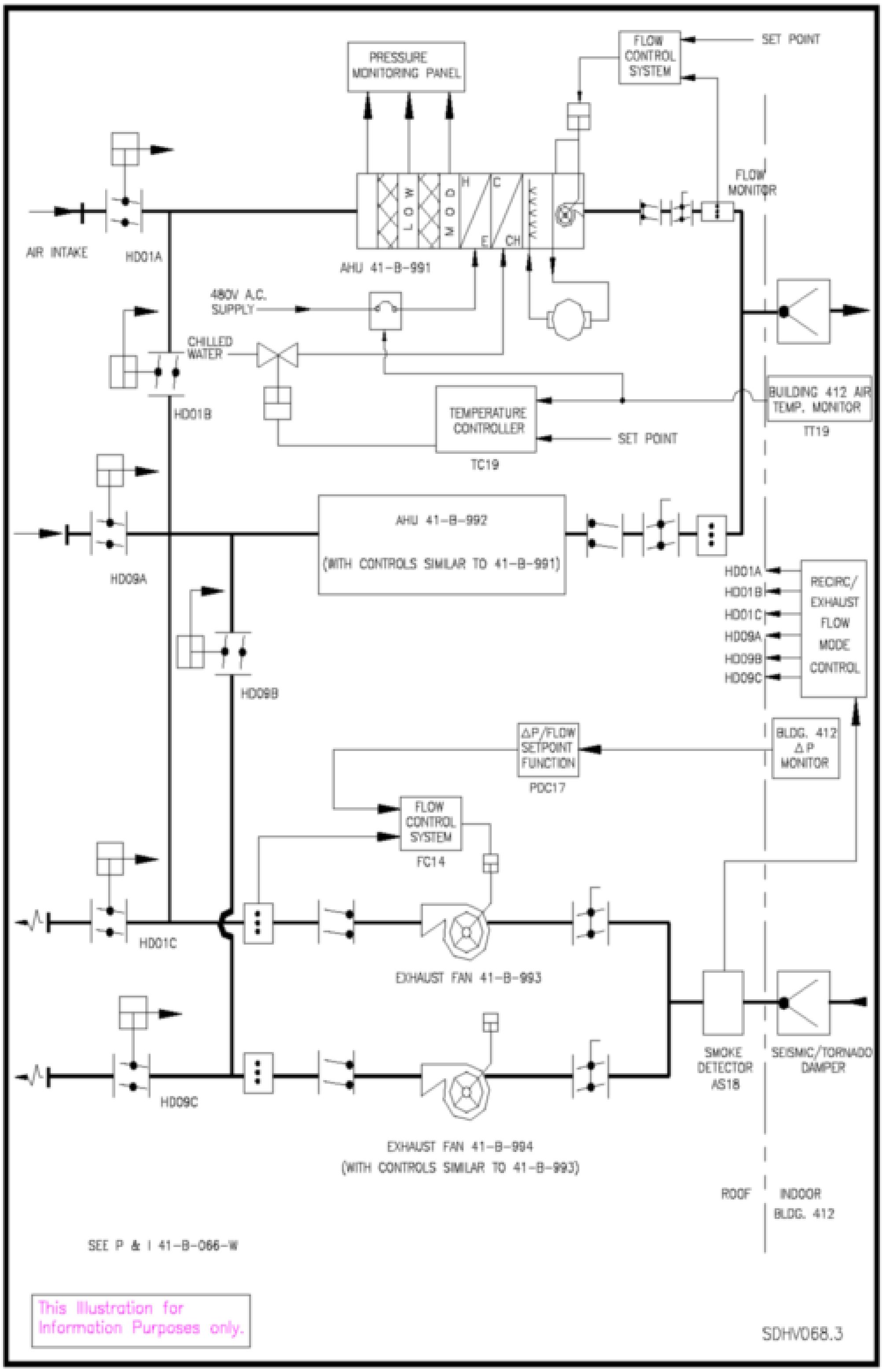

FIGURE HV II-4: Subsystem HV02 TRUPACT Maintenance HVAC Block Diagram

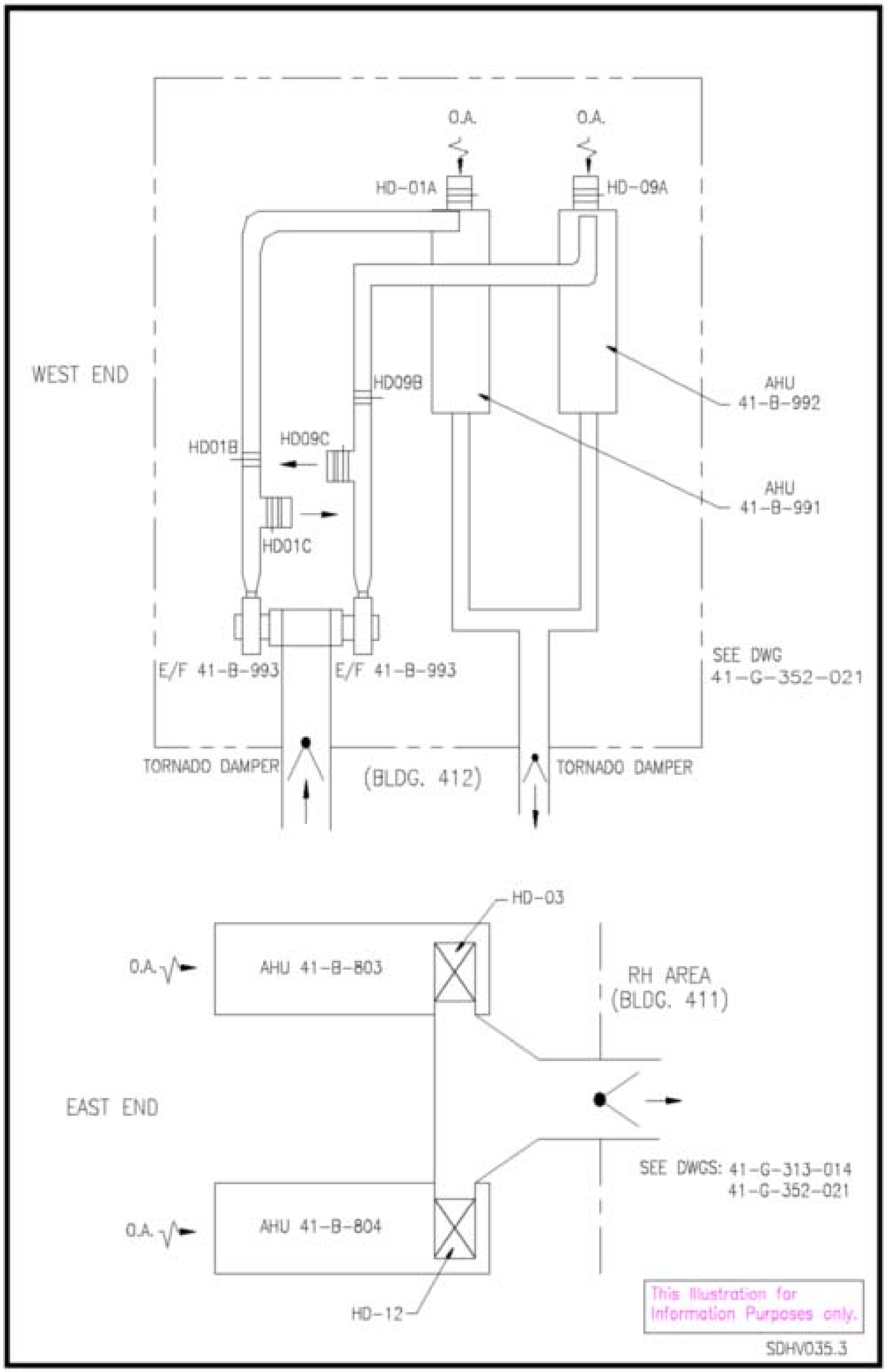

FIGURE HV II-5: Roof Layout of HV02 Components

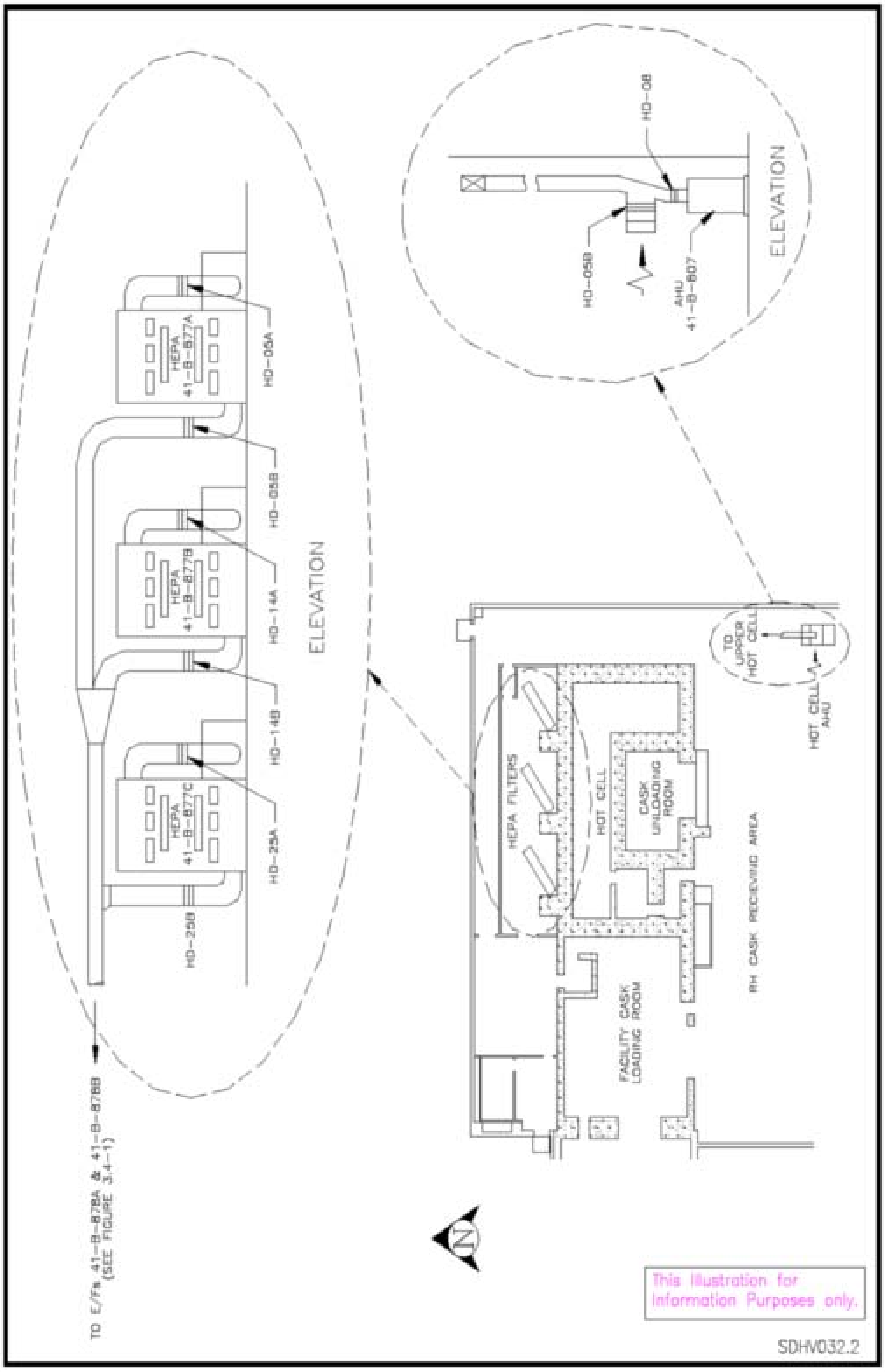

FIGURE HV II-6: Layout of HV02 Hot Cell HVAC Components at the WHB 100' Level

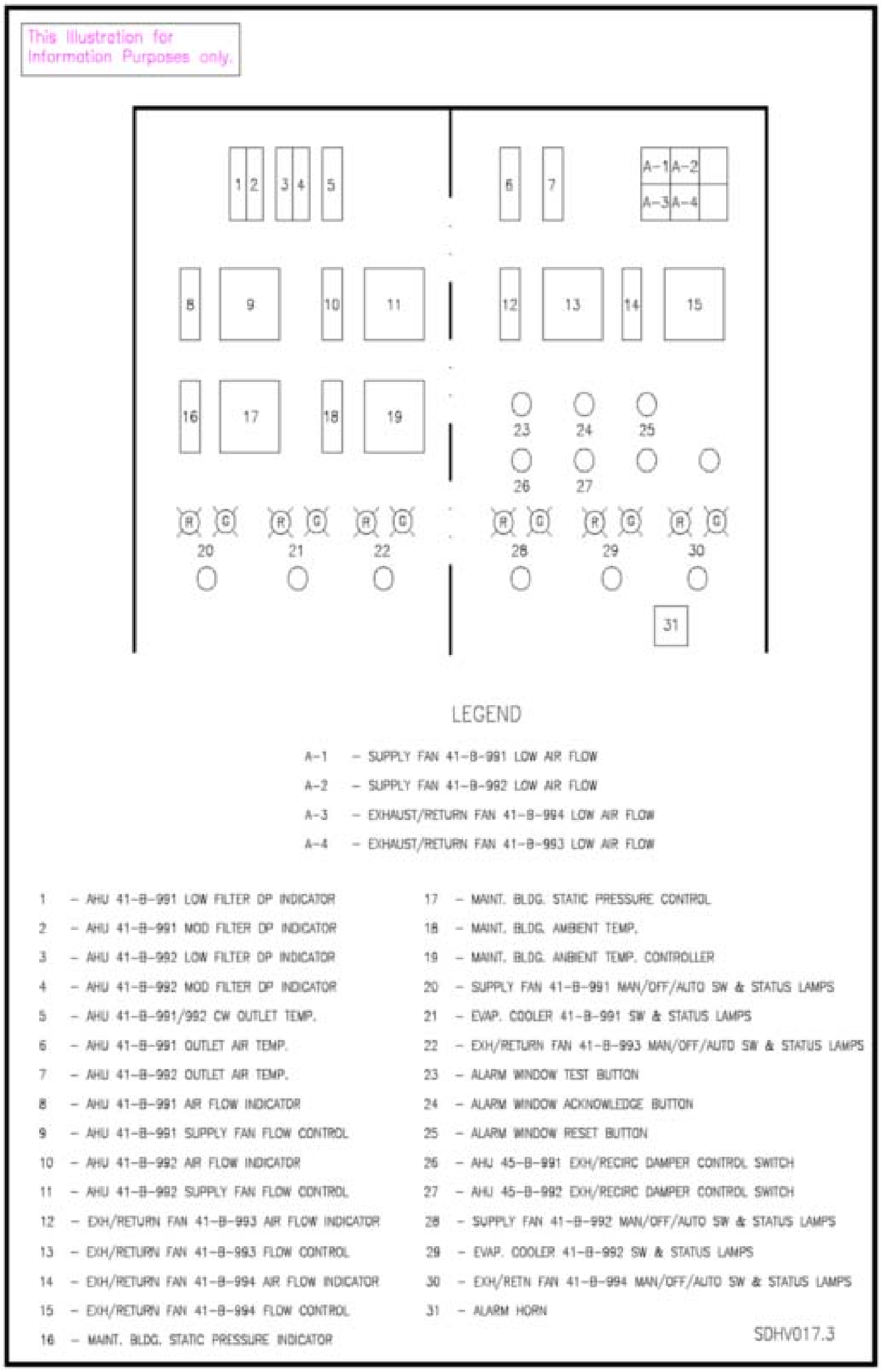

FIGURE HV II-7: TRUPACT Maintenance Facilities HVAC Control Panel 412-CP-066-01 Layout

Chapter III

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Chapter III

HV03 Support Building (Bldg. 451) HVAC

1.0 PRIMARY FUNCTIONS

Refer to Section 1.0 of Chapter G for the Primary Functions.

2.0 DESIGN REQUIREMENTS

2.1 General

Refer to Section 2.1 of Chapter G for the general design requirements.

2.1.1 Outdoor Design Conditions for CMR
(Remainder of SB refer to Chapter G.)

Outside Design Temperatures	
Design summer dry bulb	103˚ F (Note 1)
Design summer wet bulb	72˚ F (Note 1)
Design winter dry bulb	13˚ F (Note 2)

Notes

1. 1% db and mean coincident wb.
2. 99% db

2.1.2 Indoor Design Conditions

The surface HVAC System shall be designed for indoor design temperatures, with the exception of the Hot Cell, as follows:

Indoor Design Temperatures (˚ F)		
Space	Winter (Min)	Summer (Max)
Support Building (SB)		
Offices and Conference Rooms	72	50
Locker Room	80	75 (Note 1)
CMR and Computer Room	(Note 2)	(Note 2)
Other Occupied Areas	65 - 72	80
Mechanical and Electrical Rooms	50	104
Instrument Shop	70 (Note 3)	70 (Note 3)

Notes

1. 75˚ F when occupied
2. Temperatures and relative humidity per equipment manufacturer's recommendations.
3. 50% relative humidity

2.1.3 Ventilation

Refer to Section 2.1.3 of Chapter G for the general ventilation requirements.

2.2 Subsystem General Requirements

2.2.1 The design temperature requirements for the areas inside the SB shall be in accordance with Sections 2.1.1 and 2.1.2.

2.2.2 Separate HVAC (HVAC) systems shall be provided for: the office areas, laboratory areas, locker rooms, CMR, and computer room.

2.2.3 SB air handling units shall contain two stages of air filters. If high levels of airborne radioactive contaminants are detected, outside air supply shall be forced through HEPA filters to permit the CMR to be maintained at positive pressure and limit the infiltration of radioactive contamination.

2.2.4 The CMR HVAC system shall be designed to provide for continuous personnel occupancy and satisfactory equipment operation during normal and emergency conditions. A 100% equipment redundancy (except the HEPA unit, booster fan, and ductwork) is required.

2.2.5 The HVAC equipment for the CMR and the computer room shall be designed to be capable of being switched to backup power on loss of offsite power.

2.2.6 Fume exhaust hoods and 2 stages of HEPA filters shall be provided for the laboratory to support its use in sample preparation. The laboratory shall be maintained at a negative static pressure relative to the surrounding rooms. The laboratory exhaust system shall not be designed to and shall not support analytical processes that release acid vapors.

2.3 Operational Requirements

Refer to Section 2.3 of Chapter G for the general operational requirements.

2.3.1 The design shall provide for the makeup air to the CMR to be directed through a HEPA filter to increase the CMR static pressure and reduce the infiltration of untreated outdoor air. Interface requirements shall be imposed upon the CMS to provide for the required signal processing and transmission functions.

2.4 Structural

Refer to Section 2.4 of Chapter G for the structural requirements.

2.5 General Arrangement and Essential Features

2.5.1 The major components of subsystem HV03 include:

a. Supply air handling units containing:

- Filters
- Chilled water coils (Not CMR and computer room)
- Electric heaters
- Supply fans

b. Supply HEPA filter unit (CMR and computer room only)

c. Exhaust and return air fans

d. Controls and instruments

2.5.2 Direct expansion units shall be provided for the CMR and Computer Room. Humidifiers shall be added as required. HEPA filtration is provided to treat makeup air during a radiological event.

2.5.3 Other Essential Features and Feature Specifications

Refer to Section 2.5.8 of Chapter G for other essential features and feature specifications.

2.6 Maintenance

Refer to Section 2.6 of Chapter G for the general maintenance requirements.

2.7 In-Service Inspections

Refer to Section 2.7 of Chapter G for the general in-service inspection requirements.

2.8 Instrumentation and Control

Refer to Section 2.8 of Chapter G for the general I&C requirements.

2.9 Interfacing Systems

2.9.1 General

Refer to Section 2.9.1 of Chapter G for the general interfacing system requirements.

2.9.2 Primary Interface

Refer to Section 2.9.2 of Chapter G for the primary interface general information and Appendix C-1 for primary interface requirements.

2.9.3 Secondary Interfaces

Refer to Section 2.9.3 of Chapter G for the secondary interface general information and Appendix C-2 for secondary interface requirements.

2.10 Quality Assurance

Refer to Section 2.10 of Chapter G for the quality assurance requirements.

2.11 Codes and Standards

Refer to Section 2.11 of Chapter G for Codes and Standards.

2.12 Reliability Assurance

For system redundancy, the HVAC system for the CMR shall be designed to have: two air handling units, two air cooled condensing units, and two return fans of 100% capacity each.

3.0 DESIGN DESCRIPTION

3.1 Summary Description

Refer to Section 3.1 of Chapter G for the summary description.

3.1.1 HVAC in the Support Building

The separate areas of the SB are served by HVAC systems which accommodate the following special requirements:

- Laboratory fume hoods are exhausted through HEPA filter assemblies located in the adjacent WHB mechanical room.
- In the event of detection of radioactivity in the effluent air from the waste handling areas the normal outside makeup air supply to the CMR is closed and makeup air is drawn through a HEPA filter assembly by a pressurizing fan.
- The differential pressure between the CMR and the outside atmosphere is maintained positive to eliminate uncontrolled infiltration.

- In the case of fire or smoke, duct mounted smoke detectors shut off the supply and exhaust/return fans.

3.2 Detailed System Description

The SB is configured into six HVAC zones as illustrated in Figure HV III-1.

3.2.1 Zones 1, 4, and 5

The HVAC for Zone 1 is illustrated in Figure HV III-2 and is typical for Zones 4 and 5. Figure HV III-6 and Figure HV III-7 illustrate Zones 4 and 5. These three zones are similar in design and arrangement. The only significant differences are the cooling and heating capacities of the units.

3.2.1.1 Supply Air

Air drawn into the AHU is a combination of outside air and returned air. Outside air is drawn through a modulating damper to the inlet of the AHU. Under normal return flow conditions this damper is partly open, under exhaust flow conditions it is fully open.

The supply fan draws air through low and moderate efficiency filters, a chilled water cooling coil. In the case of the laboratory system, air is drawn through low and moderate efficiency filters, a chilled water cooling coil and an electric heater. Electric heating coils are installed in some VAV terminals as determined by the system designers.

The AHU supply fan ASD motor control loops maintain a constant static pressure in the supply inlet duct. A back draft damper, a manually operated isolation damper, a sound attenuator, and a flowmeter are located in the supply duct from each AHU. A smoke detector is located in the return duct from each zone.

Air Distribution

Air is distributed to individual rooms from VAV terminal units located above the ceiling. The units used are of the induction type in which supply air is mixed with returned ceiling plenum air. Some of the VAV terminals are reheat type. Control of the dampers and electrical heaters in this equipment is through individual controllers connected to local thermostats.

3.2.1.2 Exhaust/Return Air

Exhaust/return fan can deliver air to either the outside atmosphere or to a return duct which connects to the AHU inlet by way of control dampers. Operation of these dampers, in conjunction with a damper located in the AHU inlet duct, allow either a return flow mode or an exhaust mode. The normal mode of operation is return flow.

3.2.2 Zone 2 HVAC in the Support Building

The HVAC for Zone 2, the SB laboratory area, is illustrated in Figure HV III-4.

Air is supplied to the laboratories through four VAVs , but only about 20% of this supply flow is returned.

The remainder of the air is exhausted through three fume hoods to HEPA filter assemblies via exhaust fans. The HEPA filter assemblies and exhaust fans are located in the WHB mechanical equipment room.

These fume hoods are the supply air type where outside air is supplied to the face of the hoods. These arrangements are described in the following sections.

3.2.2.1 Air Supply

Air is supplied from two AHUs located on the roof of the SB. Air is drawn through modulating dampers to the intake section of each AHU; then through a prefilter bank, a high efficiency bag filter section, an electrical heating coil and a chilled water cooling coil before entering the AHU supply fan. The chilled water supply valve and the electric heater are controlled in sequence by a signal from a high signal selector which receives the demand from thermostats in Rooms 119 and 124. A low temp selector provides a signal to the heater controller on the electrical heater section of each AHU. Two VAVs supply local heat.

While both AHUs are normally in operation, the availability of one AHU will still allow acceptable Zone 2 conditions subject to limited use of the laboratory fume hoods.

3.2.2.2 Fume Hood Air Supply

A separate air supply is provided to the fume hoods to minimize loss of conditioned room air. Each hood contains a supply fan that draws air through a filter unit located on the breeze way roof between the SB and the WHB. This unit is contains a pre-filter bank, a bag filter section, and an electrical heating coil.

Each fume hood is supplied with air which enters one side and is distributed evenly across the face of the hood. During operation of the fume hoods, room air is exhausted through the hood along with the hood supply air. The VAVs have sufficient capacity to provide the lab area with the required flow of conditioned air to maintain the design differentials pressure during fume hood operation.

3.2.2.3 Exhaust/Return Air

The room air that is not exhausted from the area is returned to the AHU where it is mixed with outdoor air to become supply to the zone. The main exhaust duct also contains a sound attenuator and a smoke detector. Each fan handles 50% of the normal design flow rate so that both are normally in operation.

3.2.2.4 Exhaust Fume Hoods

Exhaust air from the fume hoods is drawn through HEPA filter assemblies located in the mechanical equipment room in the WHB. This represents 50% of the design flow rate so that both filter units are normally in operation.

These exhaust fans discharge into the main WHB exhaust stack

3.2.3 Zone 3

The HVAC for Zone 3, the SB first floor east office area, locker room and electrical equipment room is illustrated in Figure HV III-5. Room 118 with a separate mechanical air conditioning unit is also included in Zone 3 and is not described further.

3.2.3.1 Air Supply

The AHU and supply arrangement for this zone is similar to other SB air handling systems. There is no heating coil in the Zone 3 AHU.

3.2.3.2 Exhaust/Return

This zone differs from the other zones in that the locker room area exhaust is provided by a separate exhaust fan. Under certain conditions, the system can be aligned to recirculate the locker room exhaust through an odor absorbing filter unit to reduce energy consumption.

Room 118 and Room 109 are each exhausted by separate exhaust fans.

3.2.3.3 Zone 6 HVAC

The HVAC for Zone 6 is illustrated in Figure HV III-8. This system serves the CMR on the second floor and Rooms 127 and 126 on the first floor. It has been designed so that, in the event that radiation is detected, outside air can be forced in through two HEPA filter assemblies by a pressurizing fan. The principal components consist of two AHUs, a HEPA filter, pressurizing fan and exhaust/return fans. All these components are mounted on the roof of the SB. To maintain the CMR HVAC system independent from the other SB systems, cooling is provided by direct expansion refrigerant cooling coils with remote condensing units.

- Air Supply Path to Zone 6 HVAC

The air supply and distribution for this zone is a VAV system and is similar to all other zones in the SB. The two air handling units and their condensing units provide 100% redundancy. In case one unit cannot operate, the other unit can be started to provide full cooling or heating. No unit is permanently designated as the backup unit. The system is powered off of the normal distribution system and has an alternate supply from the backup diesel driven generators.

- Pressurized Makeup Air

Should a signal from the CMS indicate high radiation levels as determined by EM01 requirements and configuration, the makeup air supply to Zone 6 can be diverted from the normal outside air intake to a pressurizing fan and HEPA filter assembly. This will increase the CMR static pressure to a point that is higher than normally maintained.

Air enters the HEPA filter through a modulating damper. This damper is closed and the pressurizing fan is not running during normal operation. In the filtration mode, the pressurizing fan is energized and the damper position is modulated to maintain a constant 430 cfm flow rate of makeup air.

- Air Distribution

This zone is similar to Zone 1. All VAV units in Zone 6 have electrical heating coils.

- Exhaust/Return Air

Exhaust return fans for Zone 6 are operated similarity as in the other zones in the SB. The exhaust/return fans are also sized for 100% capacity; with one fan in the standby mode.

3.2.4 General Operational Features

3.2.4.1 Common Features

The control interface for changing the various set points and other control parameters is the Graphical User Interface (GUI); more commonly known as a computer. Access to the system is controlled by passwords with assignable levels of permission. The computer displays a graphical representation of the physical equipment with "point and click" access to changeable parameters. There are no dials, gauges, or indicators for this system, and the only switches are "HAND-OFF-AUTO" located on the face of the panel that control fans or damper positions. All indicators such as temperature, flow, pressure, condition, and alarm status are shown on the GUI graphics. Additional details for system operation are contained in the control system manufacturer's operating manuals.

All SB HVAC zones have certain features that are common to all and operate the same. These features are optimal start, smoke detection, ventilation, hand switch interlocks, alarms, economizer mode, and discharge air temperature reset.

- Occupied and Unoccupied Modes

Occupied Mode is the normal operational configuration of the system. Unoccupied mode is a set point configuration on an occupancy schedule (schedule is set and changed at the GUI). For unoccupied operation, the heating setpoint is lowered and the cooling set point is raised for the purpose of energy conservation.

- Optimal Start

The optimal start sequence is a feature that the control program uses to adjust the unoccupied set points so that the building temperatures are at the proper value when the scheduled occupancy begins.

- Economizer Mode

Economizer cooling provides a signal to control AHU discharge air temperature with outside air when possible. When the outside air temperature drops below 52°F and the outside air humidity is 85% RH or less, air side economizer cooling is enabled. When the outside air temperature rises above 55°F, or when the enthalpy rises above 21.4 British Thermal Unit (BTU) per pound of dry air, the air side economizer cooling is disabled. All temperature and humidity settings are adjustable. (The enthalpy value is set by a condition equal to 55 F and 85% RH.) When at least one terminal unit is calling for cooling and the air side economizer is enabled, the system uses an air side economizer control algorithm for discharge air temperature control. The system modulates the Outside Damper (OD) and Exhaust Damper (ED) open, and the Return Damper (RD) closed as discharge temperature rises above set point. The system modulates the outside damper and ED closed, and the RD opens as discharge temperature drops below set point.

- Smoke Detection

Upon a detection of smoke by the zone's smoke detector located in the exhaust/return air duct, three actions are executed:

- The AHU fan and the Exhaust/Return Fan (ERF)(s) are stopped.
- The OD, ED, and RD are closed.
- All electric heaters in the zone are disabled.

Upon a detection of smoke, the smoke detector signal must be cleared before the system can be restarted. The purge mode controls can override the smoke detection system shutdown.

- Ventilation

Ventilation is a special operating condition forced by manual selection from a zone ventilation control located in the fire alarm panel for use by the fire department for smoke control. The purge mode overrides a smoke detection zone system shut down. When the system is in the purge mode, the OD and ED are full open, the RD is closed tight, the AHU fan is "on," and the ERF is "on." Additionally, all terminal boxes have the primary air dampers opened to allow the delivery of schedule maximum airflow. The AHU fan is controlled to deliver designed airflow. The ERF is controlled to match the flow rate of the AHU fan.

- Hand Switch Interlocks

Hand switches are software interlocked with the automatic controls to allow manual overrides. Hand switches interfaced with adjustable speed drives allows the operator to start a drive manually. The hand switch cannot override safety contacts. The drive speed, when the drive is manually started, is either by the automatic signal from the Building Automation System (BAS) controls or by manual selection locally at the ASD. The drive is programmed to allow the speed selection as described. A hand switch is integrated into the control of the outside, return, and exhaust air dampers.

- Alarms

Loss of Air Flow

When either the AHU fan or the ERF is commanded to start, a 30-second (adjustable) time delay is initiated. Additionally, fan airflow is monitored and compared to a low limit set point. If at the end of the time delay (or anytime following the end of the time delay), the airflow is not above the low limit value, an alarm message is generated to the GUI and the fan is commanded "off." When a system fans fails due to loss of airflow, the system is placed in the normal unoccupied mode of operation until the fan is reset and restarted by an operator.

- Smoke Detection

Upon the detection of smoke by a duct mounted smoke detector. The system is shut down as described above, and indicates an alarm condition at the GUI. Once the signal has been generated, the alarm signal must be cleared. The alarm message must be acknowledged and the system must be restarted before normal operation can be resumed.

High Discharge Temperature AHU

The control system continually monitors the discharge temperature of the AHU. If the discharge temperature should rise 5 F above the discharge air temperature set point during an occupied mode of operation, the control system indicates an alarm condition at the GUI.

Low Discharge Temperature AHU

The control system continually monitors the discharge temperature of the AHU. If the discharge temperature should drop below 40 F, the control system indicates an alarm condition at the GUI.

Low Space Temperature AHU

The control system continually monitors all space temperature. If the space temperature should drop 3 F below set point during occupied times or 5 F below the night-set back set point during unoccupied times, the control system indicates an alarm condition at the GUI.

High Space Temperature AHU

The control system continually monitors all space temperature. If the space temperature should rise 3 F below set point during occupied times or 5 F above the night-set forward set point during unoccupied times, the control system indicates an alarm condition at the GUI.

High Differential Pressure Drop Across the Filter Bank

When the pressure drop across a monitored filter bank exceeds the scheduled allowable pressure drop, an alarm message is indicated at the GUI.

3.3 System Performance Characteristics

3.3.1 General

This section provides a description of the system performance characteristics under the various normal and infrequent operating modes and off-normal operating conditions.

3.3.2 Normal Operation

3.3.2.1 HVAC Systems for SB Zones 1, 3, 4, and 5 (General Office and Locker Room)

Under normal conditions, the systems will be operated in the automatic mode. These systems supply properly conditioned air to normally occupied areas of the SB. They can be shut down automatically during periods of non-occupancy and will restart by signal from the installed system timer.

3.3.3 HVAC System for Support Building Zone 2 (Office and Laboratory)

Zone 2 contains office rooms and laboratory rooms with fume hoods. Under normal conditions, the system will be operated in the automatic mode. The system can automatically reduce its capacity by 50% during off-shift periods on signal from a timer, while maintaining a negative pressure in areas of concern.

The entire area was originally designed as a radiological chemistry lab, and therefore, the ventilation system contains design features to reduce the potential release of airborne radioactive material. The HVAC system will maintain an indoor subatmospheric pressure to ensure that the air flow is from the clean area to the areas of potential contamination. The exhaust air from this area is continuously filtered through HEPA filter assemblies and exhaust fans located in the mechanical equipment room. It is then released to the outside atmosphere via the WHB exhaust stack.

The laboratory area fume hoods, operated from individual on/off switches, will operate only when at least one of the two exhaust fans is operating. Fresh air for the fume hoods is supplied through a filter unit.

3.3.4 HVAC System for Support Building Zone 6

Under normal operation conditions, the SB Zone 6 HVAC system provides the proper environment for personnel occupancy and for satisfactory operation of the CMS equipment in the CMR and computer room. Zone 6 also provides environmental control for an office area on the first floor of the SB which was the former instrument test lab.

During normal operation, the system operates at 100% capacity 24 hours a day, to maintain the required temperature and humidity levels. The standby HVAC unit will start automatically when there is low or no air flow from the primary unit.

During normal operation, outside makeup air and return air are filtered, through a two stage filtration unit consisting of one low-efficiency and one high-efficiency filters, and conditioned before being distributed to the various rooms. The HEPA filtration train is bypassed.

3.3.5 Off-Normal Operation

3.3.5.1 HVAC Systems for Support Building Zones 1, 3, 4, and 5

There are no safety implications with regard to any off-normal operation conditions of these systems.

3.3.6 HVAC System for Support Building Zone 2

There are no safety consequences involved under any off-normal operating conditions of this system. Further, in the event of a single active component failure, the system can continue to operate on one of the redundant trains.

3.3.7 HVAC System for Support Building Zone 6

In addition to the functions under normal operation conditions discussed above, the SB Zone 6 HVAC system also provides HEPA filtered outside air to the CMR and computer room in the event of a release of airborne radioactivity to the environment.

In the event of a release of airborne radioactivity from the WHB as detected at Station C Continuous Air Monitor (CAM), the outside makeup air supply will be directed through the HEPA filtration train on a signal from the CMS. Filtered makeup air to the CMR and computer room will be maintained. The initiation of this ventilation mode can be automatic based on or manual as determined based on a high radiation signal at Station C.

In the event of a single active component failure in the operating primary HVAC unit, the 100%-capacity standby unit will start automatically and continuous HVAC service to the area will be maintained.

In the event of a loss of offsite power, the supply and exhaust air handling systems can be manually connected to the backup power system for continued operation. There will be no safety consequences involved.

3.4 Heating, Ventilation and Air Conditioning System Arrangement

3.4.1 Layout of Subsystem HV03 (Support Building) Equipment

With one exception all major HV03 components are located on the roof of the SB. The sole exception consists of the two HEPA filter and exhaust fan units for Zone 2 (SB laboratory area) which are located in the west half of the mechanical equipment room in the WHB. Layout of these units is shown in Figure HV III-9.

Figure HV III-9 shows the layout of the major components for the six Zones of Subsystem HV03 on the roof of the SB. These consist of AHUs, ducts, control dampers and intake and exhaust grills. Two air cooled condensing units, provide refrigerant for the two AHUs in Zone 6. All other AHUs have cooling supplied from the chilled water system.

A roof-mounted odor absorber filter handles effluent air from change rooms, washrooms and other areas subject to the release of noxious odors.

Subsystem HV03 control cabinets are identified in Table HV III-1 and their location in the second floor electrical room in the SB is shown in Figure HV III-10.

3.5 Component Design Description

Refer to Section 3.5 of Chapter G for typical HVAC component design descriptions.

3.6 Instrumentation and Control

3.6.1 Subsystem HV03 Control Equipment

Each of the six zones in the SB HVAC (Subsystem HV03) is controlled from individual control panel. All six panels are located in the second floor mechanical/electrical equipment room. The equipment controlled by each panel and the drawings which describe it are listed in Table HV III-1.

TABLE HV III-1: Scope and Description of HV03 Control Panels

Zone	Panel Number	Equipment Controlled		
		AHU	Exh Fan	HEPA Filter
1	451-CP-051-33	41-B-101	45-B-102	-
2	451-CP--053-35	45-B-112 45-B-113 45-B-140	41-B-114 45-B-118 45-B-119	- - 45-B-116 45-B-117
3	451-CP-052-34	45-B-105	45-B-106 45-B-107	45-B-109*
4	451-CP-054-37	45-B-120	45-B-121	-
5	451-CP-055-38	45-B-125	45-B-126	-
6	451-CP-056-36	45-B-130 45-B-131	45-B-136 45-B-137	45-B-134

* 45-B-109 is an odor absorber filter assembly and not a HEPA assembly.

The following sections describe the content and layout of the individual panels identified in Table HV III-1.

All control panels contain the following control features:

Digital electronic control modules with their associated transformers, fuses, and wiring. There are no devices within the control panels that require periodic adjustment or calibration.

3.6.2 Subsystem HV03 Flowmeter Configuration

All HV03 flow meters are stack velocity transducers, with the exception of the instrument monitoring exhaust fans 45-B-118 and 45-B-119; this sensor is the KURZ EVA type, fitted with a single probe. Panel location and sensor and probe arrangement for these instruments are described in Table HV III-2.

TABLE HV III-2: Flowmeter Configuration in Subsystem HV03

Zone	KURZ Panel No	Flow Measured	Flow Ind Panel
1	451-CP-100-01	AHU 41-B-101	451-CP-051-33
		Exh Fan 45-B-102	
2	451-CP-100-01	AHU 45-B-112 & 113	451-CP-053-35
		Exh Fan 41-B-114	
		E/F45-B-118 & 119	
3	451-CP-100-01	AHU 45-B-105	451-CP-052-34
		Exh Fan 45-B-106	
		Exh Fan 45-B-107	
4	451-CP-100-01	AHU 45-B-120	451-CP-054-37
		Exh Fan 45-B-121	
5	451-CP-100-01	AHU 45-B-125	451-CP-055-38
		Exh Fan 45-B-126	
6	451-CP-100-01	AHU 45-B-130 & 131	451-CP-053-35
		Exh Fan 45-B-135	
		E/F 45-B-136 & 137	

3.7 System Interfaces

Refer to Appendix C of Chapter VIII and Section 3.7 of Chapter G for primary and secondary interface information.

4.0 OPERATION

Operation of the SB HVAC system is outlined in terms of the six zones which it comprises. These zones also form the basis of the system, and I&C descriptions contained in Section 3.2 of this chapter.

Refer to WIPP Site Controlled Operation Procedure for HV03 for operational sequences and prerequisites

5.0 SYSTEM LIMITATIONS, SETPOINTS, AND PRECAUTIONS

5.1 Conditions for Maintaining Operations Limits and Alarms

The conditions for maintaining operations of the HVAC system are described in Section 3.3. Setpoints and alarms which arise from these conditions are as follows:

5.1.1 SB Zone 1

The supply duct static pressure shall be maintained at 1.5" wg.

Supply flow rate: Approximately 9,000 cfm.

Room Temperature Controls : Set at 74 F, nominal year round.

5.1.2 SB Zone 2 (Laboratory Area)

The supply duct static pressure shall be maintained at 1.5" wg.

Exhaust/recirculation fans maintain the room static pressure +0.05" wg.

Room Temperature Controls: Set at 74 F, nominal year round.

Fume Hood Exhaust fan flows are controlled to maintain the DP in the laboratory areas at -0.05"wg.

5.1.3 SB Zone 3 (First Floor East side)

The supply duct static pressure shall be maintained at 1.5" wg.

Room Temperature Controls: Set at 74 F, nominal year round.

Exhaust/recirculation fan maintain the room DP at +0.05" wg.

Locker Room exhaust fan flow is set to maintain the DP in the locker room at -0.05" wg.

5.1.4 SB Zone 4 (Second Floor West side)

The supply duct static pressure shall be maintained at 1.5" wg.

Room Temperature Controls: Set at 74 F, nominal year round.

5.1.5 SB Zone 5 (Second Floor Center)

The supply duct static pressure shall be maintained at 1.5" wg.

Room Temperature Controls: Set at 74 F, nominal year round.

5.1.6 SB Zone 6 (Second Floor CMR Area)

The supply duct static pressure shall be maintained at 1.5" wg.

Supply flow rate: Approximately 9,000 cfm.

Room Temperature Controls: Set at 74 F, nominal year round.

The pressurizing fan shall maintain a flow rate of 430 cfm through the HEPA filter assembly when it is activated.

Exhaust/recirculation fans shall maintain the computer room at +0.1" wg.

5.1.7 HV03

All major AHU supply and exhaust/return fans are provided with low-flow alarms which operate at the nominal values in cfm listed below. Since supply air flow is controlled to maintain a set duct static pressure, these flow rates can vary noticeably.

Zone	Air Handling Units		Exhaust/Return Fans	
1	45-B-101	2,000	45-B-102	3,500
2	45-B-112/113	1,000	45-B-114/115	70
			45-B-118/119	1,000
3	45-B-105	3,500	45-B-106	1,000
			45-B-107	2,000
4	45-B-120	1,700	45-B-121	1,500
5	45-B-125	1,500	45-B-126	1,500
6	45-B-130/131	1,000	45-B-136/137	900

The HEPA Stage 1, HEPA Stage 2, and the exhaust MOD efficiency filters (where supplied) in the HEPA filter assemblies in SB Zones 2 and 6 are provided with high differential pressure alarms activated at setpoints of 3.0", 3.0", and 1.0" wg respectively.

Refer to Section 5.4 and 5.5 of Chapter G for the general information regarding HVAC system interlocks and HVAC/Chilled Water systems precautions.

6.0 OFF-NORMAL EVENTS AND RECOVERY PROCEDURES

The following list of off-normal events apply to the SB and its HVAC systems. Refer to Section 6.0 of Chapter G for a discussion of the off-normal events and the associated recovery procedures.

- Loss of Electrical Power
- Fire

7.0 MAINTENANCE

Refer to Section 7.0 of Chapter G which presents maintenance requirements for HVAC equipment.

FIGURE HV III-1: HV03 Zone Boundaries for Support Building HVAC

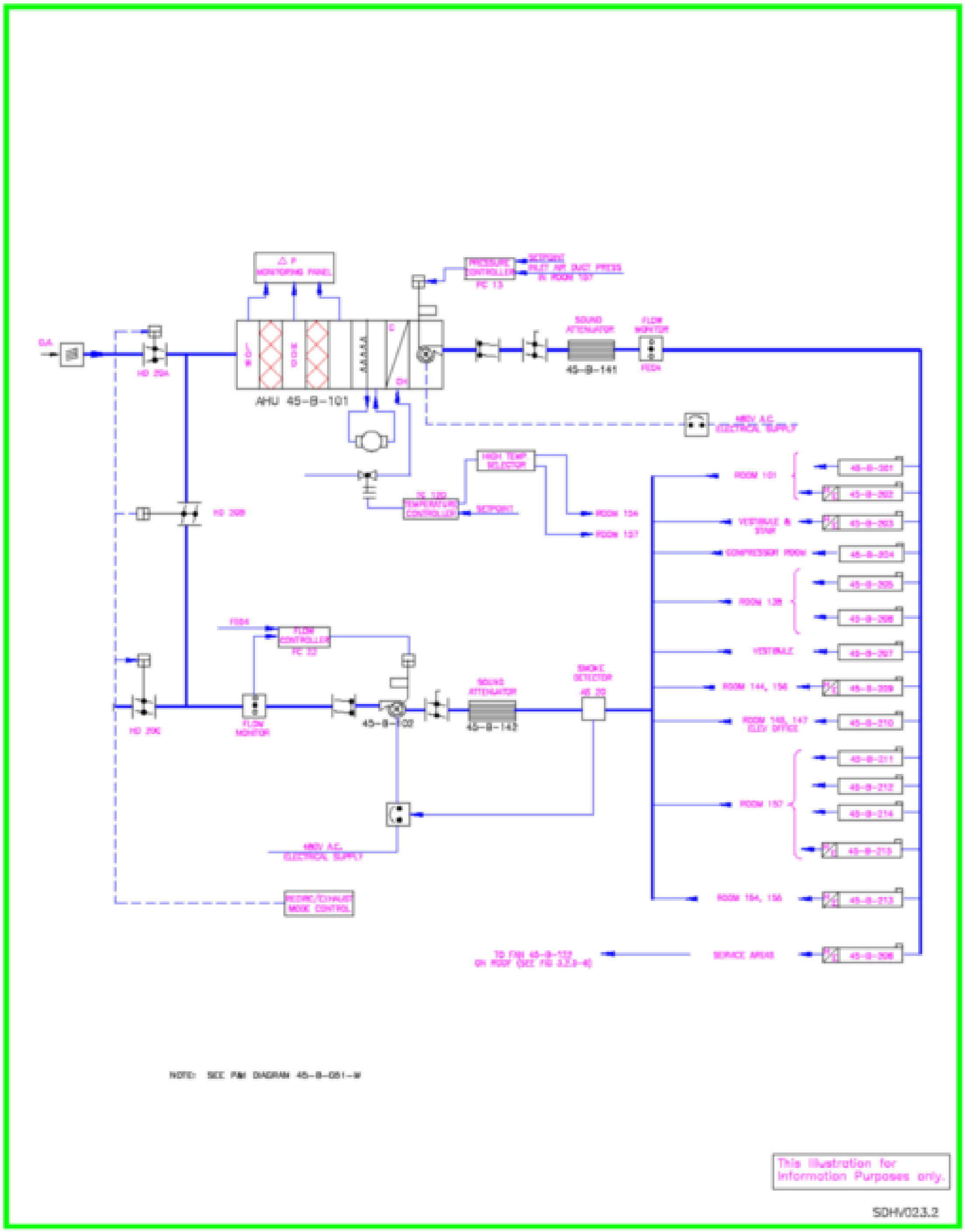

FIGURE HV III-2: HV03 Support Building Zone 1 First Fl. West HVAC Block Diagram

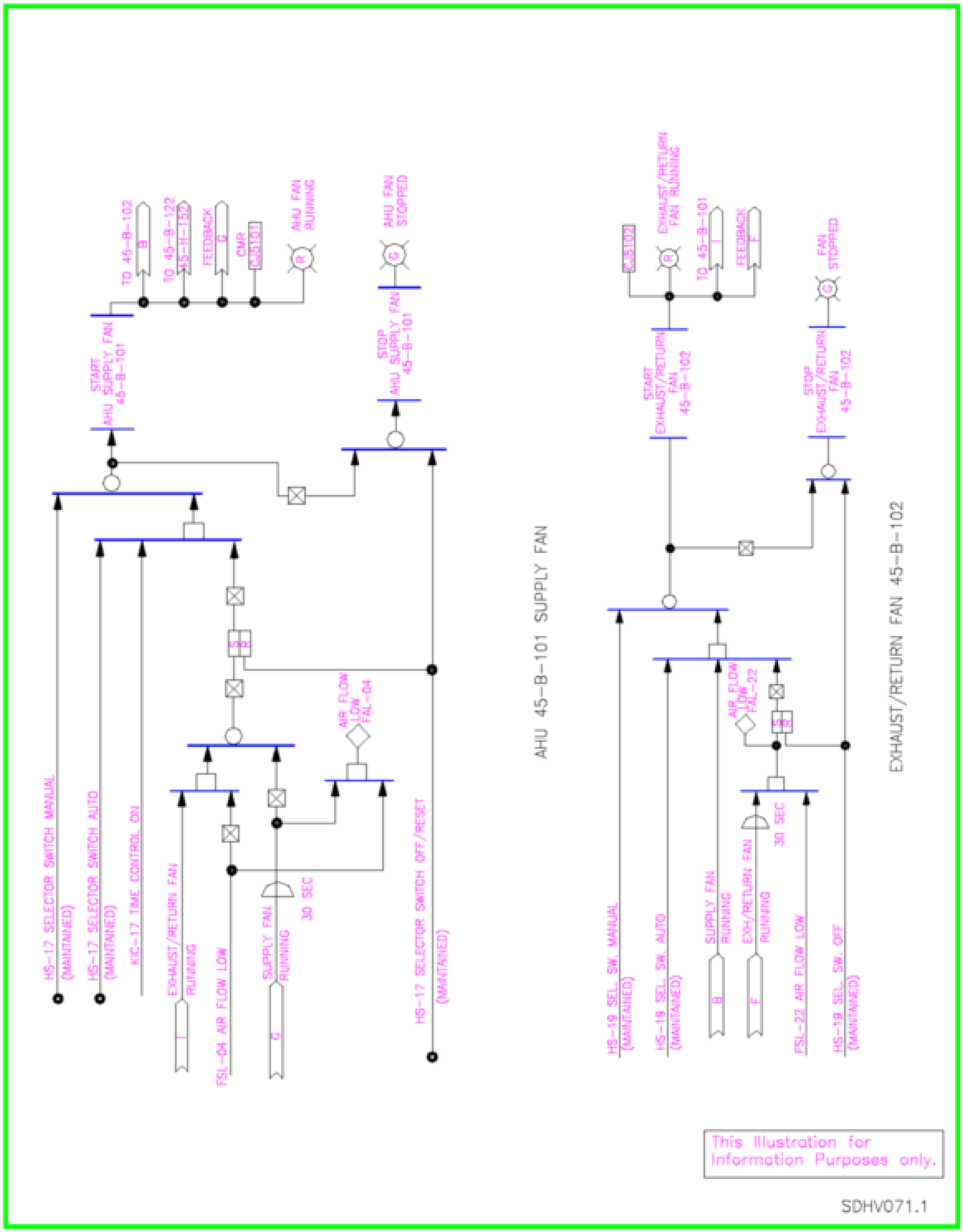

FIGURE HV III-3: HV03 Support Building Zone 1 HVAC Logic Diagrams

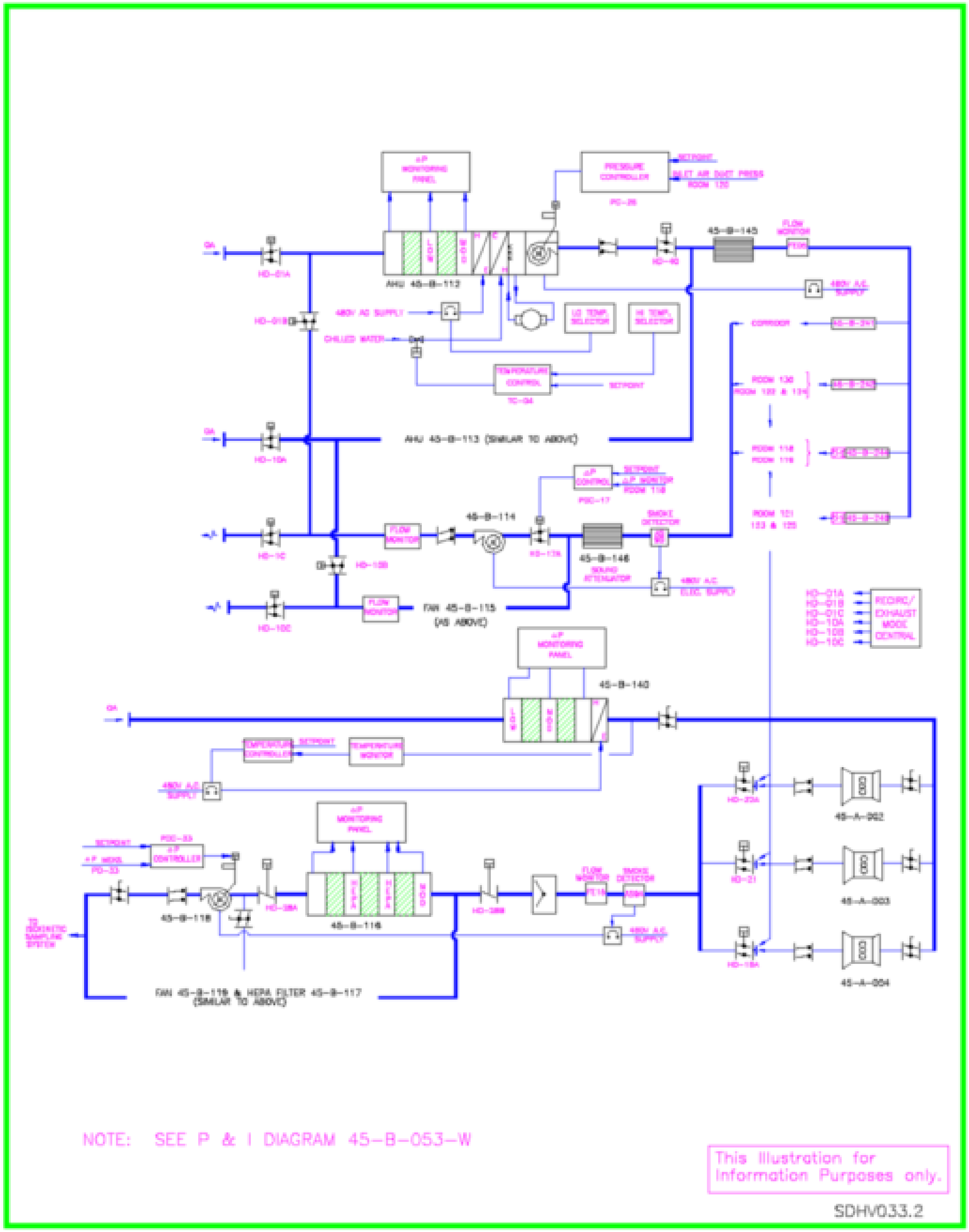

FIGURE HV III-4: HV03 Support Bldg., Zone 2 Laboratory HVAC Block Diagram

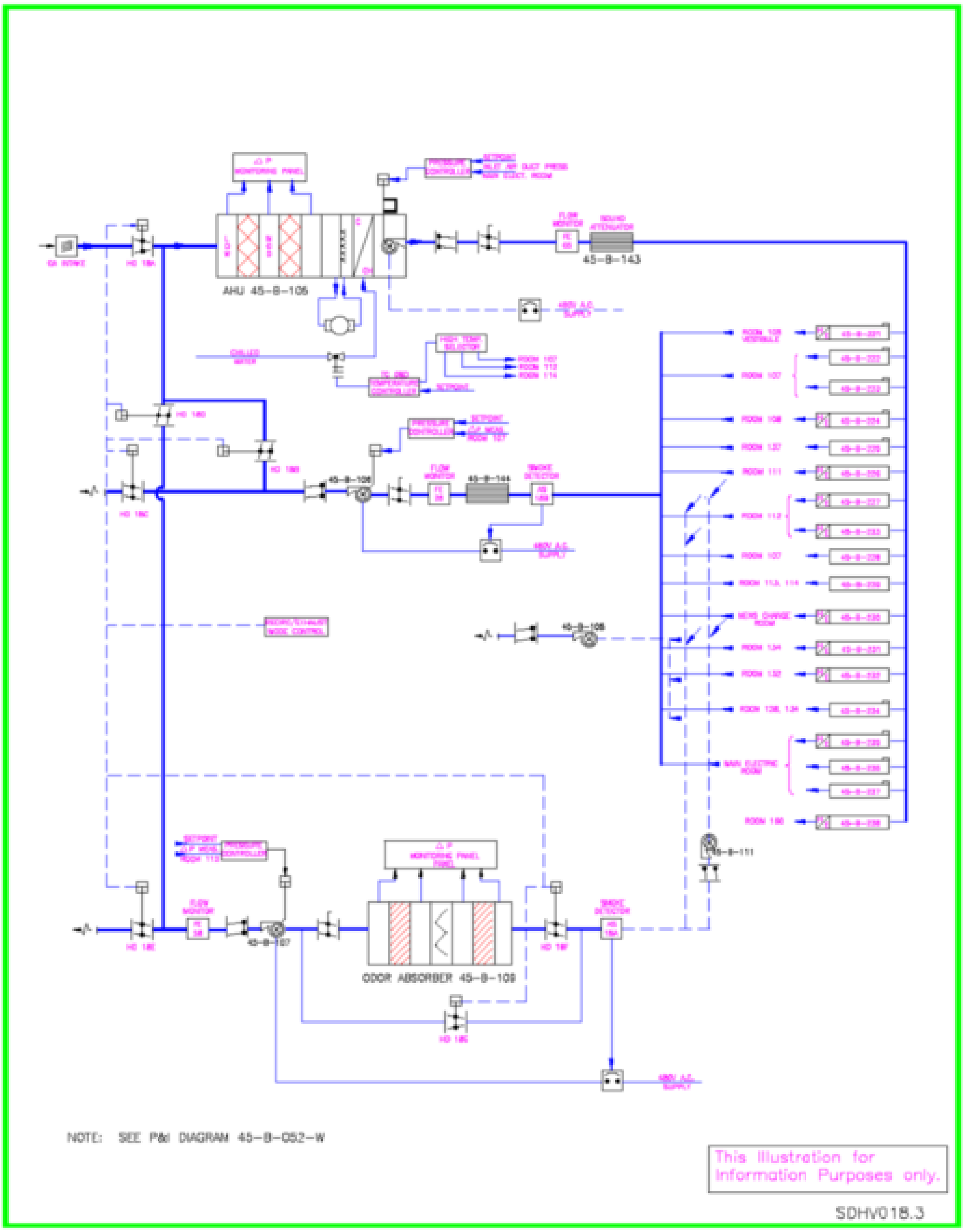

FIGURE HV III-5: HV03 Support Bldg. Zone 3 First Fl. East HVAC Block Diagram

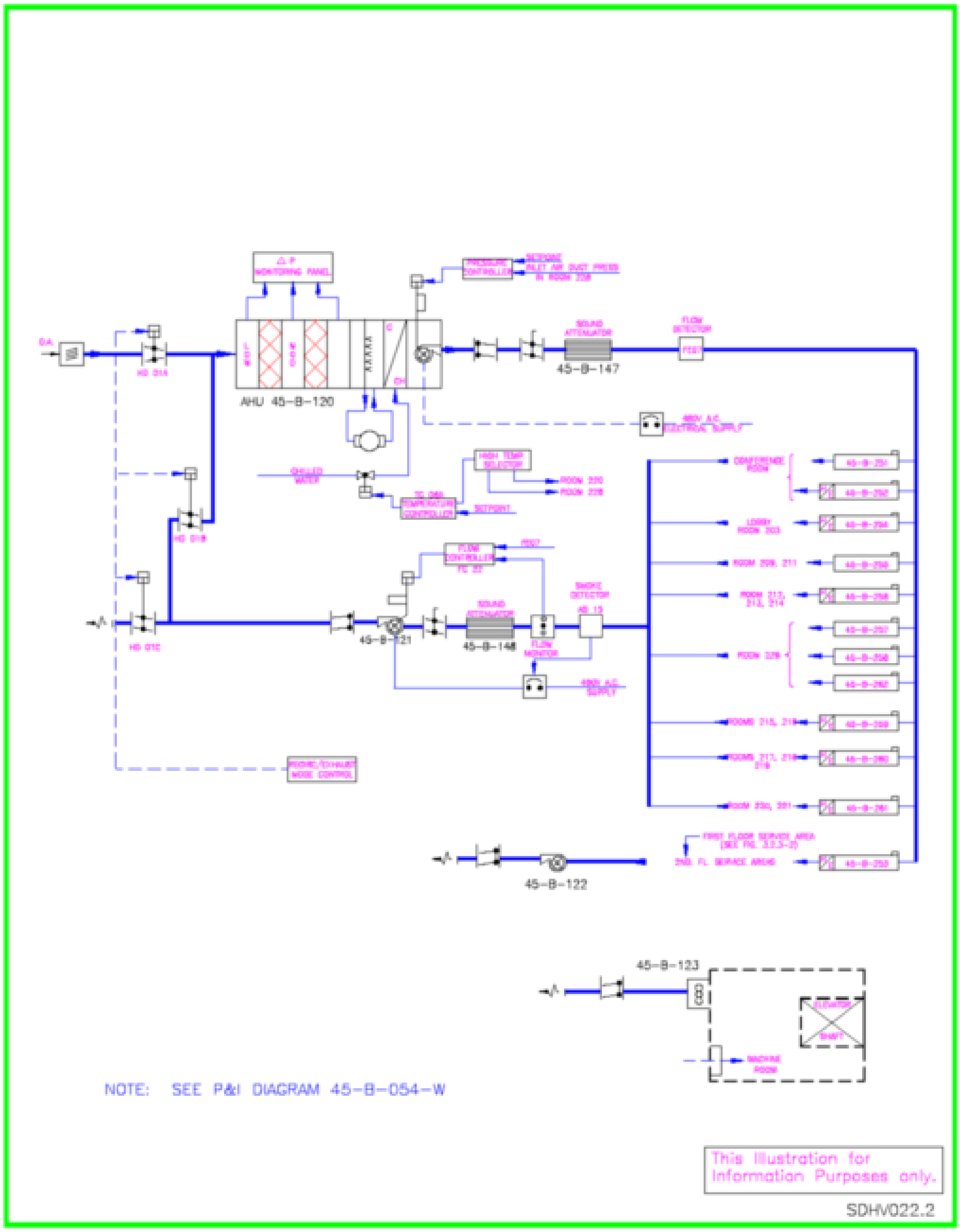

FIGURE HV III-6: HV03 Support Bldg. Zone 4 2nd Fl. West HVAC Block Diagram

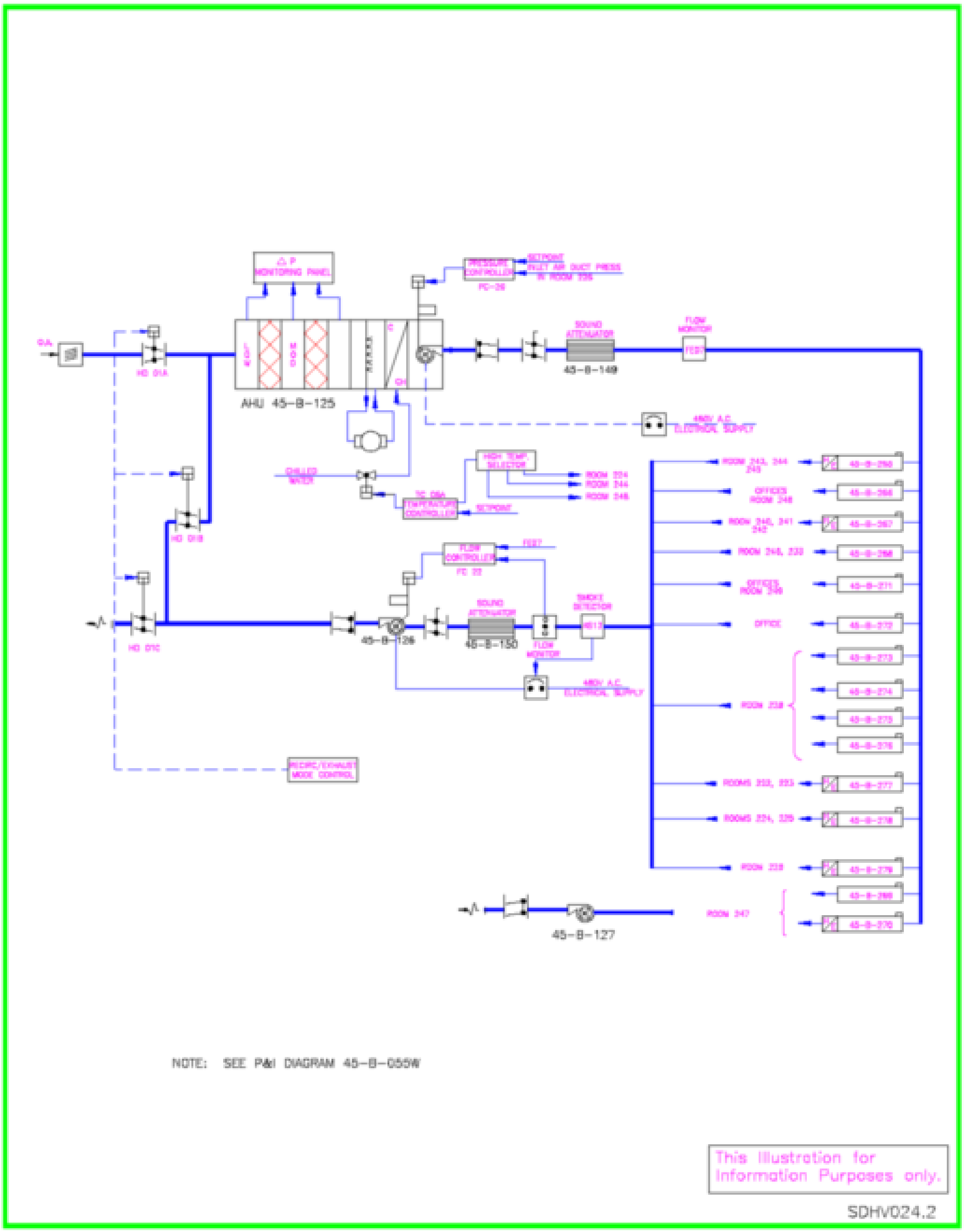

FIGURE HV III-7: HV03 Support Bldg. Zone 5 2nd Fl. East HVAC Block Diagram

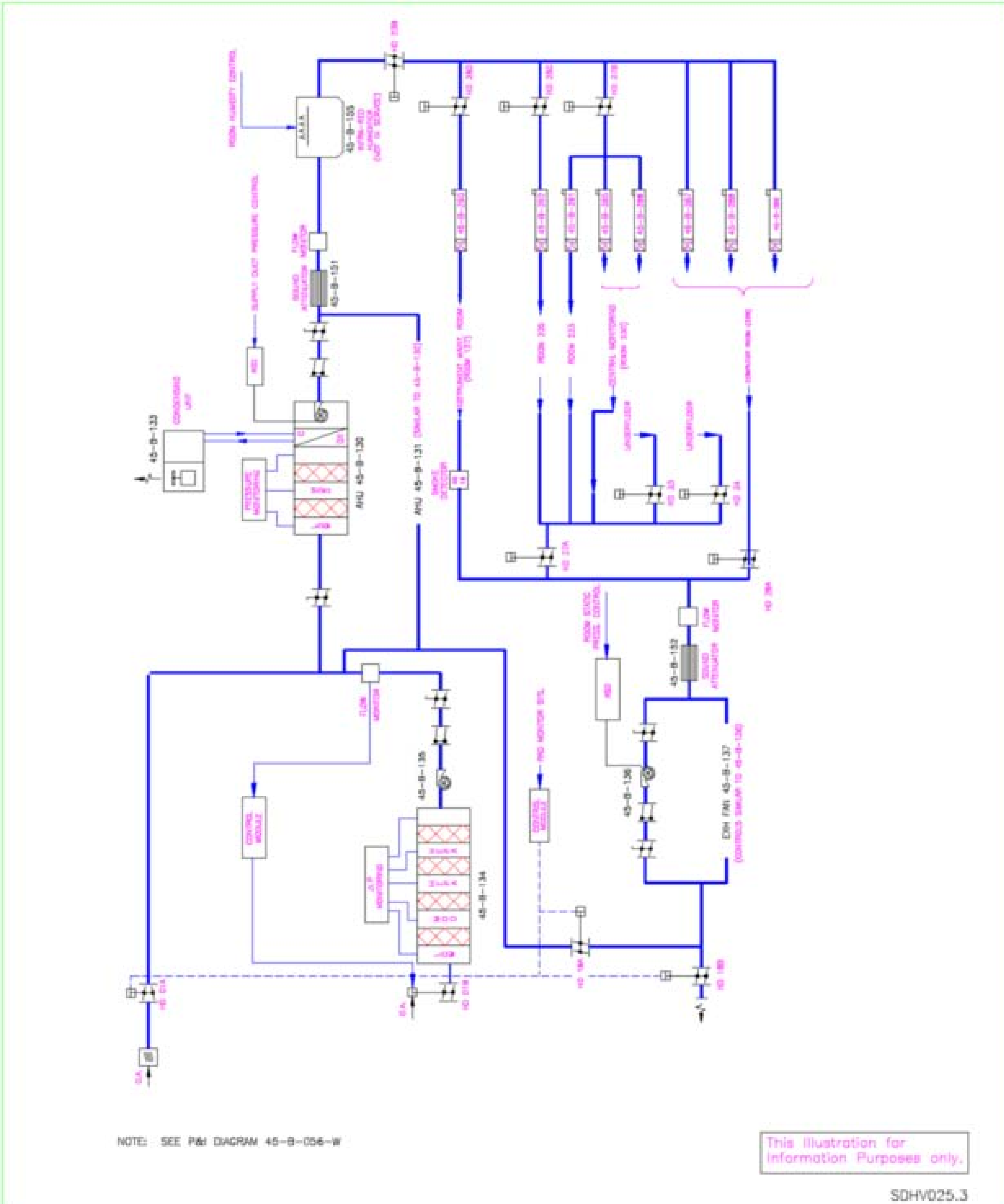

FIGURE HV III-8: HV03 Support Bldg. Zone 6 CMR & Instr. Shop HVAC Block Diagram

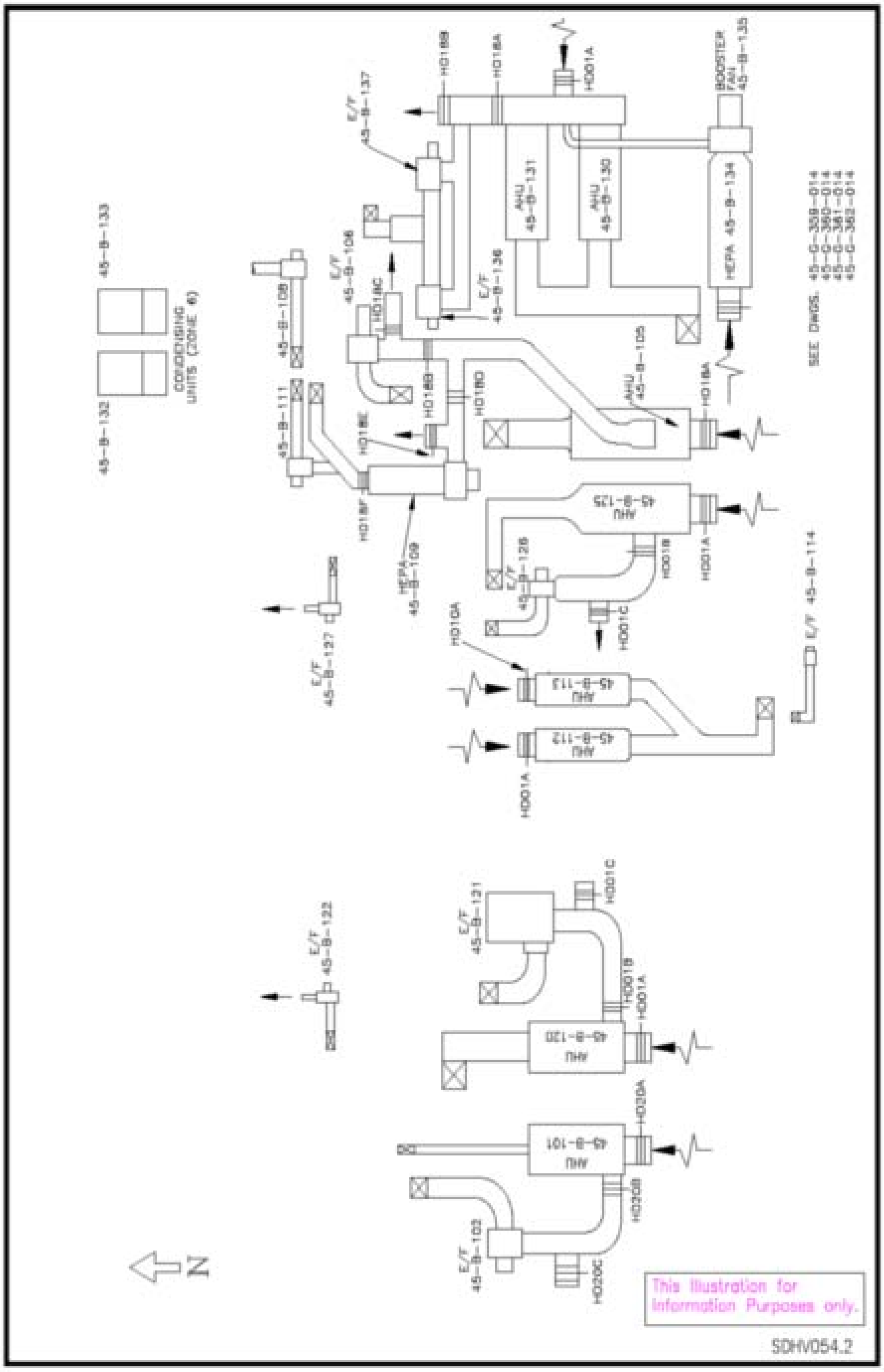

FIGURE HV III-9: Layout Plan of HV03 Components on Roof of Support Bldg.

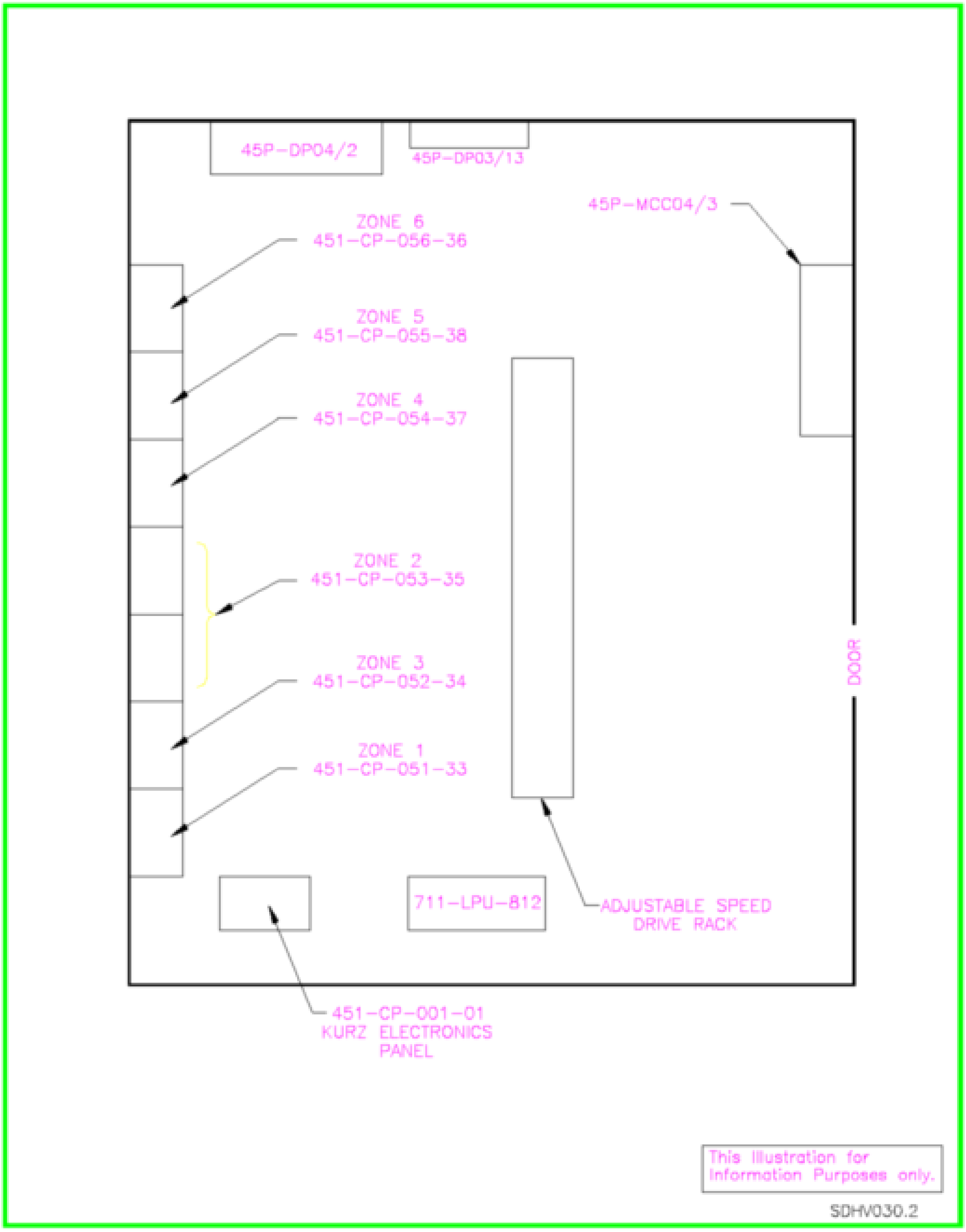

FIGURE HV III-10: Layout of HV03 Panels in the Support Bldg.

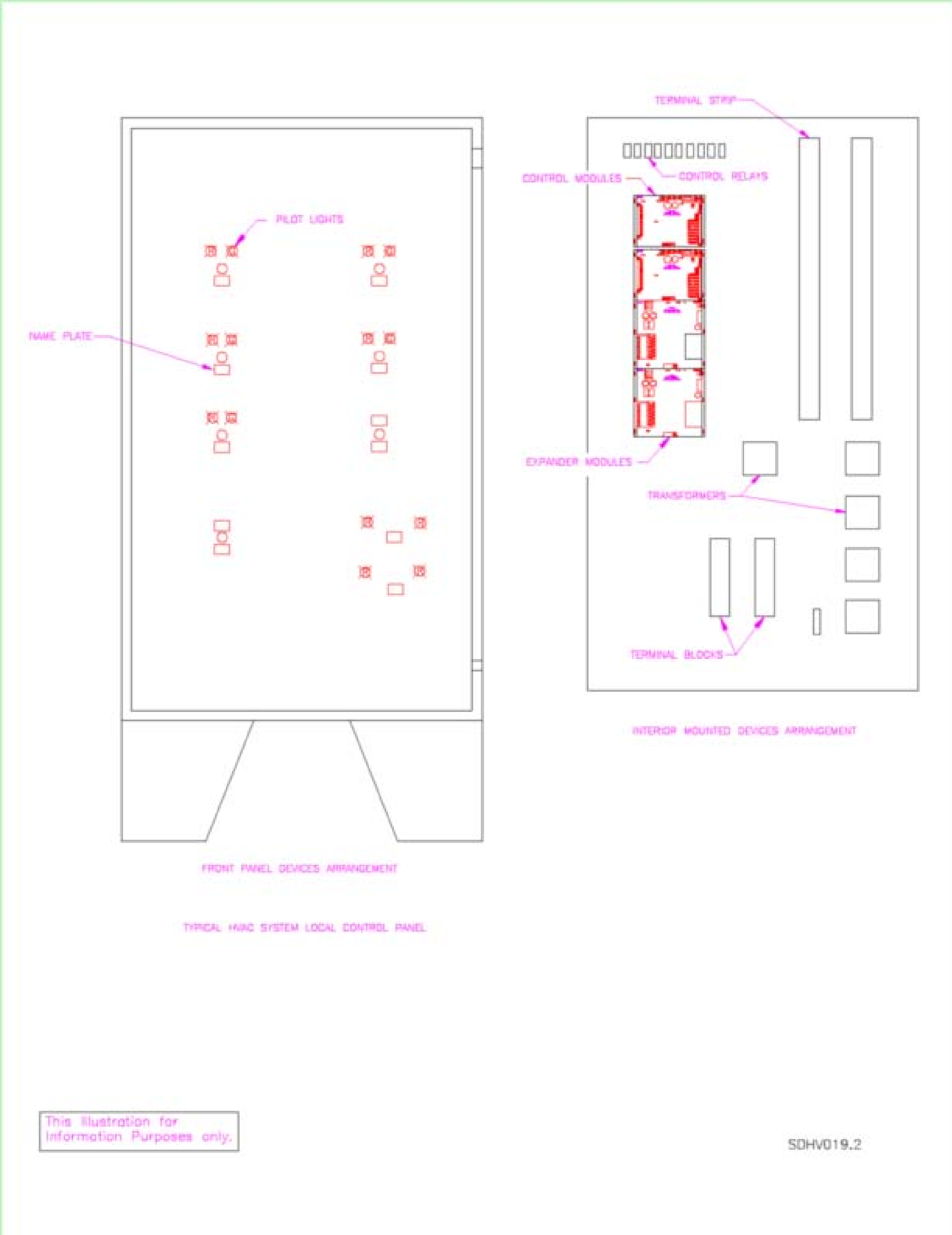

FIGURE HV III-11: Typical HV03 Control Panel Layout

Chapter IV

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Subsystem HV04 Exhaust Filter Building (Bldg. 413) HVAC

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Chapter IV

Subsystem HV04 Exhaust Filter Building (Bldg. 413) HVAC

1.0 PRIMARY FUNCTIONS

Refer to Section 1.0 of Chapter G for the Primary Functions.

The HV04 subsystem provides HVAC for the EFB, Effluent Station A, and Monitoring Rooms 413A and 413B.

2.0 DESIGN REQUIREMENTS

2.1 General

Refer to Section 2.1 of Chapter G for the general design requirements.

2.1.1 Outdoor Design Conditions

Refer to Section 2.1.1 of Chapter G for the outdoor design conditions.

2.1.2 Indoor Design Conditions

The HV04 system shall be designed for indoor design temperatures, as follows.

Indoor Design Temperatures (˚ F)		
Winter (Min)	Summer (Max)	Space
50	95	Exhaust Filter Building (EFB)
50	80	Effluent Monitoring Equipment Rooms
50	80	Effluent Station A

2.1.3 Ventilation

Refer to Section 2.1.3 of Chapter G for the general ventilation requirements.

2.2 Subsystem General Requirements

2.2.1 The design temperature requirements for the areas inside the EFB shall be in accordance with Sections 2.1.1 and 2.1.2.

2.2.2 The static pressures within the building shall be maintained to ensure the required directions of migratory air flows.

2.2.3 Two 50% capacity supply air handling units and two 50% capacity exhaust fans shall be provided.

2.2.4 Provisions shall be made to exhaust air from the filter room through banks of pre-filters and two stages of HEPA filters.

2.2.5 Airlocks shall be provided at access points to permit HVAC system to maintain differential pressures between adjacent areas.

2.2.6 During loss of offsite power, the building exhaust fans shall be capable of being manually switched to backup power.

2.2.7 Relative humidity in the monitoring rooms adjacent to the EFB shall be maintained between 30% and 50% year round with infrared humidifier.

2.3 Operational Requirements

Refer to Section 2.3 of Chapter G for the general operational requirements.

The EFB shall provide negative pressure control and exhaust filtration similar to the WHB (subsystem HV01). The HVAC exhaust from the EFB shall be monitored for high radiation levels.

2.4 Structural

Refer to Section 2.4 of Chapter G for the structural requirements.

2.5 General Arrangement and Essential Features

2.5.1 The major components of the EFB HVAC system include:

- Supply AHU with filters, supply fan, Direct-Expansion (DX), and electric heating coil
- Ductwork
- Exhaust HEPA filter units
- Exhaust fans
- Controls and instruments

2.5.2 The HVAC equipment shall be located in the Mechanical Room and the Exhaust Equipment Room.

2.5.3 The HVAC system for the Monitoring Rooms adjacent to the EFB shall provide for heat removal and humidity control. Tornado Dampers shall be included for Station A.

2.6 Maintenance

Refer to Section 2.6 of Chapter G for the general maintenance requirements.

2.7 In-Service Inspections

Refer to Section 2.7 of Chapter G for the general in-service inspection requirements.

2.8 Instrumentation and Control

Refer to Section 2.8 of Chapter G for the general I&C requirements.

2.9 Interfacing Systems

2.9.1 General

Refer to Section 2.9.1 of Chapter G for the general interfacing system requirements.

2.9.2 Primary Interface

Refer to Section 2.9.2 of Chapter G for the primary interface general information and Appendix C-1 for primary interface requirements.

2.9.3 Secondary Interfaces

Refer to Section 2.9.3 of Chapter G for the secondary interface general information and Appendix C-2 for secondary interface requirements.

2.10 Quality Assurance

Refer to Section 2.10 of Chapter G for the quality assurance requirements.

2.11 Codes and Standards

Refer to Section 2.11 of Chapter G for codes and standards.

2.12 Reliability Assurance

Refer to Section 2.12.1 of Chapter G for the general reliability assurance requirements.

In the event of malfunction of an active component, the HVAC system for the EFB shall be designed to have the capability of isolating the failed component and permitting the system to operate at 50% capacity.

3.0 DESIGN DESCRIPTION

3.1 Summary Description

Refer to Section 3.1 of Chapter G for the summary description.

3.1.1 HVAC in the Exhaust Filter Building Areas

Included in this HVAC program are the EFB (413), Monitoring Rooms 413A and 413B, and Effluent Station A.

3.2 Detailed System Description

3.2.1 Exhaust Filter Building

Subsystem HV04 is the HVAC system for the EFB (413), and the smaller modular units which serve Effluent Monitoring Station A (364) and the two Monitoring Rooms (413A and 413B) on the east side of the EFB.

3.2.2 Exhaust Filter Building (413) HVAC

The system for the EFB is illustrated in Figure HV IV-1. The principal components are air handling units, HEPA filters, and exhaust fans. These units are located in the Exhaust Equipment Room and the Mechanical Room within the EFB. For normal operating conditions both HVAC trains are in use.

3.2.3 Air Supply

The air handling units are described in Chapter G. The 2 AHUs draw air through intake louvers in the north wall of the EFB.

Supply ducts contain a back draft damper, a pneumatically operated isolation damper, and an air flow measuring element. The electronic flow measuring equipment along with the pneumatic controllers maintain constant air flow.

3.2.4 Supply and Exhaust

Room temperature is maintained with the AHU heaters and the DXs controlled in sequence by the temperature control system.

The exhaust flow rate from each room is varied by the PDD to maintain the necessary room static pressure. As the room DP varies, the PDD increases or decreases the exhaust flow rate to satisfy the controller setpoint. The DP signal is processed through the low signal selector to change the exhaust flow rate as necessary.

3.2.5 Exhaust Air from the EFB

Exhaust air is drawn through two HEPA filter units assemblies located in the exhaust room. The HEPA filter units contain one pre-filter stage and two HEPA stages. The pressure drop across each stage is indicated by DP sensors on an adjacent panel and is displayed on the control panel in the mechanical room and transmitted to the CMS. A manual isolation damper is located at the inlet and outlet of each filter. The exhaust fan control system differs from other control loops in that inlet vortex vanes are not used. A damper on the fan discharge is modulated to control air flow.

The EFB exhaust is discharged into the VU00 system exhaust duct upstream from the Station B effluent monitors.

3.2.6 EFB HVAC Controls and Interlocks

Interlocking between the AHU and the exhaust fans in the EFB is similar to that illustrated in Figure HV II-4 of Chapter 2 for the CH area in the WHB. The principal features may be summarized as follows:

- Exhaust fans can only be started if their respective discharge dampers are already open.
- The AHU can only be started in automatic mode if exhaust fan is already running. Also, if either AHU or exhaust fan trips the other unit will be tripped automatically.
- Low flow signals in flow meters connected to the AHUs and exhaust fans, trip their respective fan motors on loss of flow.
- Electrical heating coils in the AHUs can only be energized if their supply fans are already running.
- The DX units can only run if its AHU is running and if the thermostat is calling for cooling.

3.2.7 Effluent Station A HVAC

The principal components consist of two packaged heat pump units. The following sections describe design features of this subsystem.

3.2.8 Effluent Station A HVAC Configuration

Two redundant, air to air heat pumps are located on a pad at ground level adjacent to Station A as illustrated on Figure HV IV-2. The two units are connected by common supply and return ducts to Station A. Each unit provides 100% of the design requirement to maintain the Station A environment within a temperature controlled range of 75 to 80 degrees F. Pneumatically operated isolation dampers are located between each heat pump unit and the common ducts.

An infrared humidifier is located in the common duct supplying Station A. This unit is designed to maintain humidity within the range 30 to 60%.

3.2.9 Effluent Station A Controls and Interlocks

Figure HV IV-3 describes the control logic for the two heat pumps. Significant features of this system are as follows:

- Each pump unit is controlled by a thermostat switch in Station A. Operation of this thermostat automatically opens the isolation dampers and allows the respective unit to start.

- When the hand switch for each heat pump is in the "ON" position, different setpoints on the two thermostats allows one heat pump to operate as a backup to the other.

3.2.10 HVAC for Monitoring Rooms 413A and 413B

The HVAC for Monitoring Rooms 413A and 413B is illustrated in Figure HV IV-4.

The principal component in each room consists of a single roof mounted packaged air conditioning unit.

The ducts which connect these units with the room below are equipped with manually operated isolation dampers and with tornado dampers where they penetrate the roof.

An infrared humidifier is located in the supply ducting within each room. Each humidifier is activated by a manual control switch and is controlled by an adjacent humidistat.

Operating temperature can be adjusted from thermostats located in each Monitoring Room.

3.3 System Performance Characteristics

3.3.1 General

This section provides a description of the system performance characteristics under the various normal and infrequent operating modes and off-normal operating conditions.

3.3.2 Normal Operation

Under normal conditions, the system will be operated in the automatic mode.

The system provides properly conditioned air to areas of the EFB, provides temperature control, and ensure that air is confined to prescribed flow paths and pattern within the EFB.

3.3.3 Off-Normal Operation

In the event of a single active component failure, the system can continue to operate on one of the redundant trains at 50% capacity and shall be able to maintain negative DPs in areas in the building as required. The 50% capacity operation maintains confinement integrity; hence there are no uncontrolled release issues involved.

3.4 Heating Ventilating and Air Conditioning System Arrangement

3.4.1 Layout of Subsystem HV04 (Exhaust Filter Building) HVAC Equipment

EFB HVAC layout is shown in Figure HV IV-5. HVAC equipment is contained in two rooms:

- The Mechanical Room contains the AHUs and control panels.

- The Exhaust Equipment Room contains the HEPA filter assemblies along with their exhaust fans. Exhaust air from the main filter chamber, the access corridor and the Exhaust Equipment Room is ducted to the HEPA filter assemblies.

3.5 Component Design Description

Refer to Section 3.5 of Chapter G for typical HVAC component design descriptions.

3.6 Instrumentation and Control

3.6.1 I&C Equipment

HVAC equipment in the EFB is controlled from two panels located in the Mechanical Room in the EFB.

The functions performed by these panels are outlined in Section 3.2.4. Figure HV IV-1 contains a block diagram of the control systems supervised from these panels. Figure HV IV-6 shows the layout of instruments on the panel. The following describe the instruments contained in the panels.

- Alarm display windows for:
  - Low air flow in the AHUs
  - Low air flow in the exhaust fans
  - High pressure filter pressure drop across the HEPA filter banks

- Alarm test, acknowledge and reset pushbuttons.

- Air flow indicators monitor:
  - AHUs
  - Exhaust fans

- Pressure indicators for static pressure in the Mechanical Room, the Exhaust Equipment Room and the access corridor.

- Auto/manual stations:
  - Supply air flow rate
  - Room static pressure
  - Exhaust flow rate

- START/STOP fan selector switches

- "MAN/OFF/AUTO" for controlling the AHU supply fan.

The panel houses the pressure regulator, controllers, pneumatic circuits, relays and alarm modules required for the functioning of the EFB HVAC control system.

3.7 System Interfaces

Refer to Appendix C of Chapter VIII and Section 3.7 of Chapter G for primary and secondary interface information.

4.0 OPERATION

4.1 Operation of the Exhaust Filter Building HVAC

4.1.1 References

A detailed description of the EFB HVAC system is contained in Section 3.2.2.

Figure HV IV-1 provides a block diagram of the EFB HVAC system.

The layout of one of the two similar EFB HVAC control panels is shown in Figure HV IV-6.

Refer to WIPP Controlled Operating Procedures for HV04. The procedures provide current control information regarding HV04 operating sequences and prerequisites.

5.0 SYSTEM LIMITATIONS, SETPOINTS, AND PRECAUTIONS

5.1 Setpoints

The air flow controller shall be set so that the air flow is approximately 2,200 cfm for each fan.

The cooling setpoint is approximately 76 F.

The heating setpoint is approximately 65 F.

The room static DP setpoints are established in accordance with the following Table:

Area	Setpoint
Exhaust Equipment Room	-0.05" wg
Filter Chamber	-0.105" wg
Access Corridor	-0.075" wg

5.2 Alarms

EFB HVAC System Parametric alarm setpoints are as follows:

Area	Alarm Point	Notes
Exhaust Equipment Room static pressure	-0.025" wg	Signal to CMS (no local alarm)
Filter Chamber	-0.05" wg	Signal to CMS (no local alarm)
Access Corridor	-0.037" wg	Signal to CMS (no local alarm)
Supply flow rate, each fan	1,410 cfm	Local and CMS
Exhaust flow rate, each fan	950 cfm	Local and CMS
HEPA pre-filter	1" wg	Signal to CMS
HEPA filter	3" wg	Signal to CMS

6.0 OFF-NORMAL EVENTS AND RECOVERY PROCEDURES

The following list of off-normal events applies to the EFB and its HVAC systems. Refer to Section 6.0 of Chapter G for a discussion of the off-normal events and the associated recovery procedures.

- Release of radioactive particulates
- Loss of electrical power
- Loss of compressed air supply
- Fire
- Tornado
- Seismic

7.0 MAINTENANCE

Refer to Section 7.0 of Chapter G which presents maintenance requirements for HVAC equipment.

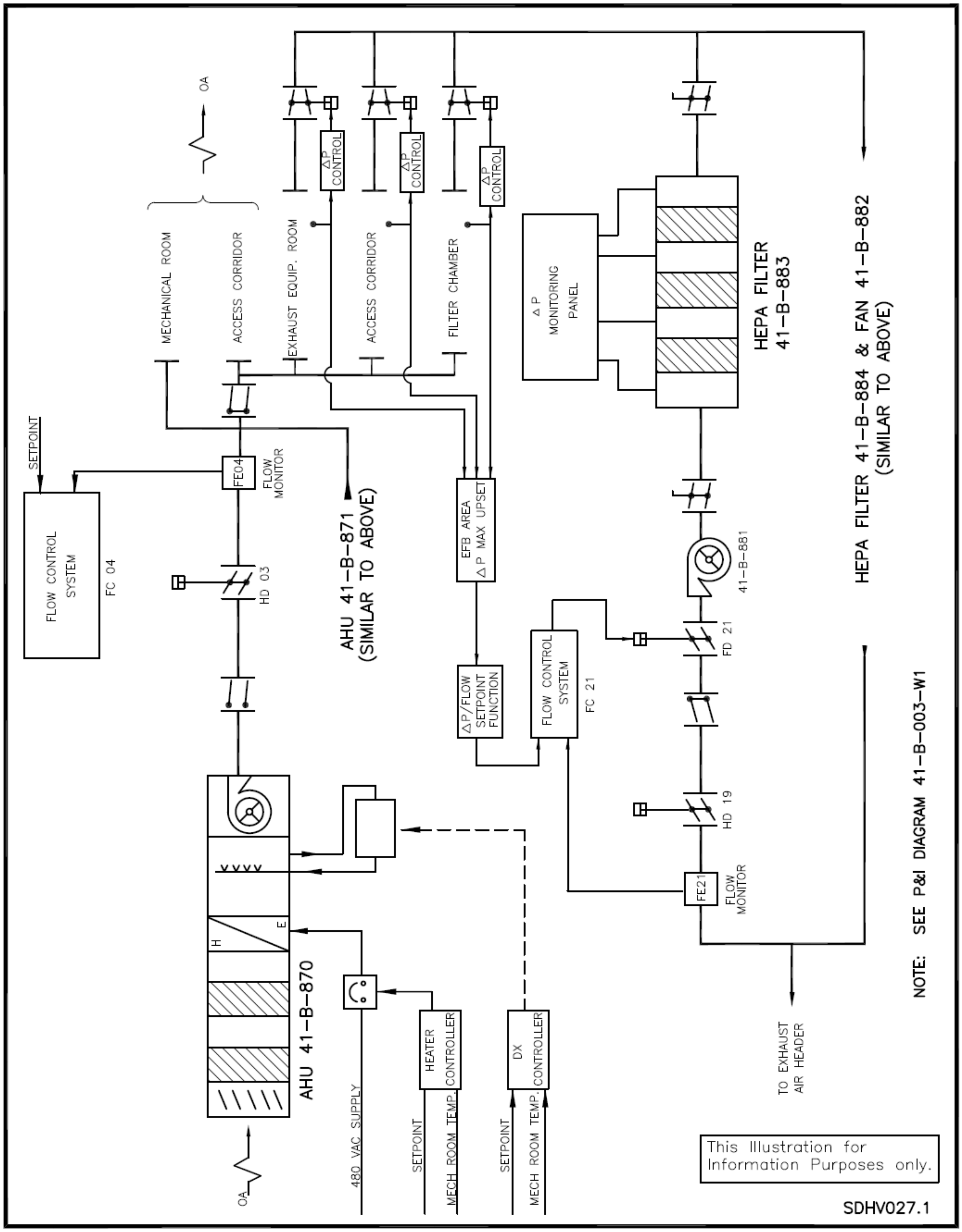

FIGURE HV IV-1: Subsystem HV04 Exhaust Filter Bldg. HVAC Block Diagram

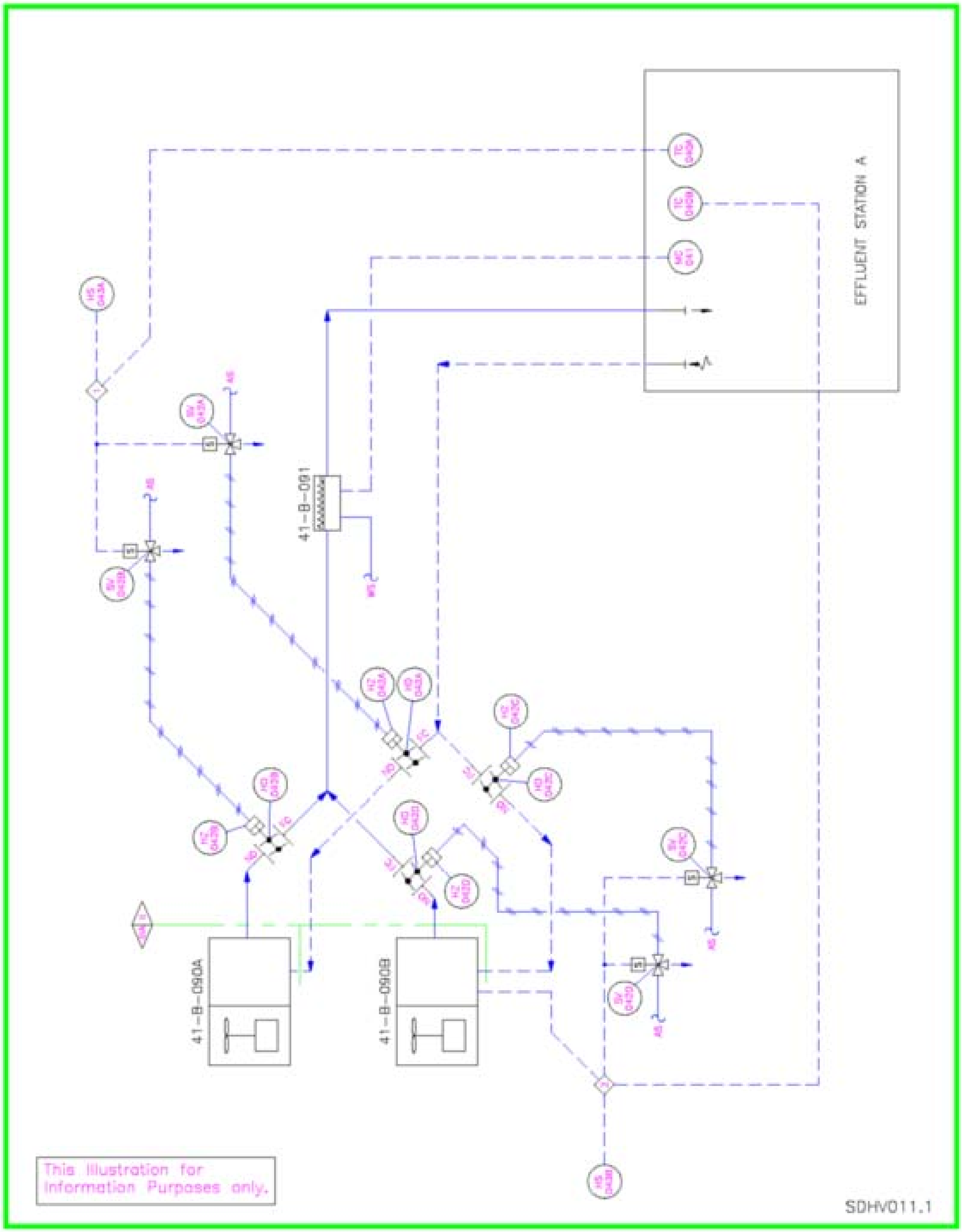

FIGURE HV IV-2: Effluent Station "A" HVAC Block Diagram

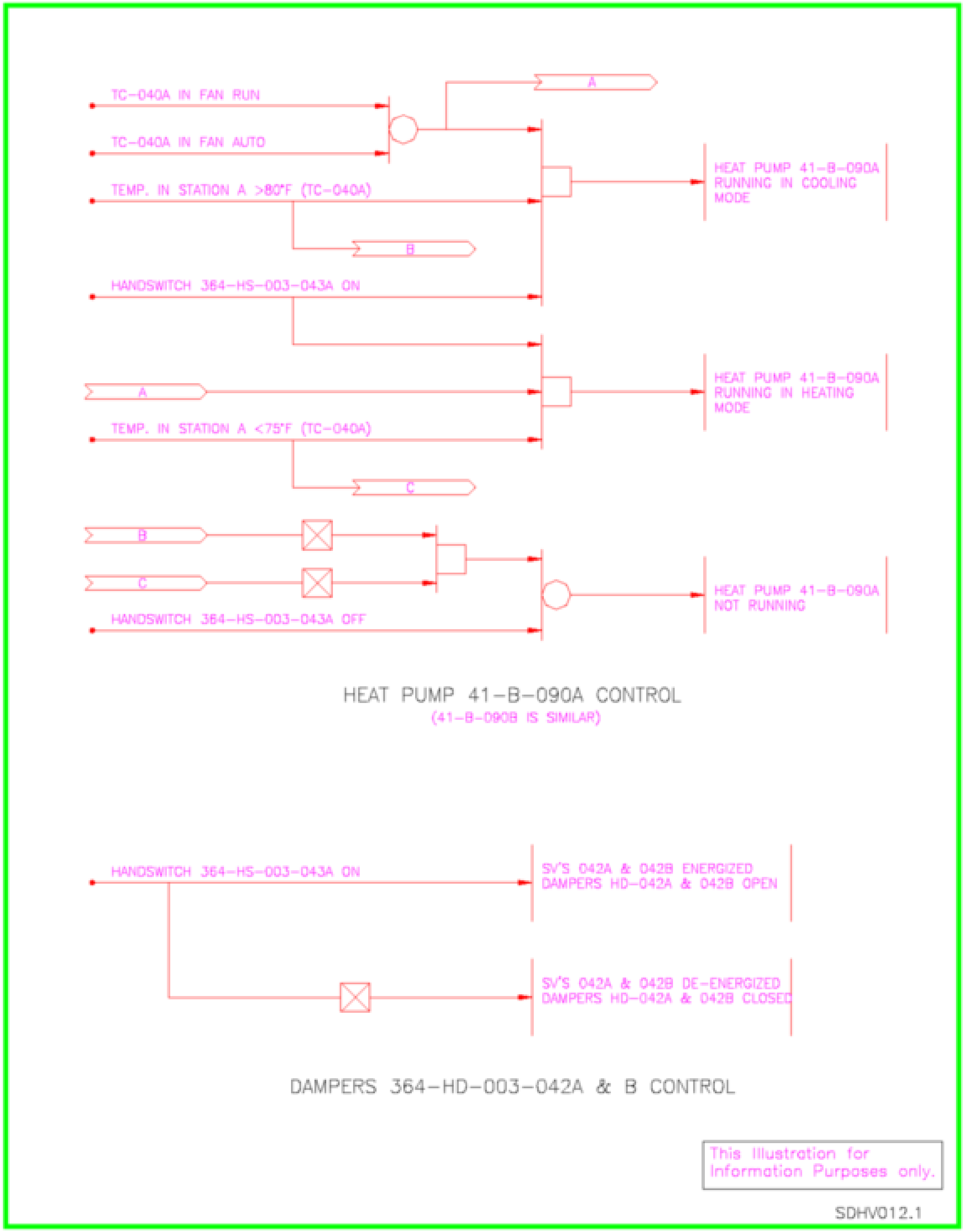

FIGURE HV IV-3: Effluent Station "A" HVAC Control Logic

STATION	EQUIPMENT NO.	INSTRUMENTATION HS	INSTRUMENTATION MC	INSTRUMENTATION TSH/TSL	TORNADO DAMPER NO.
STATION A	AIR COND. UNIT 41-B-886	23	–	23	XD-23A
	HUMIDIFIER 41-B-887	24	24	–	XD-23B
STATION B	AIR COND. UNIT 41-B-888	25	–	25	N/A
	HUMIDIFIER 41-B-889	26	26	–	

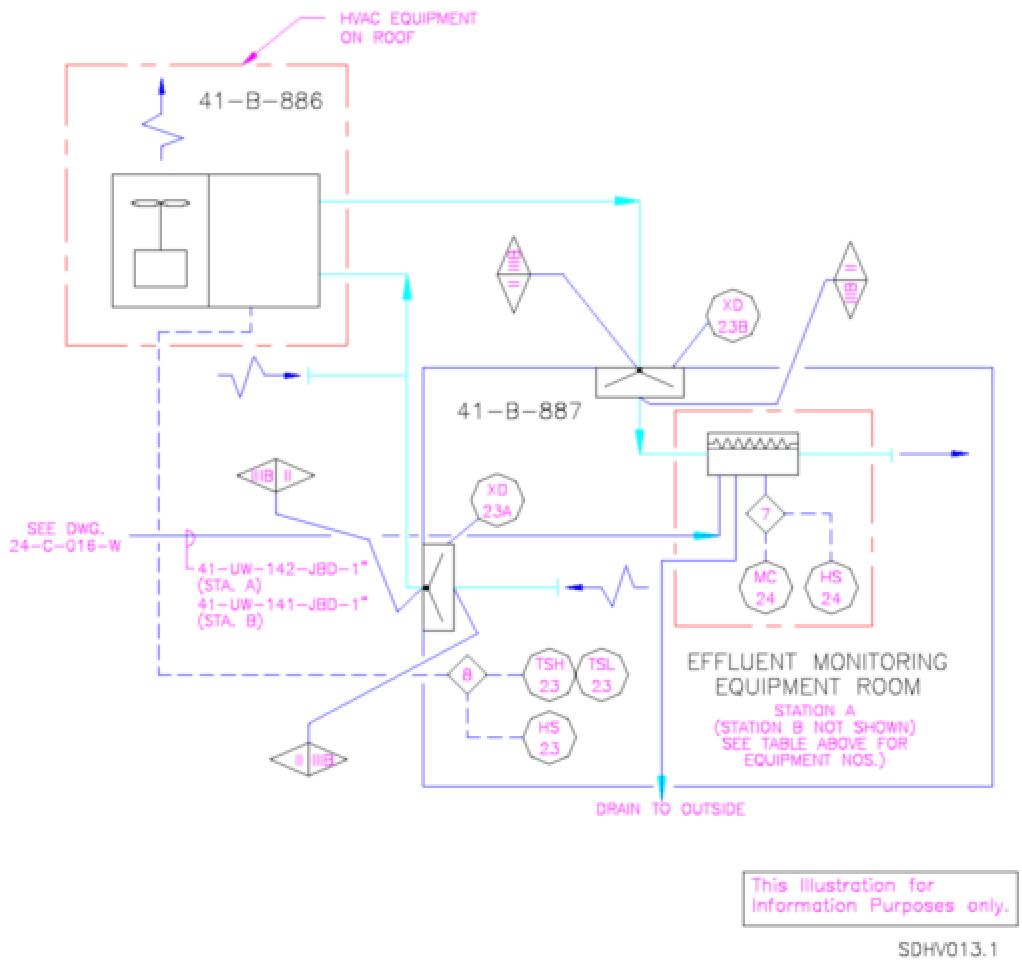

FIGURE HV IV-4: Monitoring Room 413A HVAC Block Diagram

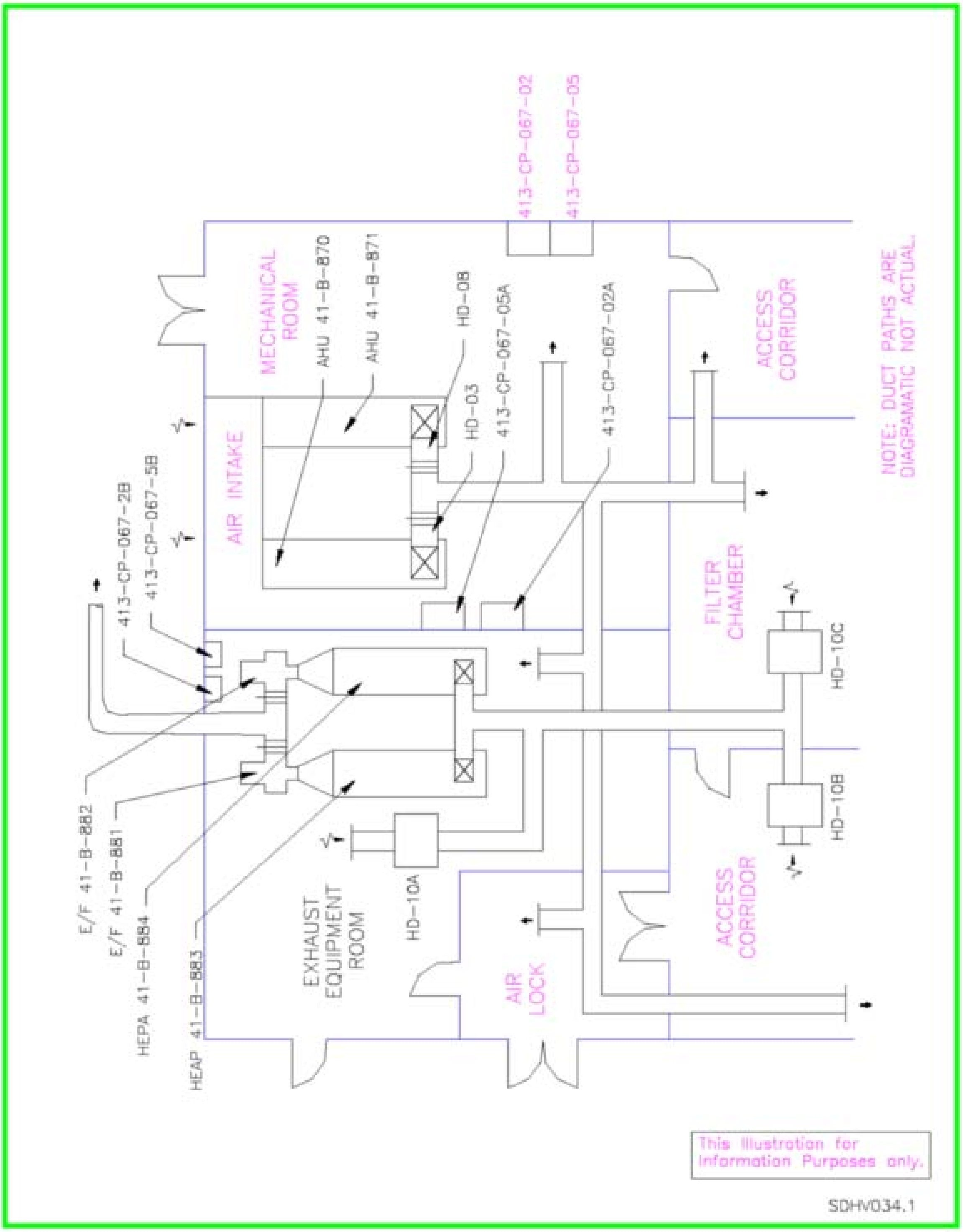

FIGURE HV IV-5: Layout of HV04 in Exhaust Filter Building (413)

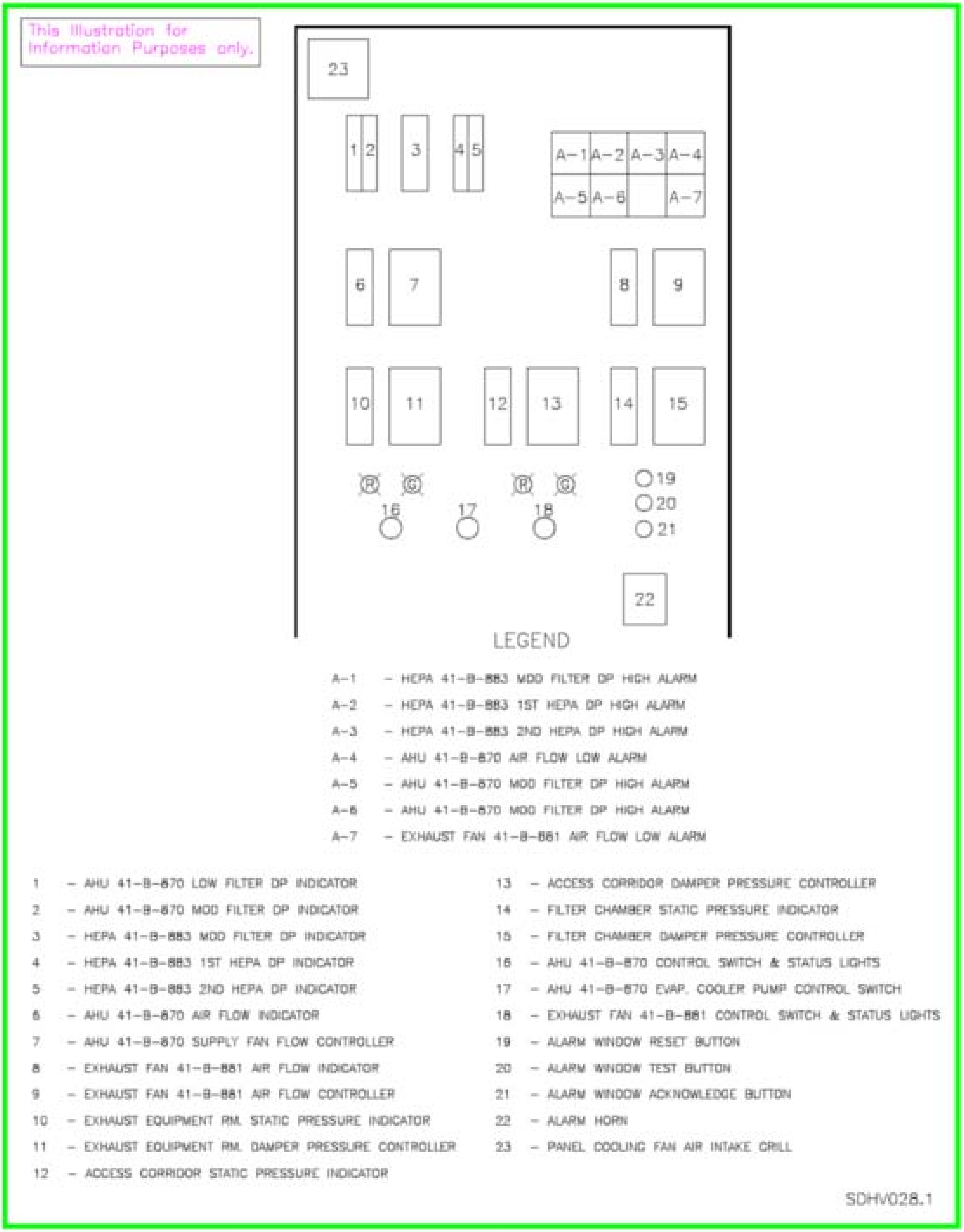

FIGURE HV IV-6: Exhaust Filter Building HVAC Panel 314-CP-067-02 Layout

Chapter V

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Subsystem HV05 HVAC in Buildings 452, 453, and 456

1.0 PRIMARY FUNCTIONS

Refer to Section 1.0 of Chapter G for the Primary Functions.

2.0 DESIGN REQUIREMENTS

2.1 General

Refer to Section 2.1 of Chapter G for the general design requirements.

2.1.1 Outdoor Design Conditions

Refer to Section 2.1.1 of Chapter G for the outdoor design conditions.

2.1.2 Indoor Design Conditions

The HV05 system shall be designed for indoor design temperatures, with the exception of the hot cell, as follows.

Indoor Design Temperatures (˚ F)		
Winter (Min)	Summer (Max)	Space
65	85	Shop Areas
55	110	Storage Areas
72	80	Offices
50	104	Pumphouse

2.1.3 Ventilation

Refer to Section 2.1.3 of Chapter G for the general ventilation requirements.

2.2 Subsystem General Requirements

2.2.1 The design temperature requirements for the areas in the Warehouse/Shop Building, Water Pumphouse, and Safety and Emergency Services Facilities building shall be in accordance with Sections 2.1.1 and 2.1.2.

2.2.2 Separate welding fume collectors shall be provided for all welding stations.

2.2.3 The storage area of the warehouse shall be provided with electric unit heaters to protect critical supplies.

2.3 Operational Requirements

Refer to Section 2.3 of Chapter G for the general operational requirements.

There are no unique-function related operational requirements for subsystem HV05.

2.4 Structural

Refer to Section 2.4 of Chapter G for the structural requirements.

2.5 General Arrangement and Essential Features

2.5.1 The HVAC systems for the warehouse storage and shops areas shall include an AHU with a supply fan, intake filters, and evaporative coolers, and roof exhaust fans. Unit heaters shall be provided for winter heating. For the shops area, welding fume collectors shall be provided. The office area shall be provided with an air conditioning unit.

2.5.2 The Water Pumphouse HVAC system shall include a supply AHU with filters, evaporative cooler and supply fan; roof exhaust fans; unit heaters; and controls and instruments. The AHU shall be located inside the building.

2.6 Maintenance

Refer to Section 2.6 of Chapter G for the general maintenance requirements.

2.7 In-Service Inspections

Refer to Section 2.7 of Chapter G for the general in-service inspection requirements.

2.8 Instrumentation and Control

Refer to Section 2.8 of Chapter G for the general I&C requirements.

2.9 Interfacing Systems

Refer to Section 2.9 of Chapter G for system requirements.

2.10 Quality Assurance

Refer to Section 2.10 of Chapter G for the quality assurance requirements.

2.11 Codes and Standards

Refer to Section 2.11 of Chapter G for codes and standards.

2.12 Reliability Assurance

Refer to Section 2.12.1 of Chapter G for the general reliability assurance requirements.

3.0 DESIGN DESCRIPTION

3.1 Summary Description

Refer to Section 3.1 of Chapter G for the summary description.

3.1.1 HVAC in HV05 Identified Buildings

HVAC systems in these administrative and auxiliary buildings are designed to normal commercial standards.

3.2 Detailed System Description

3.2.1 HV05 HVAC in Buildings 452, 453 and 456

Subsystem HV05 consists of the HVAC systems in the following areas:

- Safety and Emergency (S&E) Building
- Warehouse and Shops (W/S) Building
- Water Pumphouse (WP)

3.2.2 S&E Building (452)

The layout of the S&E Bldg. is shown in Figures HV V-1 and HV V-2. This system is made up of a number of separate locally operated fan coil units. The following sections describe the layout and principal features of the S&E building subsystem HV05.

3.2.3 Air Supply

Ventilation and air conditioning of the S&E Building is provided from 13 fan coil units, six on the ground floor and seven on the second floor. These units are located in the ceiling space with ducted air supply through ceiling mounted diffusers

Each fan coil unit has a medium efficiency disposable filter, a three-speed centrifugal fan, a chilled water cooling coil, and an electric heating coil.

Makeup air to the ceiling space (return plenum) is provided by two makeup units.

Exhaust air is ducted to fans which discharge it directly to the outside.

The systems for the EOC and the First Aid Addition are conventional heat pumps with supply ducts and simple heat pump type controls.

3.2.4 S&E Building Vehicle Area

Heating is provided by two thermostatically controlled unit heaters, mounted in opposite corners of the vehicle area.

An exhaust fan is installed for removal of engine exhaust fumes.

Cooling is provided by an evaporative cooler with supply ducts mounted on a concrete pad on the east side of the building.

Air intake louvers on the west side of the room contain a moderate efficiency filter and motor operated dampers. These units are used to control area DP.

3.2.5 S&E Building HVAC Controls and Interlocks

Each fan coil unit is controlled by a dual setpoint thermostat. Each thermostat contains a fan switch, a three position fan speed setting and setpoint adjustment.

When in the heating mode, the fan coil heaters are cycled by the thermostat. A motor interlock prevents activation of the fan coil heater section if the fan motor is not running. All heaters have high limit thermal cutouts. The cooling coils do not have a control valve and chilled water continues to flow as long as the Chilled Water (CW02) system is operational.

When in the cooling mode, space temperature is maintained by starting and stopping the fan; chilled water continues to flow through the cooling coil.

The controls of makeup air units are similar to fan coil unit controls but without the cooling operating mode.

All exhaust fans are controlled from local switches. When smoke detectors in the S&E Building indicate the presence of a fire, the Fire Protection (FP00) system commands the exhaust fan to stop.

3.2.6 Warehouse and Shops Building (453) HVAC

The layout of the HVAC in the Warehouse Bldg is shown in Figure HV V-3. The principal feature consists of two AHUs located in the NE corner of the building.

3.2.7 W/S Bldg HVAC General Description

Since cooling is from evaporative cooling sections in each AHU, the units supply 100% outdoor air. The AHUs are once through units; hence, there is no return air. Ducts distribute air throughout the warehouse. To prevent over pressurization of the building, roof mounted exhaust fans are installed.

Heating is from eight down flow type electrical unit heaters.

Cooling in office areas is provided by two packaged HVAC units.

3.2.8 W/S Bldg. Controls and Interlocks

AHUs are controlled by individual thermostats. The roof exhaust fans in the warehouse areas can be operated in either a manual or an automatic mode. When in automatic mode the following conditions apply:

- Starting the AHU for the west area, starts three exhaust fans in the warehouse area.
- Starting the AHU for the east area, starts the two exhaust fans in the shop area.

3.2.9 Water Pumphouse (456)

The layout of the HVAC in the WP Bldg is shown in block diagram form in Figure HV V-4. The principal features of the system are described in Section 3.2.10, the controls and interlocks are described in Section 3.2.11.

3.2.10 Water Pumphouse HVAC General Description

The principal components of this system consist of one AHU and distribution ducts supplying 100% outdoor air.

Heating is from four roof suspended electric heater units.

Air is exhausted by two roof mounted exhaust fans.

3.2.11 Water Pumphouse HVAC Controls and Interlocks

The two exhaust fans can be started manually or they can be connected to start automatically when the supply fan in the AHU is energized.

The evaporative cooler circulating pump can be either started manually, or controlled to maintain the temperature in the building by the thermostat.

3.3 System Performance Characteristics

In the event of a malfunction in the HV05 subsystems, there are no significant consequences involved. Hence, there are no special system performance characteristics or requirements for the HV05 subsystems other than operation under ambient environmental conditions.

3.4 Heating Ventilating and Air Conditioning System Arrangement

There are no requirements set forth for arrangement information for conventional administration and auxiliary buildings.

3.5 Component Design Description

Refer to Section 3.5 of Chapter G for typical HVAC component design descriptions.

3.6 Instrumentation and Control

Safety and Emergency Building and Warehouse

The controls provided for the S&E Bldg and the W/S Bldg. use a system of distributed controls in which HVAC equipment is supervised locally in the areas where it functions. As the scope of this equipment is limited to commercial thermostats, switches and motor starters no additional description is warranted in this section.

The WP Bldg. HVAC is supervised from a central control panel.

3.6.1 WP Bldg. HVAC Control Panel

The WP Bldg. HVAC is supervised from a central control panel. The WP Bldg. HVAC system is described in Section 3.2.9 and is illustrated in block diagram form in Figure HV V-4. This equipment is controlled from the panel located on the south wall of the building. The following features are provided by these instruments:

- DP indicators for pressure drop across the low and moderate efficiency filters in the AHU.
- An airflow indicator for the flow in the AHU.
- Selector switches, "MANUAL/OFF/AUTO" control the following equipment:
  - AHU evaporative cooler pump
  - AHU supply fan

- Roof exhaust fans

- Red (running) and green (stopped) pilot lights are located above each switch.

3.7 System Interfaces

Refer to Appendix C of Chapter VIII and Section 3.7 of Chapter G for primary and secondary interface information.

4.0 OPERATION

The WIPP Controlled Operating Procedure presents the HV05 operational sequences and prerequisites. The subject procedures are controlled under WIPP Policies and Procedures.

5.0 SYSTEM LIMITATIONS, SETPOINTS, AND PRECAUTIONS

5.1 S&E Bldg. Setpoints

HVAC controls in the S&E Bldg. discussed in this SDD are limited to thermostats. Operation of these thermostats provides control of the fan coil units.

Occupants can set desired temperatures at these thermostats to meet their requirements.

5.2 W/S Bldg. HVAC Setpoints

Thermostats should be set to operate the AHU fans and evaporative coolers in sequence. The fan thermostat should be set to start the fans at 70 F; the evaporative cooler should be set to start at 80 F.

The eight ceiling mounted heater units in this building are controlled by adjacent room thermostats. Control of these units will be exercised by user adjustments to the thermostats. Since the heaters and evaporative coolers are not controlled with a central temperature controller it is possible that some heaters could be on while the evaporative coolers are operating.

Window AC units that are installed for the offices will be similarly controlled by user operation of local room thermostats.

5.3 WP Bldg. HVAC Setpoints

The AHU and exhaust fans start when the room temperature is above 70˚ F.

The thermostat initiates AHU evaporative cooler operation when the temperature is above 90˚ F.

The four ceiling mounted heater units in this building are controlled by thermostats. Control of these units is by user adjustments to the thermostats.

6.0 OFF-NORMAL EVENTS AND RECOVERY PROCEDURES

The following list of events can impact the subsystem HV05 HVAC zones. However, these events are not considered off-normal relative to waste handling operations. The EOC is used as a command center under off-normal events; however, it being challenged by the subject events does not impact the waste handling operations.

- Loss of Electrical Power
- Fire

7.0 MAINTENANCE

Refer to Section 7.0 of Chapter G which presents maintenance requirements for HVAC equipment.

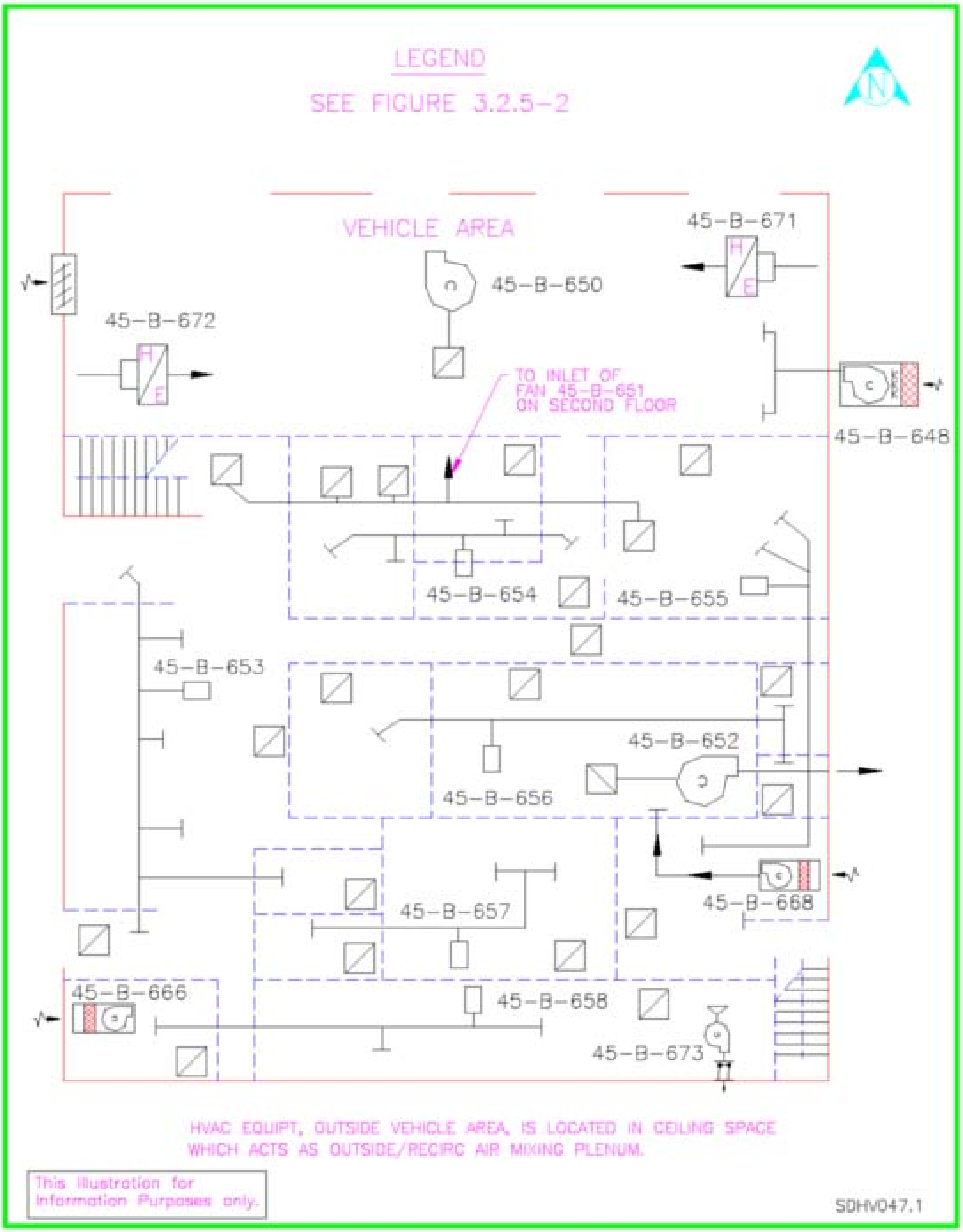

FIGURE HV V-1: HV05 S&E Building Ground Floor HVAC Block Diagram

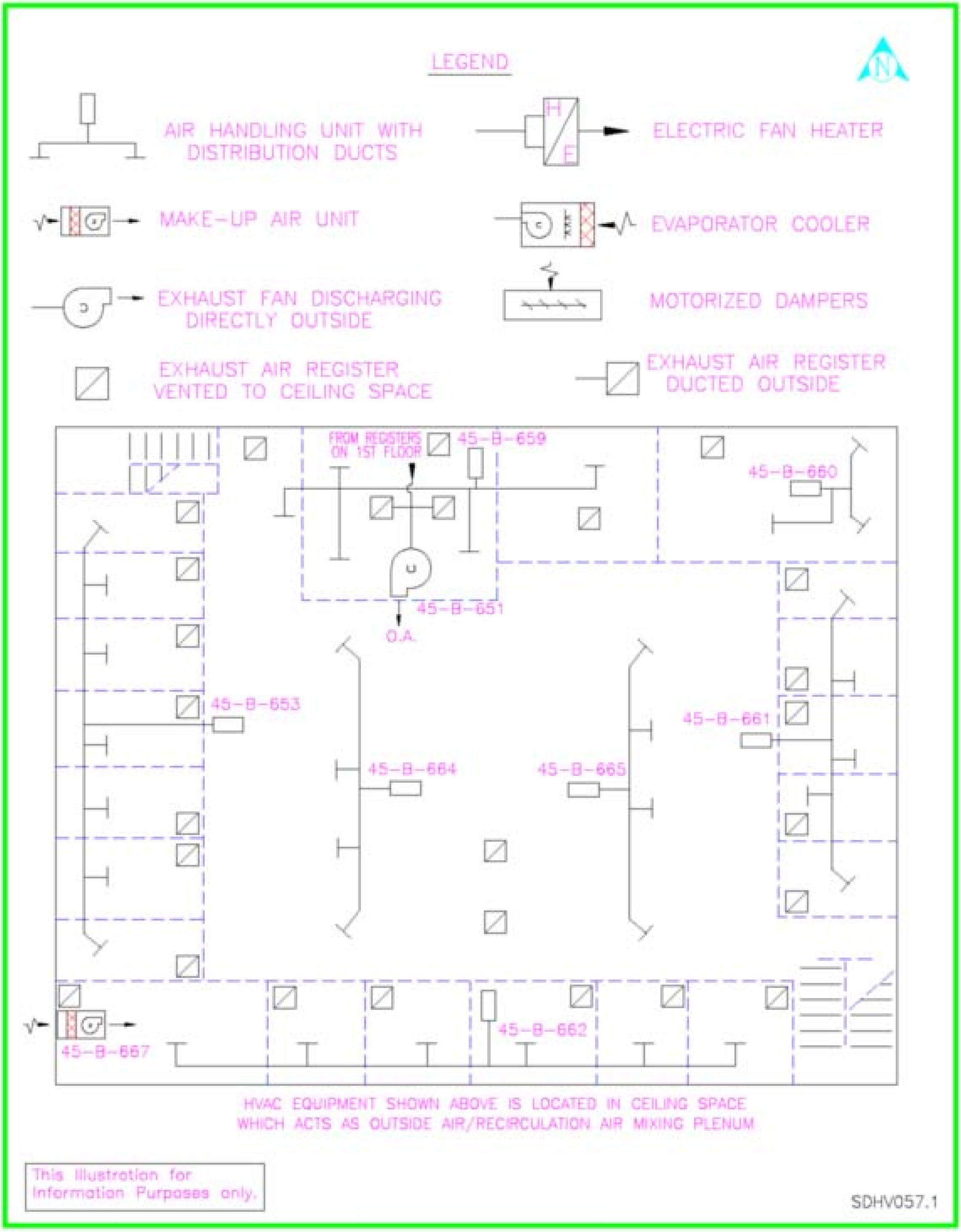

FIGURE HV V-2: HV05 S&E Building Second Floor HVAC Block Diagram

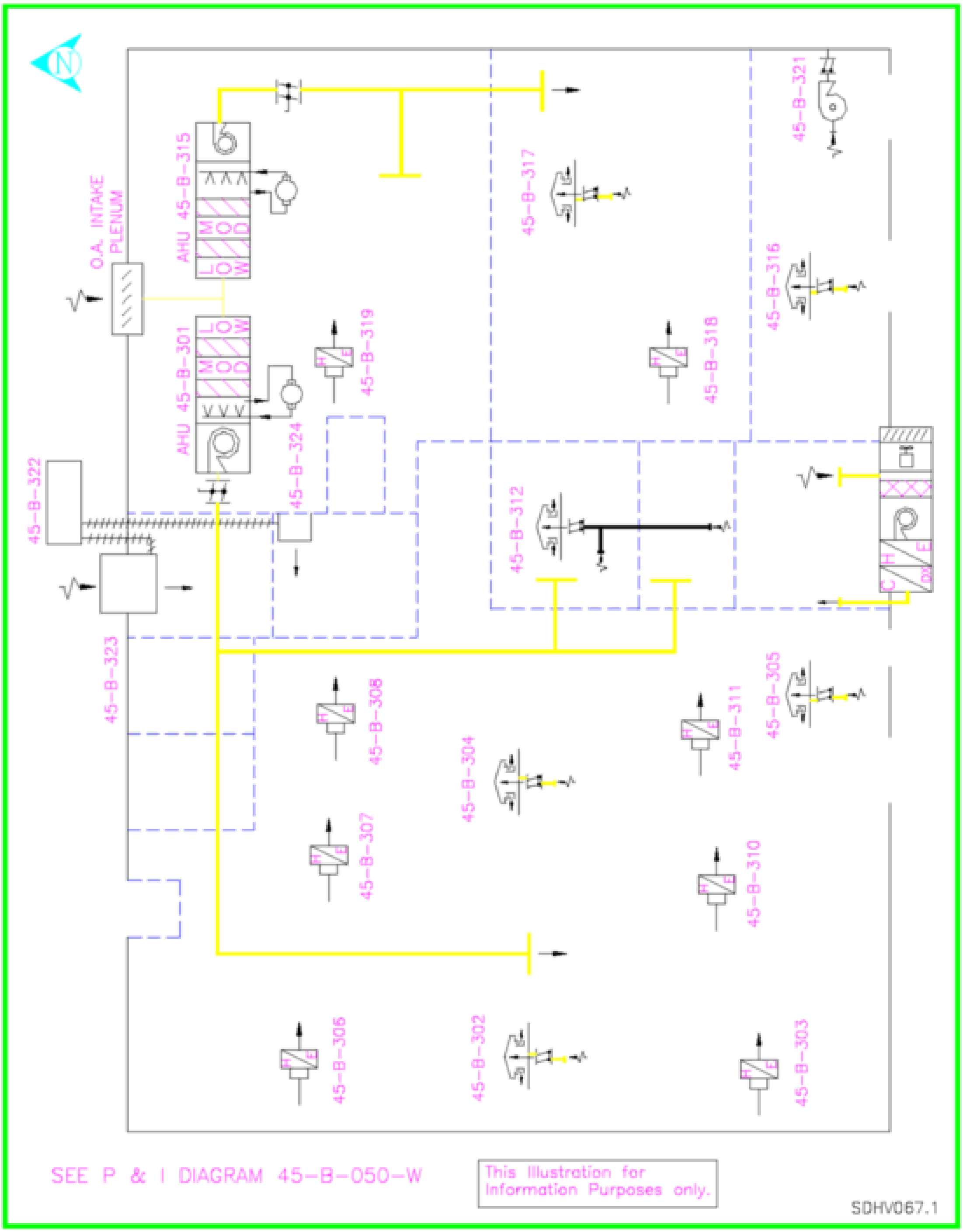

FIGURE HV V-3: HV05 Warehouse Building HVAC Block Diagram

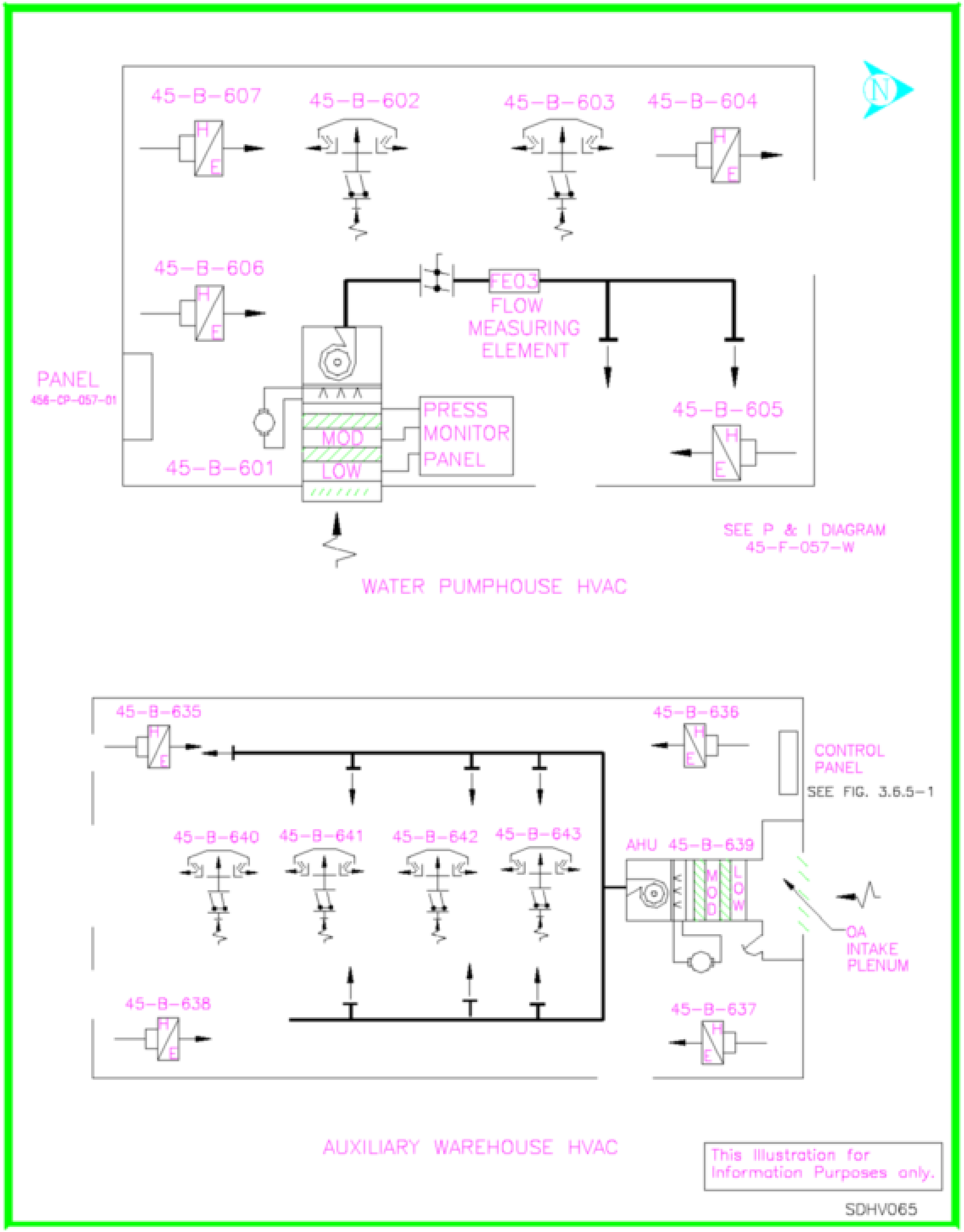

FIGURE HV V-4: HVAC Block Diagrams for Water Pumphouse (HV05) and Auxiliary Warehouse (HV06)

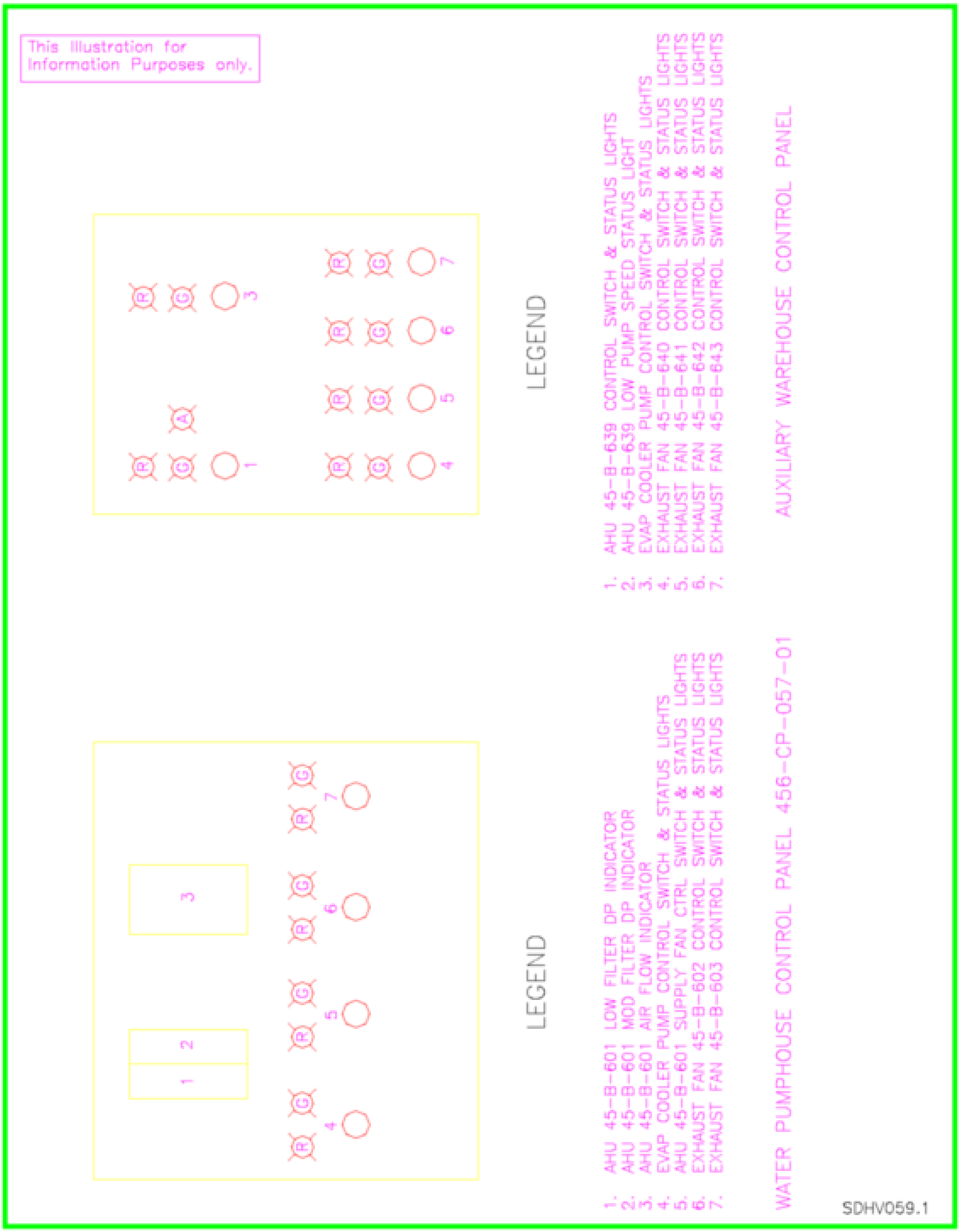

FIGURE HV V-5: Water Pumphouse & Aux. Warehouse Control Panel Layout

Chapter VI

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Subsystem HV06 Miscellaneous Buildings HVAC

1.0 PRIMARY FUNCTIONS

Refer to Section 1.0 of Chapter G for the Primary Functions.

2.0 DESIGN REQUIREMENTS

2.1 General

Refer to Section 2.1 of Chapter G for the general design requirements.

2.1.1 Outdoor Design Conditions

Refer to Section 2.1.1 of Chapter G for the outdoor design conditions.

2.1.2 Indoor Design Conditions

Subsystem HV06 consists of the HVAC systems in the following buildings:

362	Air Intake Shaft Hoisthouse	459	Core Storage Building
384	Salt Handling Shaft Hoisthouse	463	Compressor Building
384A	Hoisting Operations	468	Telephone Hut
475	Gatehouse	455	Machine Shop
481	Warehouse Annex	489	Training Building
482	Elect. Calibration Shop	486	Engineering Building
458	Guard and Security Bldg.		

Indoor design conditions are according to the following Table:

Space	Winter	Summer
Guard and Security Bldg. Mech. rooms	50	104
G&S Bldg. offices, lobby and lunch room	72	76
Core Storage Building	72	76
Hoisting Operations	72	76
Telephone Hut	72	76
Gatehouse	72	76
Machine Shop	72	80
Elect. Calibration Shop	72	76
Engineering Building	72	76
Training Building	72	76
Compressor Building # 463	50	104
Warehouse Annex #481	50	104
Salt Handling and Air Intake Shaft Hoist Houses	See Note	See Note

NOTE

Indoor design conditions are based on the thermal environmental requirements of the hoisting machinery.

2.1.3 Ventilation

Refer to Section 2.1.3 of Chapter G for the general ventilation requirements.

2.2 Subsystem General Requirements

There are no specific or unique requirements except as noted in Section 2.3. The systems perform the usual HVAC functions of heat removal, comfort conditioning, and other functions dictated building codes.

2.3 Operational Requirements

Refer to Section 2.3 of Chapter G for the general operational requirements.

2.4 Structural

Refer to Section 2.4 of Chapter G for the structural requirements.

2.5 General Arrangement and Essential Features

There are no specific requirements to arrange or locate the equipment in special places. Equipment may be mounted on pads, roofs, in rooms, or other locations as the situation may dictate according to manufacturers' recommendations and good engineering practice.

2.6 Maintenance

Refer to Section 2.6 of Chapter G for the general maintenance requirements.

2.7 In-Service Inspections

Refer to Section 2.7 of Chapter G for the general in-service inspection requirements.

2.8 Instrumentation and Control

Refer to Section 2.8 of Chapter G for the general I&C requirements.

2.9 Interfacing Systems

Refer to Section 2.9 of Chapter G for the general interfacing system requirements.

2.10 Quality Assurance

Refer to Section 2.10 of Chapter G for the quality assurance requirements.

2.11 Codes and Standards

Refer to Section 2.11 of Chapter G for codes and standards.

2.12 Reliability Assurance

Refer to Section 2.12 of Chapter G for the general reliability assurance requirements.

3.0 DESIGN DESCRIPTION

3.1 Summary Description

Refer to Section 3.1 of Chapter G for the summary description.

3.1.1 HVAC in Other Permanent Surface Buildings

HVAC systems in these administrative and auxiliary buildings are designed to normal commercial standards.

3.2 Detailed System Description

3.2.1 HV06 Miscellaneous Buildings HVAC

The HVAC systems for the buildings listed below are either split type or packaged air conditioning units with simple thermostatic controls. The system may have one or more of these units for zoning purposes. There are no special considerations beyond comfort conditioning or equipment heat removal, and the design is standard commercial equipment. Therefore, no descriptive materials are provided regarding the HVAC system implementation for these facilities.

362	Air Intake Shaft Hoisthouse	468	Telephone Hut
384	Salt Handling Shaft Hoisthouse	475	Gatehouse
384A	Hoisting Operations	481	Warehouse Annex
455	Machine Shop	482	Elect. Calibration Shop
459	Core Storage Building		

The remaining buildings listed below are described in more detail because of their HVAC complexity or unique design features.

486	Engineering Building (EB)
458	Guard and Security Bldg. (G&S)
489	Training Building
463	Compressor Building

3.2.2 Engineering Building (486) HVAC

The layout of the HVAC in the single story EB is illustrated in Figure HV VI-1. It is a multizone type system with Chilled Water (CW02) supplied as the cooling source. CW02 equipment utilized in the engineering building HVAC is described in Chapter VII.

3.2.2.1 Air Supply

Four AHUs located in two mezzanines supply air to the EB. One unit is a single zone type for a room adjacent to the men's bathroom that was originally intended to be a reprographics room.

These units are multizone type units. Each zone is separately controlled by individual wall mounted thermostats. Figure HV VI-2 contains an illustration of the configuration of a multizone AHU by a single chilled water coil in the AHU. Separate dampers in the ducts to each zone mix cooled air and bypass air to provide the proper supply air temperature as determined by the thermostats in each zone. Each zone duct in the AHU contains a heating coil which is controlled in sequence with each zone damper.

Figure HV VI-1 shows the layout of distribution ducts to the zones supplied by the four AHUs.

3.2.2.2 Return Air

Air is drawn into the ceiling plenum through return grilles in the ceiling of the EB.

3.2.2.3 EB Controls and Interlocks

Figure HV VI-2 contains typical control diagrams for the single zone and the three multizone AHUs which service the EB.

The system utilizes an economizer mode for energy conservation. When the outdoor temperature is within the proper range, the outdoor and return air dampers at the AHU inlet are cycled to increase the outdoor airflow rate so that the supply air temperature is decreased to satisfy the cooling requirements. This function, sometimes called "free cooling," reduces the cooling load on the chiller and reduces energy consumption. The exhaust fans along the north wall are installed to operate during the economizer cycle to prevent over pressurization of the building.

The principle interlock is a smoke detector located in each AHU which stops the AHU fan when smoke is detected.

3.2.3 Guard and Security Building HVAC (458)

Figure HV VI-3 contains a block diagram of the G&S Building HVAC. The principal components of this system consist of two AHUs. This system does not have return fans. Operation of these AHUs maintains pressure within the building at a slight positive pressure level.

Each AHU is a split type heat pump operated in sequence by the temperature control system. The AHUs contain two separate refrigerant circuits for capacity reduction.

3.2.3.1 Exhaust Air

Exhaust fans are installed for the locker rooms, utility room, and the kitchen.

3.2.3.2 G&S Controls and Interlocks

Controls for this system are typical for commercial HVAC installations. Control is from two standard heat pump thermostats with interlocks to prevent heater operation without the fan running. Smoke detectors in the AHU return ducts shut off the fans upon detection of smoke.

3.2.4 Compressor Building (463)

The building is ventilated with two centrifugal roof exhausters that are controlled in sequence via two thermostats for compressor heat removal. When the thermostat with the lowest setpoint starts its fan, the inlet dampers are opened along with the dampers in the corresponding intake louver. If the temperature in the building rises further, the second thermostat starts the other fan and opens its corresponding dampers. When the room temperature decreases, the sequence is reversed.

3.2.5 Training Building

The Training Building temperature is maintained with ten split type air conditioning units with electric heating coils; these are not heat pumps. Each unit is powered from a circuit breaker, and not from a control panel. Each unit is controlled with a room thermostat that is programmable for night set back and other scheduling type functions. The air conditioning unit controls are usual for standard air conditioning units.

3.3 System Performance Characteristics

In the event of a malfunction in the HV06 subsystems, there are no significant consequences involved. Hence, there are no special system performance characteristics or requirements for the HV06 subsystems other than operation under ambient environmental conditions.

3.4 Heating Ventilating and Air Conditioning System Arrangement

There are no requirements set forth for arrangement information for conventional administration and auxiliary buildings.

3.5 Component Design Description

Refer to Section 3.5 of Chapter G for typical HVAC component design descriptions.

3.6 Instrumentation and Control

3.6.1 Subsystem HV06 I&C Equipment

The HVAC systems which makeup subsystem HV06 includes widely different equipment. Summaries of the principal control and instrumentation features are outlined in the following sections.

3.6.1.1 EB (486) HVAC I&C Equipment

This system utilizes an arrangement of local controls which corresponds with equipment location and power distribution within the building. Principal features are as follows:

Each AHU and exhaust fan has a 3-position, HAND/OFF/AUTO control.

- When in the auto position these units can be cycled from a timer control panel in the mechanical room (128) in the SE corner of the first floor on a daily and weekly basis.

- Thermostats, located in the areas served by the different zones, control the outlet dampers and duct heaters in each AHU so as to maintain the required temperatures.

3.6.1.2 G&S Bldg (458) Control Panel

HVAC equipment in the G&S bldg. is controlled from a panel located in the mechanical room.

The panel contains elapsed time indicators, switches for controlling supply and exhaust fans, and status indicating lights.

3.6.1.3 Training Building

There are no control panels for the various air conditioning units in this building. The units are supplied from circuit breakers. The control of each unit is via its thermostat which is programmable for automatic night set back and schedule.

3.7 System Interfaces

Refer to Appendix C of Chapter VIII and Section 3.7 of Chapter G for primary and secondary interface information.

4.0 OPERATION

Refer to WIPP Controlled Operating Procedures for the current/approved HV06 operational sequences and prerequisites.

5.0 SYSTEM LIMITATIONS, SETPOINTS, AND PRECAUTIONS

5.1 Engineering Building HVAC Setpoints

5.1.1 Single Zone AHU Control

A unit mounted thermostat controls the 3-way valve which maintains the temperature of the air leaving the chilled water cooling coil (see Figure HV VI-2). The thermostat should be set at 51˚ F.

A room type thermostat controls the electric heaters in the final stage of the AHU. It should be set at 72˚ F.

5.1.2 Multizone Control

Zone temperature control is accomplished with individual heating and cooling thermostats; care must be taken to set the thermostats and adjust the differential (throttling range) so that control ranges of the thermostats do not overlap. If there is a heating and cooling demand in the same zone at the same time, a condition of maximum cooling output and maximum heating output will eventually result, and the space temperature will become uncontrolled.

5.2 Guard and Security Building HVAC

The heat pumps are staged so that if one unit cannot control the space temperature, the second unit is started. One thermostat should be set at 72˚ F and the second one set at 76˚F.

The lunch room area heat pumps are similar in operation, except that the AHU has dual cooling coils. The setpoints for this unit are also 72˚ F and 76˚ F.

Refer to Sections 5.4 and 5.5 of Chapter G for the general information regarding HVAC system interlocks and HVAC/Chilled Water system precautions.

5.3 Training Building

Setpoints are adjusted within the range of the controller as necessary to maintain comfort conditions.

6.0 OFF-NORMAL EVENTS AND RECOVERY PROCEDURES

The following list of events can impact the subsystem HV06 HVAC zones. However, these events are not considered off-normal relative to waste handling operations. The HV06 HVAC zones being challenged by the subject events does not impact the waste handling operations.

- Loss of electrical power
- Fire

7.0 MAINTENANCE

Refer to Section 7.0 of Chapter G which presents maintenance requirements for HVAC equipment.

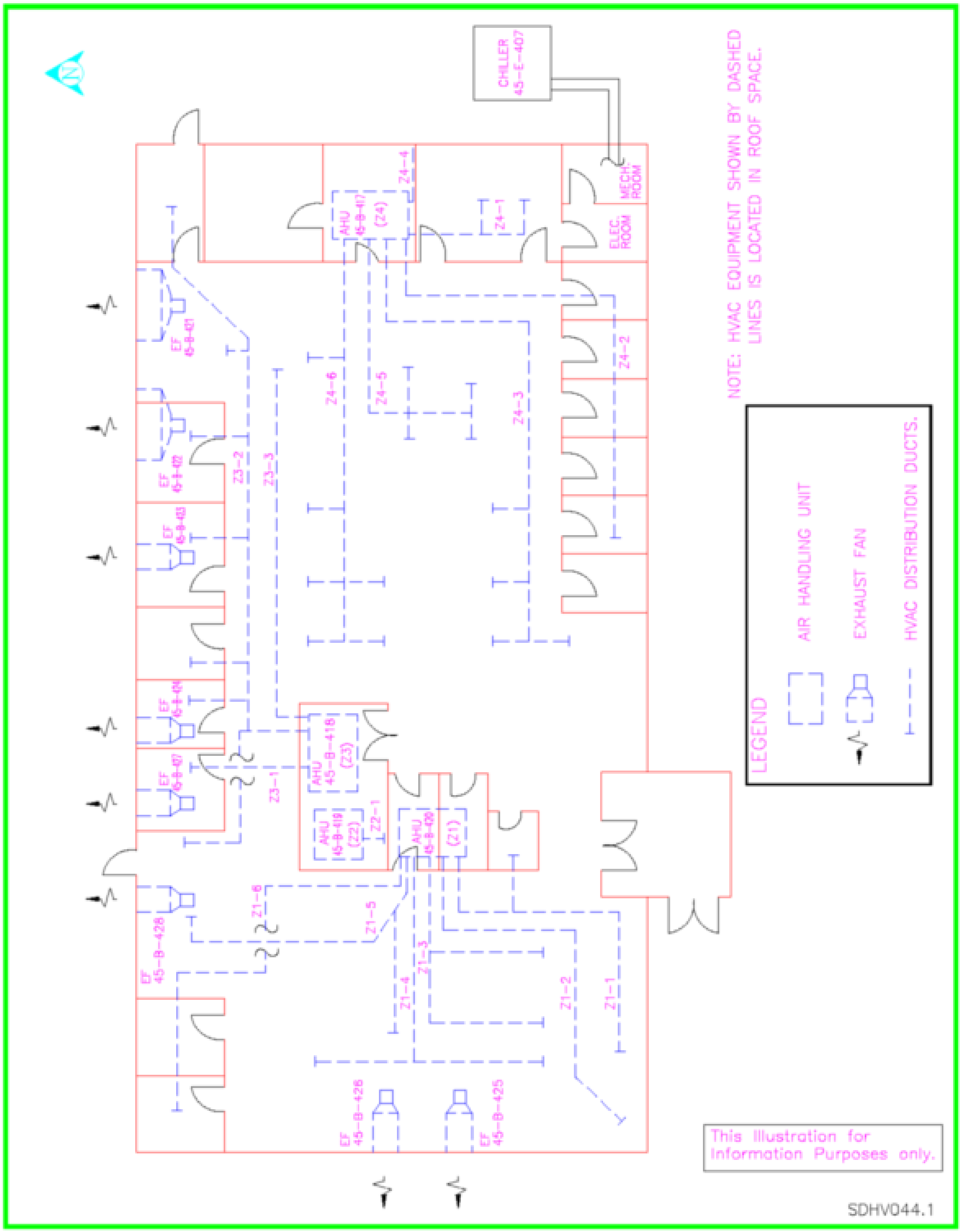

FIGURE HV VI-1: HV06 Engineering Bldg. HVAC System Block Diagram

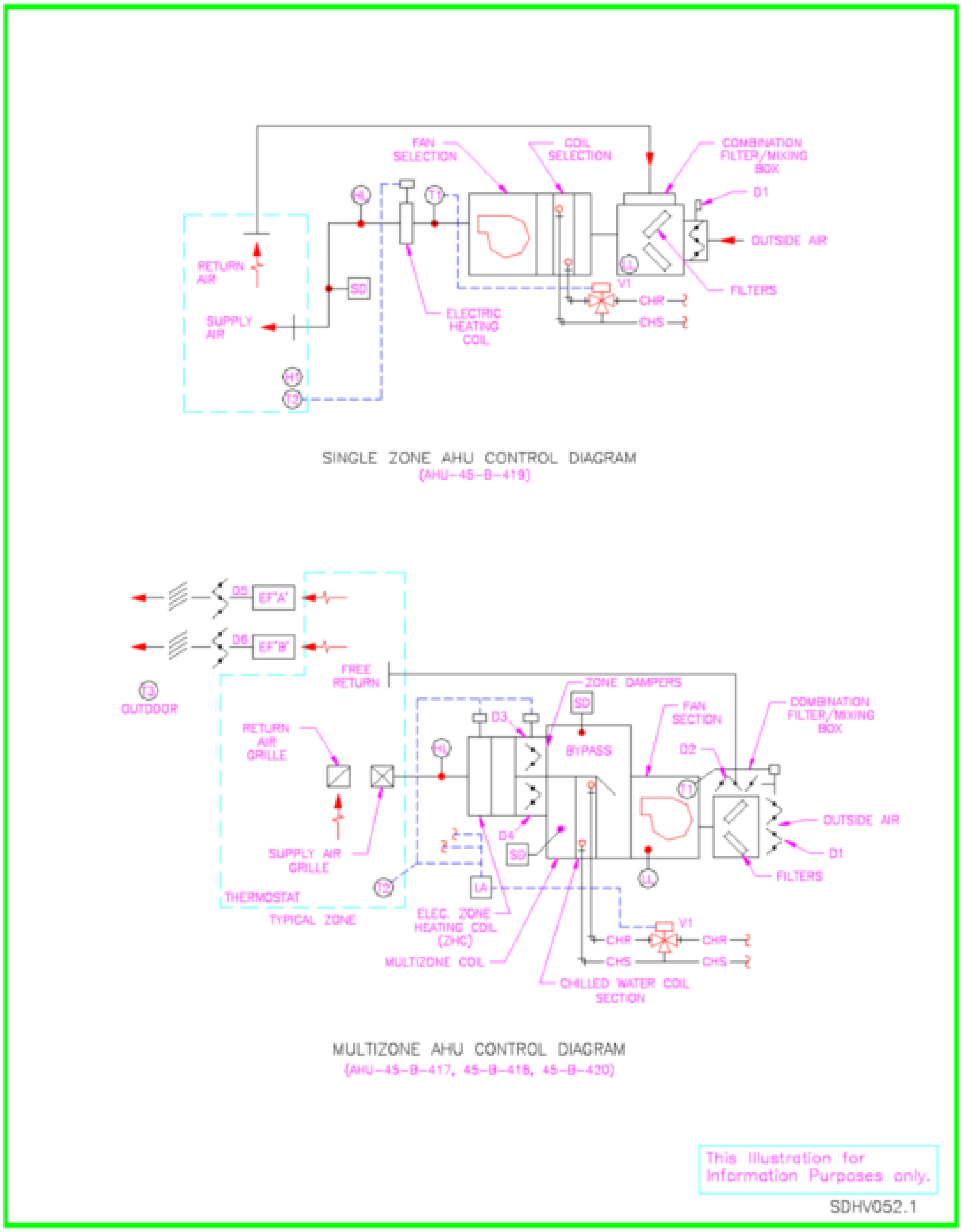

FIGURE HV VI-2: HV06 Engineering Building HVAC Control Diagrams

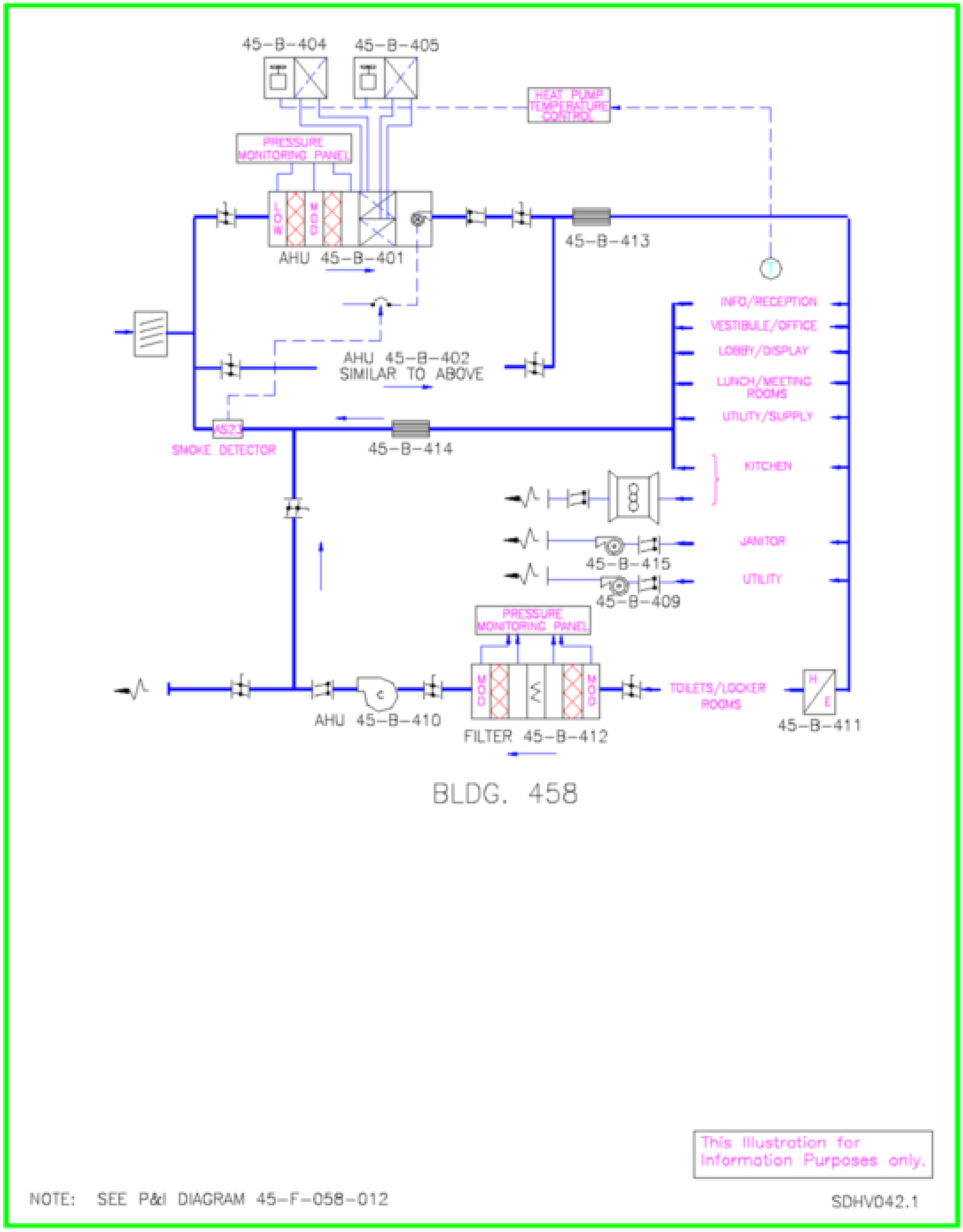

FIGURE HV VI-3: HV06 Guard and Security Bldg. HVAC Block Diagram

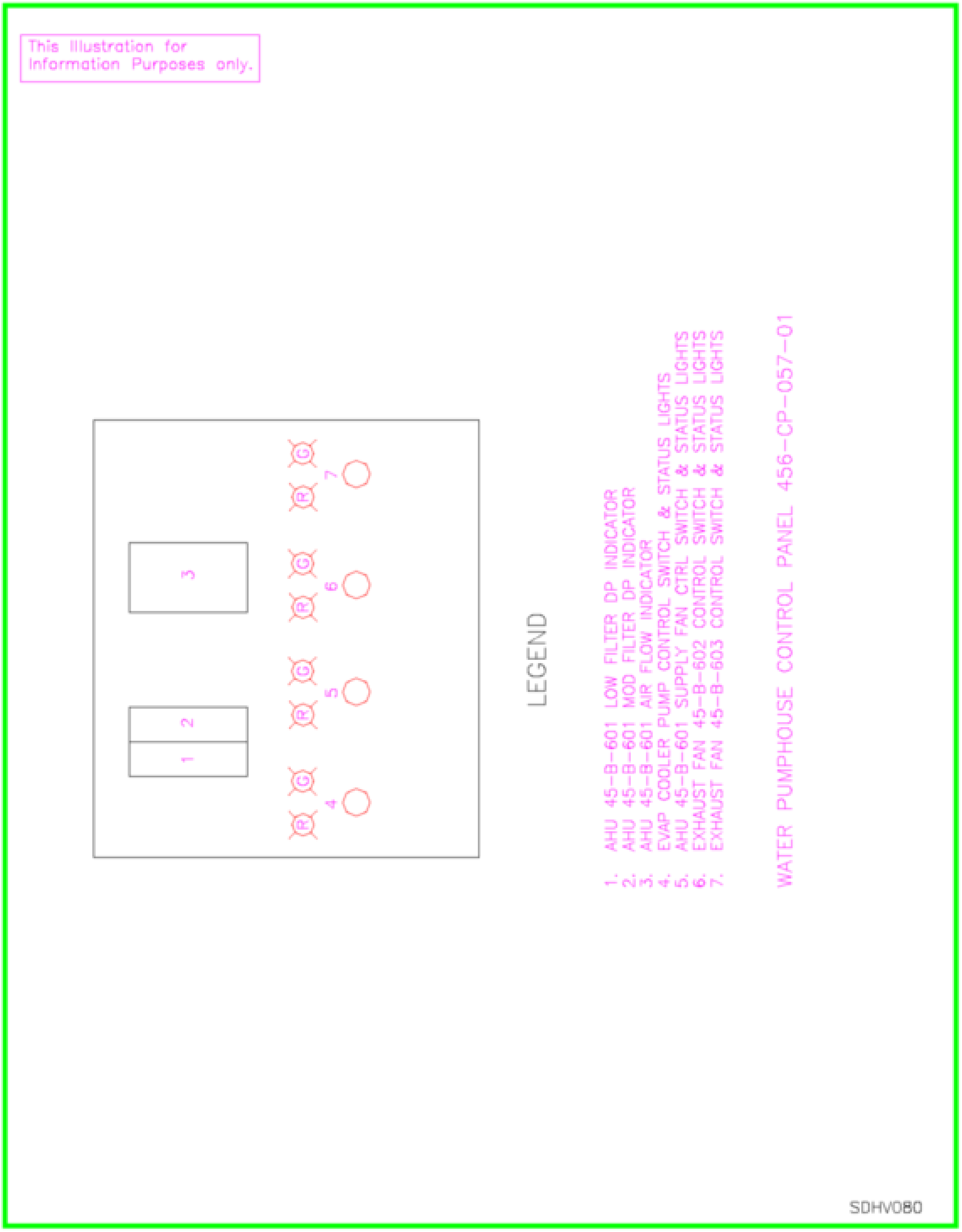

FIGURE HV VI-4: Water Pumphouse Control Panel Layout

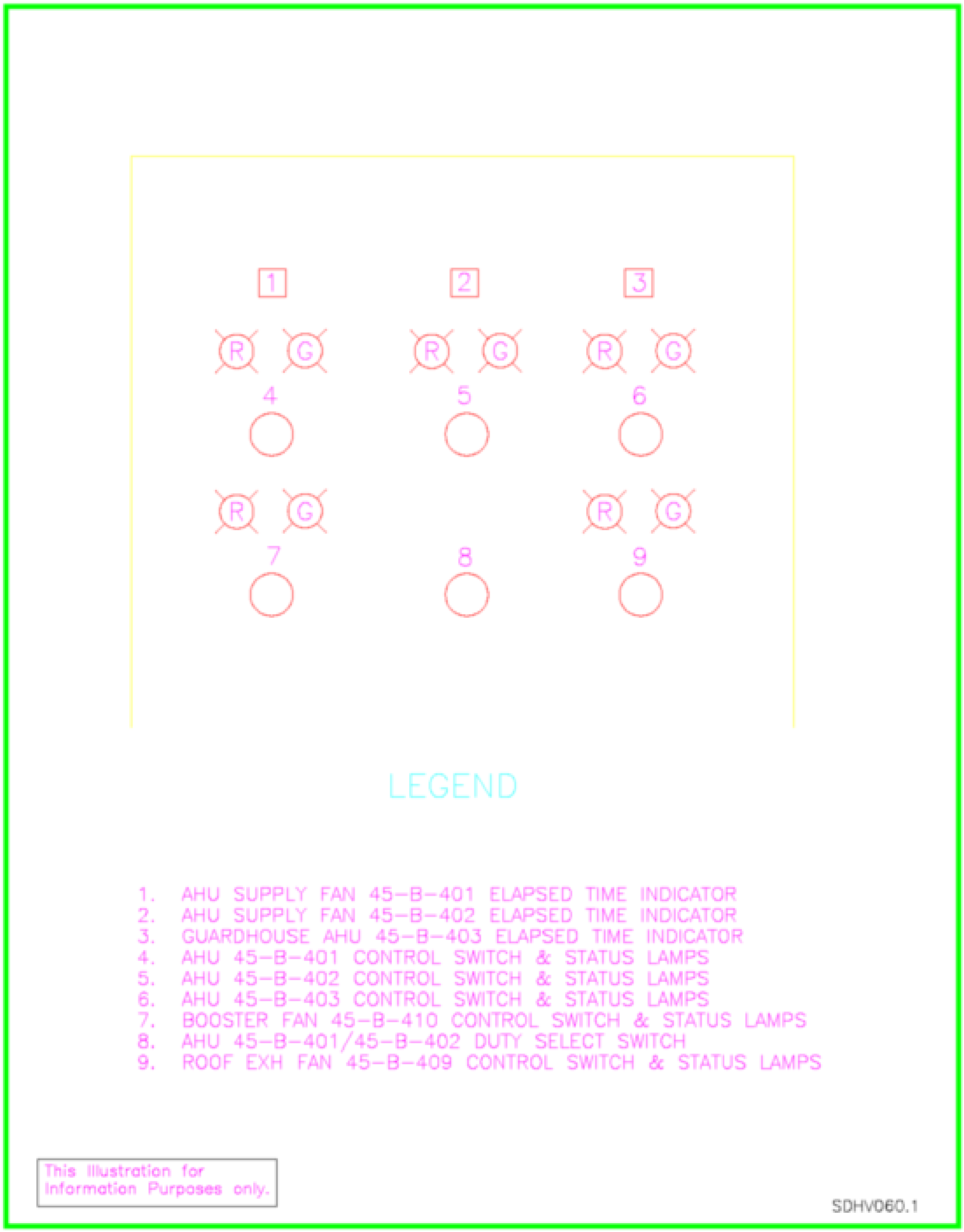

FIGURE HV VI-5: Guard & Security Bldg. HVAC Control Panel 458-CP-058-01

Chapter VII

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Chapter VII

Subsystem CW02 Chilled Water Cooling System

1.0 PRIMARY FUNCTIONS

Refer to Section 1.0 of Chapter G for the Primary Functions.

2.0 DESIGN REQUIREMENTS

2.1 General

Refer to Section 2.1 of Chapter G for the general design requirements.

2.1.1 Outdoor Design Conditions

Refer to Section 2.1.1 of Chapter G for the outdoor design conditions.

2.1.2 Ventilation

Refer to Section 2.1.3 of Chapter G for the general ventilation requirements.

2.2 Subsystem General Requirements

2.2.1 Chilled Water System (CW02)

2.2.2 Two 50% capacity air cooled centrifugal chilled water units along with two 50% capacity chilled after pumps shall be provided for the WHB. These chillers shall also serve the SB and the TMF.

2.2.3 Normal design supply temperature for chilled water shall be 44 F and the return water temperature shall be 56° F.

2.3 Operational Requirements

Refer to Section 2.3 of Chapter G for the general operational requirements.

2.3.1 Chilled Water System CW02

There are no unique-function related operational requirements for the CW02 System.

2.4 Structural

Refer to Section 2.4 of Chapter G for the structural requirements.

2.5 General Arrangement and Essential Features

2.5.1 CW02 System

2.5.1.1 The water chiller units shall be located outside the WHB on a concrete pad.

2.5.1.2 A 35%-50% mixture of glycol, water, and inhibitors shall be used to protect the CW02 system against freezing and the piping from corrosion.

2.5.1.3 The major components of the CW02 system include:

a. Air cooled water chillers
b. Chilled water pumps
c. Piping
d. Expansion Tanks
e. Controls and instruments

2.6 Maintenance

Refer to Section 2.6 of Chapter G for the general maintenance requirements.

2.7 In-Service Inspections

Refer to Section 2.7 of Chapter G for the general in-service inspection requirements.

2.8 Instrumentation and Control

Refer to Section 2.8 of Chapter G for the general I&C requirements.

2.9 Interfacing Systems

2.9.1 General

Refer to Section 2.9.1 of Chapter G for the general interfacing system requirements.

2.9.2 Primary Interface

Refer to Section 2.9.2 of Chapter G for the primary interface general information and Appendix C for primary interface requirements.

2.9.3 Secondary Interfaces

Refer to Section 2.9.3 of Chapter G for the secondary interface general information and Appendix C-2 for secondary interface requirements.

2.10 Quality Assurance

Refer to Section 2.10 of Chapter G for the quality assurance requirements.

2.11 Codes and Standards

Refer to Section 2.11 of Chapter G for codes and standards.

2.12 Reliability Assurance

2.12.1 General

Refer to Section 2.12.1 of Chapter G for the general reliability assurance requirements.

2.12.2 CW02 System

In the event of a malfunction of one of the two 50%-capacity units, the system shall have the capability to operate at 50% capacity, by the shutdown of one chiller unit, and the associated pump.

3.0 DESIGN DESCRIPTION

3.1 Summary Description

Refer to Section 3.1 of Chapter G for the summary description.

3.1.1 CW02 Systems

Three separate CW02 systems provide cooling in the WHB, SB, the S&EB

The WHB CW02 system contains two pump/chiller trains which operate in a lead/lag mode as the demand for cooling changes.

The CW02 systems in the EB and S&EB each consist of a single-pump/chiller combination.

3.2 Detailed System Description

3.2.1 CW02 Cooling System

Three separate CW02 cooling systems provide cooling for the WHB and SB, the EB and the S&EB. Layout and design features of these three systems are provided in the following sections.

Major components of the CW02 subsystems are described in Section 3.5.1.

3.2.2 WHB and SB CW02 System

The main units of the WHB and SB CW02 system are located outdoors on pads to the west of the SB (FAC 414). An adjacent hut contains the system control panel, which is described in Section 3.6.1. The secondary loop pumps are located on the second floor mechanical equipment room in the WHB.

3.2.3 WHB and SB CW02 System General Description

A block diagram, describing the principal features of this CW02 system and the loads it supplies, is shown in Figure HV VII-1. The system comprises two centrifugal pumps, which operate in parallel to circulate a ethylene glycol/water mixture in the primary loop. A second pair of variable speed pumps are provided to circulate water to the SB and WHB.

An air separator is located on the suction of the primary pumps to remove any entrained air and vent it to the expansion tank.

Cooling water coils in Air Handling Units (AHUs) in the WHB and SB are supplied by secondary pumps drawing water from the primary loop. Control of the cooling water coil isolation valves is described in connection with the controls and interlocks of the AHUs which they serve.

3.2.4 WHB and SB CW02 System Controls and Interlocks

The main chilled water system operates as a primary-secondary pumping system. A constant flow pipe and pump loop (primary) contains connections for the secondary pumps. The secondary loops draw water from the primary loop and sends water to the chilled water coils. See figures HV VII-1 and VII-1A. Each secondary loop, WHB and SB, operate independently of one another.

DDC (Building Automation System) controls for the CH Bay, RH Bay, TMF, and the SB, transmit cooling demand signals based on an adjustable demand level to the chiller and pump controls which request chilled water for each of the above listed buildings.

<u>Primary Loop</u>

The controller modules control the operation of the chillers and primary pump independently of the secondary loop. A primary pump will be paired with one chiller, and the control system allows any pump to be paired with any chiller.

Chiller A and B operate in a lead/standby configuration so that should the lead chiller fail to operate or otherwise maintain chilled water setpoint, the associated pump will be de-energized and the standby pump and chiller will automatically be energized. The BAS controller will alternate "lead" designation between chiller systems based on adjustable runtime hours. If the extreme environmental conditions prevent the operating chiller from maintaining the chilled water temperature below an adjustable high limit, the control system will automatically start the idle chiller to lower the chilled water temperature.

In case the secondary pumps fail to operate, manual valves can be opened to allow the primary pumps to supply a reduced flow of chilled water to the WHB or SB through a secondary pump bypass.

Secondary Pumps

The differential pressure transmitter measures the differential pressure between the supply and return loop. The ASD regulates the speed of the pump according to the input from the proportional-integral-derivative control in order to maintain a constant, predetermined differential pressure. As the cooling requirements decrease, the chilled water control valves will close to reduce the flow through the coil. As this happens, the pump discharge pressure will increase. It is necessary to reduce the pump flow rate in response to the decreased flow demand. The pump speed is slowed when the differential pressure is higher than the predetermined setpoint, and the pump speed is increasing when the differential pressure is lower than the setpoint.

When hand switches are in the off position, the system is shut down, and there is no power or control signal.

When in the "AUTO" position, a cooling demand signal will control the secondary pumps. When the cooling demand reaches a preset, adjustable value, the pumps will start.

The lead-lag-setting in the control program will determine which pump starts. The control system will close the motor starter relay, and give the run command to the ASD. Then the pump will start and operate according to the operation sequence. When the motor starter relay is energized, it opens the normally closed contacts to prevent the lag (standby) pump from starting.

3.2.5 Engineering Building (EB) CW02 System

This system comprises a chiller unit located on an outdoors concrete pad at the SE corner of the EB. It is connected to a chilled water pump and other coolant circulation equipment contained in the adjacent mechanical equipment room in the EB.

3.2.6 EB CW02 System General Description

Figure HV VII-2 contains a block diagram showing the principal features of the EB CW02 system. The system consists of centrifugal pump 45-G-405, which circulates a glycol water mixture through the AHU cooling coils, and chiller unit 45-E-407. The chiller is a package unit as described in Section 3.5.2 for the WHB chiller system.

An air separator, positioned at the inlet to the pump, vents air to the system expansion tank.

Makeup water is provided through a connection to the facility water main which contains a pressure regulating valve. Two backflow valves with an intermediate connection to a drain tank eliminate the risk of ethylene/glycol entering the facility water distribution system.

A shot feeder, connected across the pump, provides means for adding ethylene/glycol to the system. Note that because of the presence of ethylene/glycol this system cannot be vented into the facility drains. It must be emptied into drums which can then be stored or disposed per WIPP Controlled Operating Procedures.

3.2.7 EB CW02 System Controls and Interlocks

The circulating pump is controlled by an adjacent starter. A timer is provided which, when activated, will provide coolant flow only at selected times.

The chiller is controlled by an integral control panel which operates to maintain the evaporator outlet chilled water temperature at its setpoint value.

An interlock prevents the startup of the chiller if the circulating pump is not in operation.

Interlocks de-energize the chiller in the event of low evaporator coolant flow or low coolant inlet temperature.

Chiller operation is based on a constant chilled water flow rate with bypasses around loads to allow for changing demand. Chilled water is supplied to the cooling coil in each AHU through a separate modulating three way valve which adjusts the flow through that AHU cooling coil in accordance with the ambient temperature requirements of the zones supplied.

3.2.8 Safety and Emergency Building (S&EB) CW02 System

This system is very similar to the EB CW02 system described in Section 3.2.5. It is made up of an outdoor chiller unit located on a concrete pad on the east side of the S&EB connected to coolant circulation equipment within the adjacent garage area, circulating pump and associated equipment.

3.2.9 S&EB CW02 System General Description

Figure HV VII-2 contains a block diagram showing the principal features of the S&EB CW02 system. The system consists of a centrifugal pump, which circulates a glycol water mixture through the AHU cooling coils, and chiller unit. The chiller is a package unit described in Section 3.5.2 for the WHB CW02 system.

An air separator positioned at the pump suction vents air to the system expansion tank.

Makeup water is provided through a connection to the facility water main which contains a pressure regulating valve. A backflow valve eliminates the risk of ethylene/glycol entering the facility water distribution system.

A shot feeder, connected at the pump outlet, provides means for adding ethylene/glycol to the system. Note that because of the presence of ethylene/glycol this system cannot be vented into the facility drains. A drain cock at the air separator allows it to be emptied into drums which can then be stored or disposed of as appropriate.

3.2.10 S&EB CW02 System Controls and Interlocks

The circulating pump is controlled by an adjacent starter. A timer is provided which, when activated, will provide coolant flow only at selected times. A thermostat overrides the time clock when the temperature exceeds its setpoint.

The chiller is controlled by an integral control panel which operates to maintain the evaporator outlet chilled water temperature at its setpoint value.

An interlock prevents the startup of the chiller if the circulating pump is not in operation.

Interlocks de-energize the chiller in the event of low evaporator coolant flow or low coolant inlet temperature to minimize the risk of freezing pipes.

Chiller operation is based on a constant chilled water flow rate through the cooling coils in AHUs. Air cooling in areas served by these AHUs is provided by local thermostats which cycle the fans in the AHUs on and off.

3.3 System Performance Characteristics

In the event of a malfunction in the CW02 Subsystems for any of the HVAC areas supported (i.e., WHB, Support Bldg CMS, EB, and S&EB), there are no safety consequences involved. Hence, there are no special system performance characteristics or requirements for the CW02 Subsystem other than operation under ambient environmental conditions.

3.4 Heating Ventilating and Air Conditioning System Arrangement

3.4.1 Layout of CW02 (Chilled Water System) Equipment for the WHB

The WHB CW02 system is located outdoors on the west side of the WHB. Figure HV VII-3 shows the layout of the equipment. Individual components are positioned on pads grouped near Building 414 which contains a control panel. The interconnecting piping of the CW02 system is carried in overhead pipe runs supported by steel trestles which also support the expansion tanks. It then connects to the WHB through a below grade run in a concrete lined trench. The pipe insulation is protected by an outer cladding aluminum.

Each of the two chiller units has an external electrical supply cubicle and a control panel located inside an enclosed equipment module which also contains the compressor, evaporator and lubrication system as shown in Figure HV VII-4.

The chemical injection system is carried on a skid which can be positioned alongside either pump. At each location it can be connected across the pump by flexible hoses fastened to hose connection stubs at the inlet to the pump and at the inlet to the chiller unit related to that pump.

3.4.2 Layout of CW02 (Chilled Water System) Equipment for the Engineering Building

The Engineering Building (EB) chilled water system is located outdoors on the east side of the EB. Figure HV VII-6 shows the layout of the equipment. Individual components are grouped on a pad outside the building, and also, inside the building. The interconnecting piping of the chilled unit has an external electric supply cubicle and a control panel located inside the chiller unit as shown in Figure HV VII-8.

3.4.3 Layout of CW02 (Chilled Water System) Equipment for the Safety and Emergency Building

The Safety and Emergency Building chilled water system is similar to the Engineering Building chilled water system. Figure HV VII-7 shows the layout of the equipment. Individual components are grouped on a pad outside the building, and also, inside the building. The interconnecting piping of the chilled water system is carried in buried piping from the chiller to the building. The chiller unit has an external electric supply cubicle and a control panel located inside the chiller unit as shown in Figure HV VII-9.

3.5 Component Design Description

3.5.1 CW02 Equipment

This equipment is described in terms of two equipment categories:

The packaged chillers are described in Section 3.5.2.

The centrifugal pumps and other chilled water circulation components are described in Section 3.5.3.

3.5.2 Air-Cooled Water Chillers

Four chiller units serve the CW02 equipment in the WHB, SB, EB and S & EB as described in Table HV VII-1.

TABLE HV VII-1: Summary of Subsystem CW02 Chillers

Area Served	Capacity (Nom Tons)
WHB/SB	260
EB	80
S&EB	50

All four chillers are modular, factory assembled units designed for outdoor operation. Each design incorporates a serviceable hermetic reciprocating or rotary compressor, a direct expansion liquid cooler, an air cooled condenser and an enclosure which contains these components with all their accompanying piping, wiring, controls, etc. A description of the two units are available in the Installation and Instruction manuals available in the Engineering File Room.

3.5.3 CW02 Circulation Components

The components which make up the CW02 system consist of circulating pumps, expansion tanks, air separators and the required interconnecting piping. Below is a list of the components supplied with the WHB CW02 system. This list can be used to provide an account of similar components in the chilled water systems in the EB and S&EB.

- Chilled Water Circulating Pumps
- Air Separators and Expansion Tanks
- Piping, Valves and Insulation

3.6 Instrumentation and Control

3.6.1 Subsystem CW02 I&C Equipment

All three CW02 systems utilize modular chillers with integral control panels. A description of a typical control panel for the two chillers serving the WHB/SB CW02 system is contained in Section 3.2.1.

Additional controls on the CW02 systems in the EB and S&EB are limited to a local motor starter on the circulating pump in each instance. The EB and S & EB systems are simple in operation and therefore are not discussed in detail. In the case of the WHB CW02 system, which has dual chiller/circulating systems, a separate panel, is provided. This panel is described in Section 3.6.2

3.6.2 WHB/SB CW02 System Control Panel

The WHB/SB CW02 system controls are in the BAS control module in the hut near the chiller pad. This panel contains the control modules, transformers, and other electronic devices; there are no controls within this panel that require periodic calibration or maintenance. Like all BAS subsystems at WIPP, control manipulations are made through the computer interface.

The functions performed by this panel are described in Section 3.2.2. Figure HV VII-1 contains a block diagram of the principal components controlled in Subsystem CW02.

3.7 System Interfaces

Refer to Appendix C of Chapter VIII and Section 3.7 of Chapter G for primary and secondary interface information.

4.0 OPERATION

4.1 Operation of the WHB and SB CW02 System

CW02 operational sequences and prerequisites are presented in the WIPP Controlled Operating procedures which are controlled documents.

5.0 SYSTEM LIMITATIONS, SETPOINTS, AND PRECAUTIONS

Refer to Section 5.5 of Chapter G for the general information regarding CW02 system precautions.

An explanation of all points that are contained in the digital control system are beyond the scope of this document; furthermore most set points are the type that are established during start up of the system or will be changed as operators gain experience and adjust the system for optimal performance.

Some, not all, of the different set points are established as operational adjustments and not as a design function are listed below:

- Number of cooling demand signals required to start chilled water pumps
- Pump speed control pressure set point
- Alarm lock out timers
- "Delay on make" and "delay on break" timers

The following set point is established as a design function and should not normally be adjusted:

- Chilled water supply temperature, 44 F

NOTE

Chilled water return temperature is not a set point.

6.0 OFF-NORMAL EVENTS AND RECOVERY PROCEDURES

The following list of events can impact the Subsystem CW02 systems. However, these events relative to the CW02 systems are not considered off-normal relative to waste handling operations.

- Loss of electrical power
- Fire
- Design Basis Earthquake/Tornado

7.0 MAINTENANCE

Refer to Section 7.0 of Chapter G which presents maintenance requirements for chilled water process equipment.

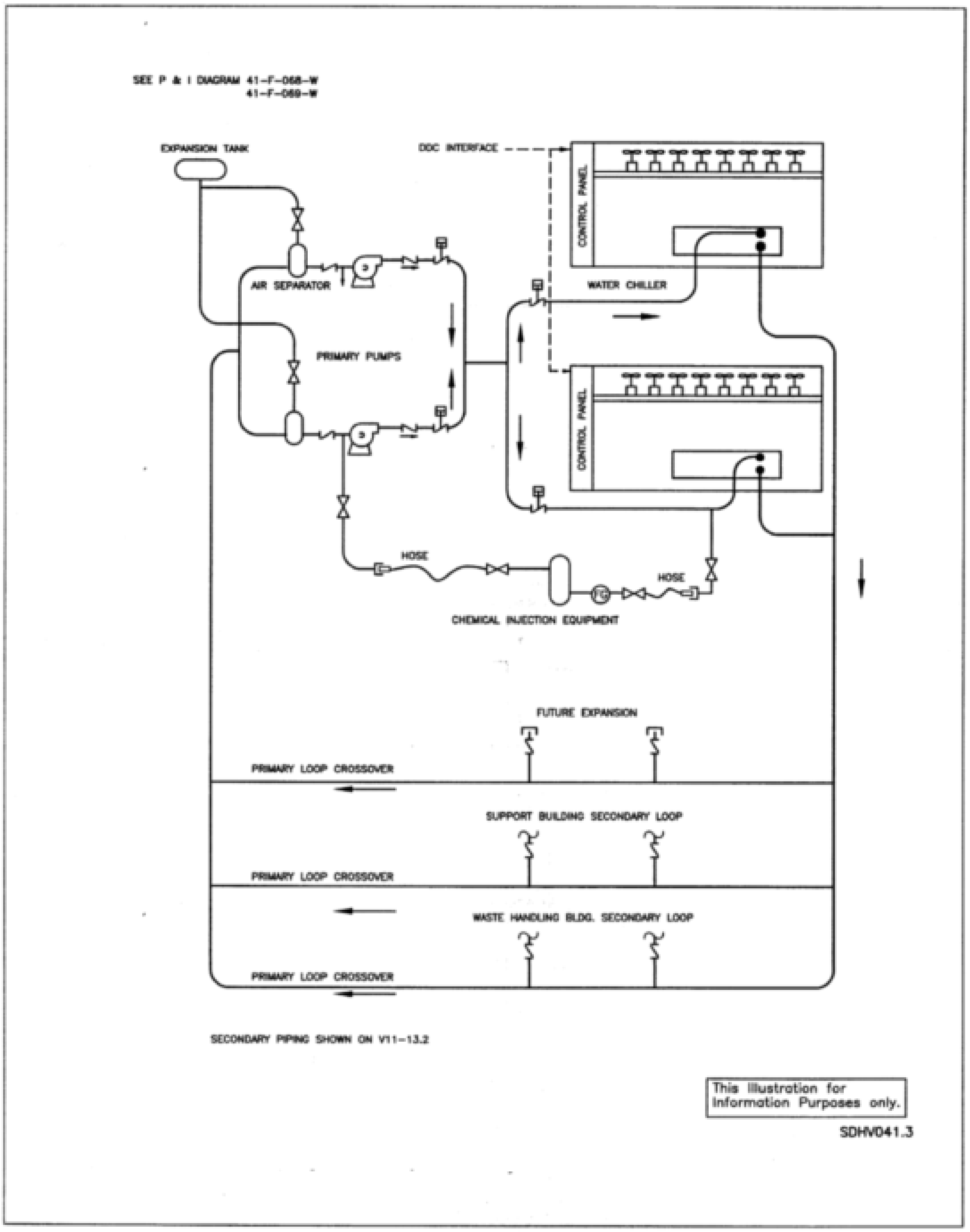
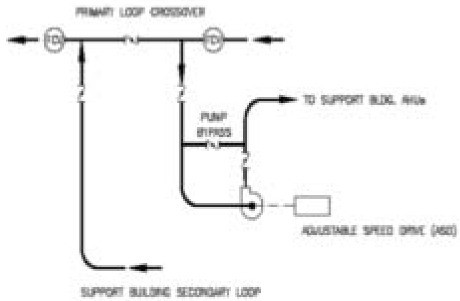
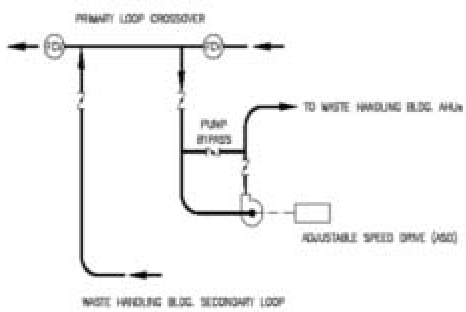


FIGURE HV VII-1: CW02, Waste Hdlg. Bldg. Chilled Water Subsystem Block Diagram



CHILLED WATER SERVICES IN SUPPORT BLDG.451			
SUBSYSTEM	SERVICE	AHU NO.	P & ID
HV03	ZONE 1	45-B-101	45-B-051-W
	ZONE 2	45-B-112 45-B-113	45-B-053-W
	ZONE 3	45-B-105	45-B-052-W
	ZONE 4	45-B-120	45-B-054-W
	ZONE 5	45-B-125	45-B-050-W



CHILLED WATER SERVICES IN WASTE HANDLING BLDG.411			
SUBSYSTEM	SERVICE	AHU NO.	P & ID
HV01	CH WASTE HANDLING AREA HVAC SYSTEM	45-B-812 45-B-813	45-B-001-W
	MECHANICAL ROOM HVAC SYSTEM	45-B-881 45-B-883	
HV02	RH WASTE HANDLING & HOT CELL HVAC	45-B-803 45-B-804 45-B-807	45-B-051-W
	BIN MODEL HVAC SYSTEM	45-B-891 45-B-892	45-B-086-W

This Illustration for Information Purposes only.

SDHV043.1

FIGURE HV VII-1A: CW02 Waste Hdlg. Bldg. Chilled Water Subsystem Block Diagram

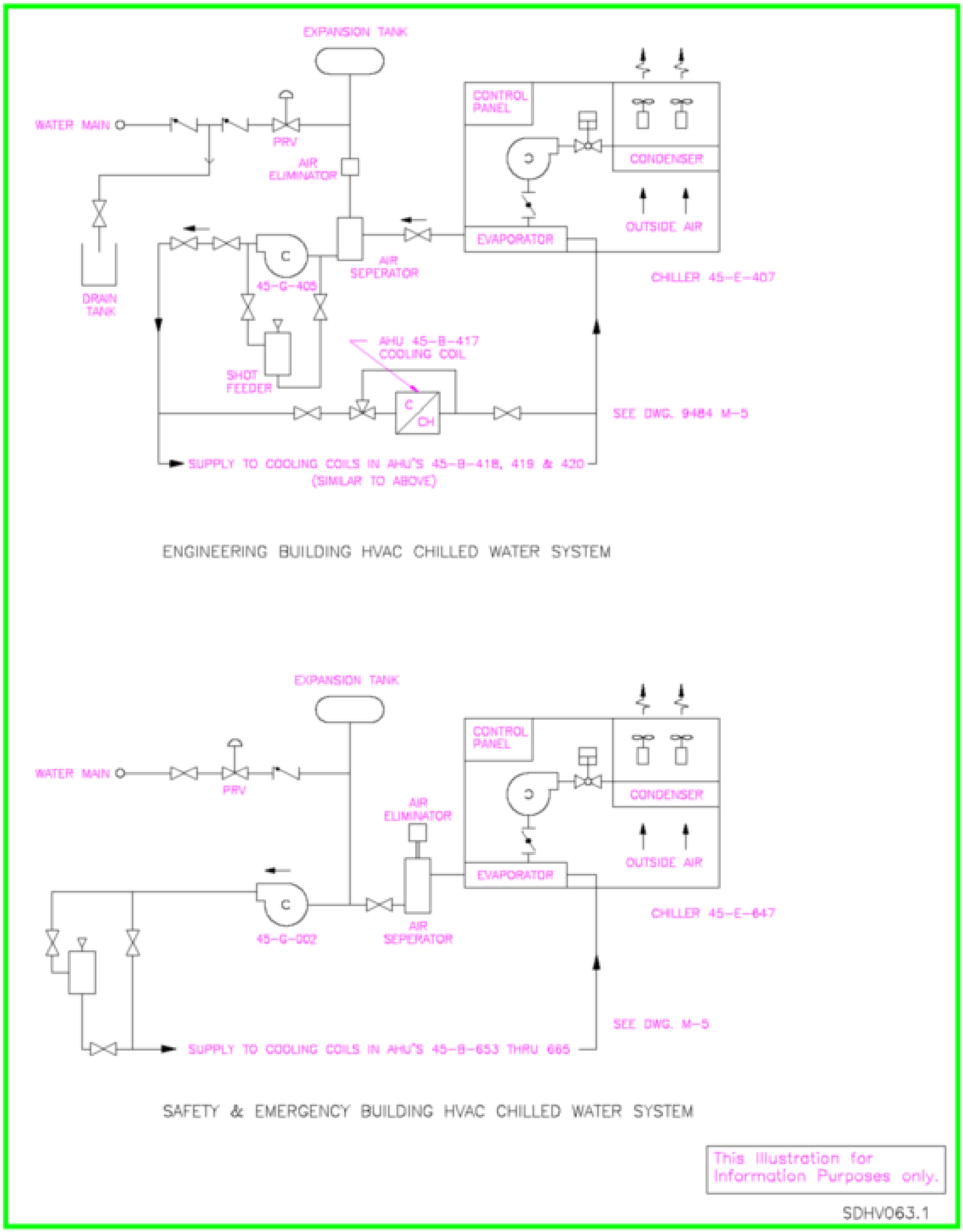


FIGURE HV VII-2: Block Diagrams of Chilled Water Systems in the Engineering and Safety and Emergency Buildings

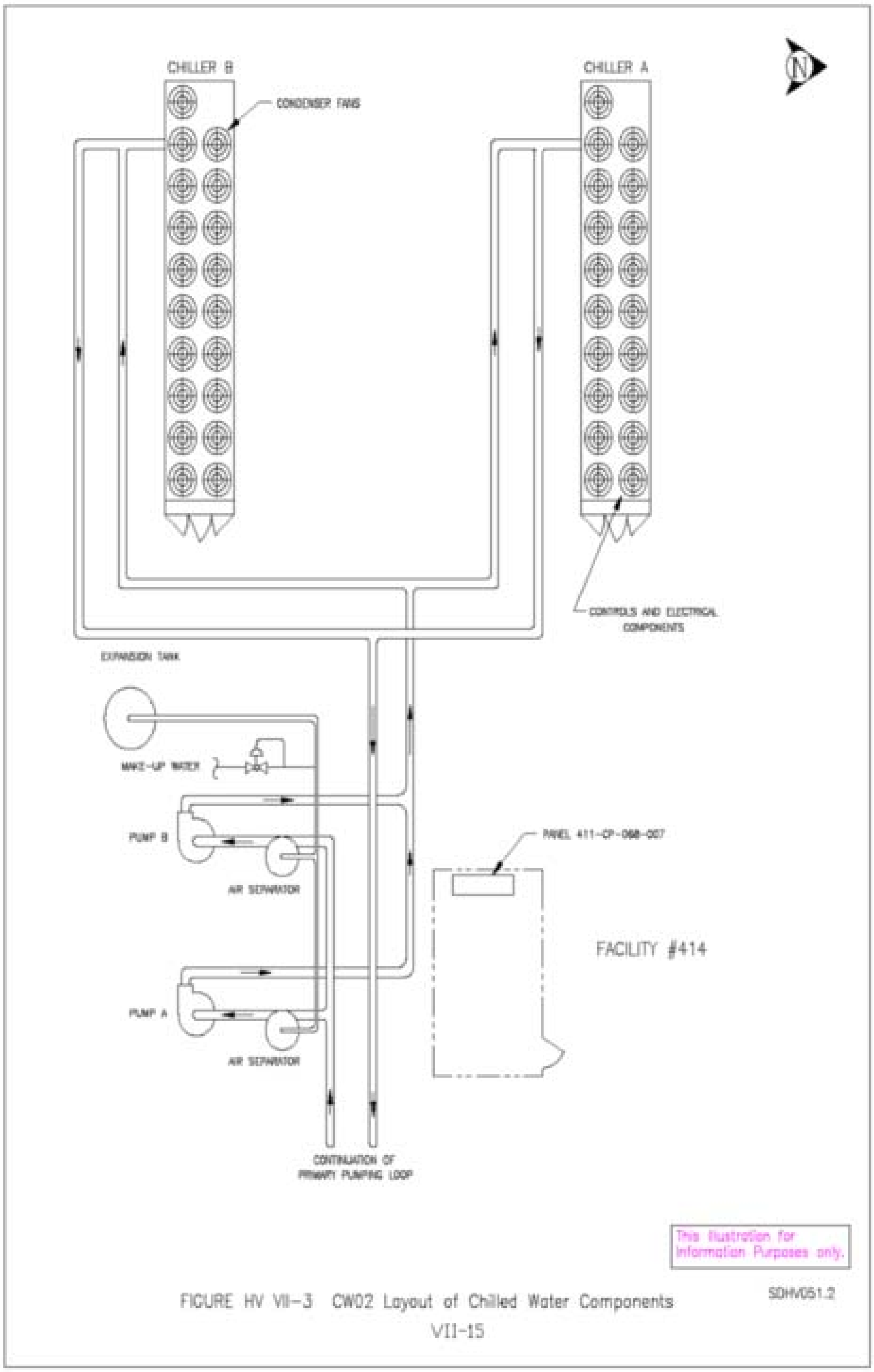


FIGURE HV VII-3: CW02 Layout of Chilled Water Components

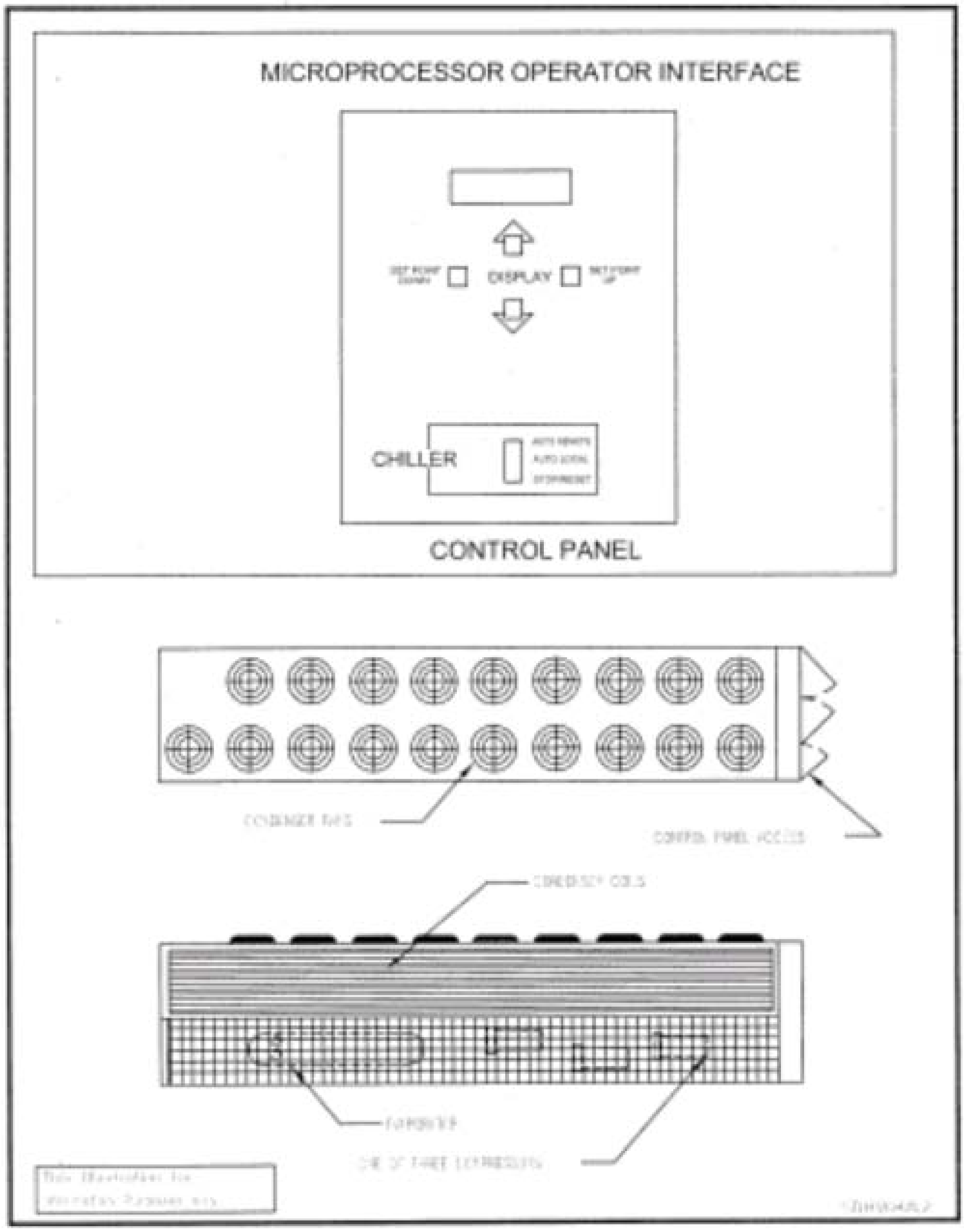


FIGURE HV VII-4: CW02 Chiller, Component Schematic and Panel Layout

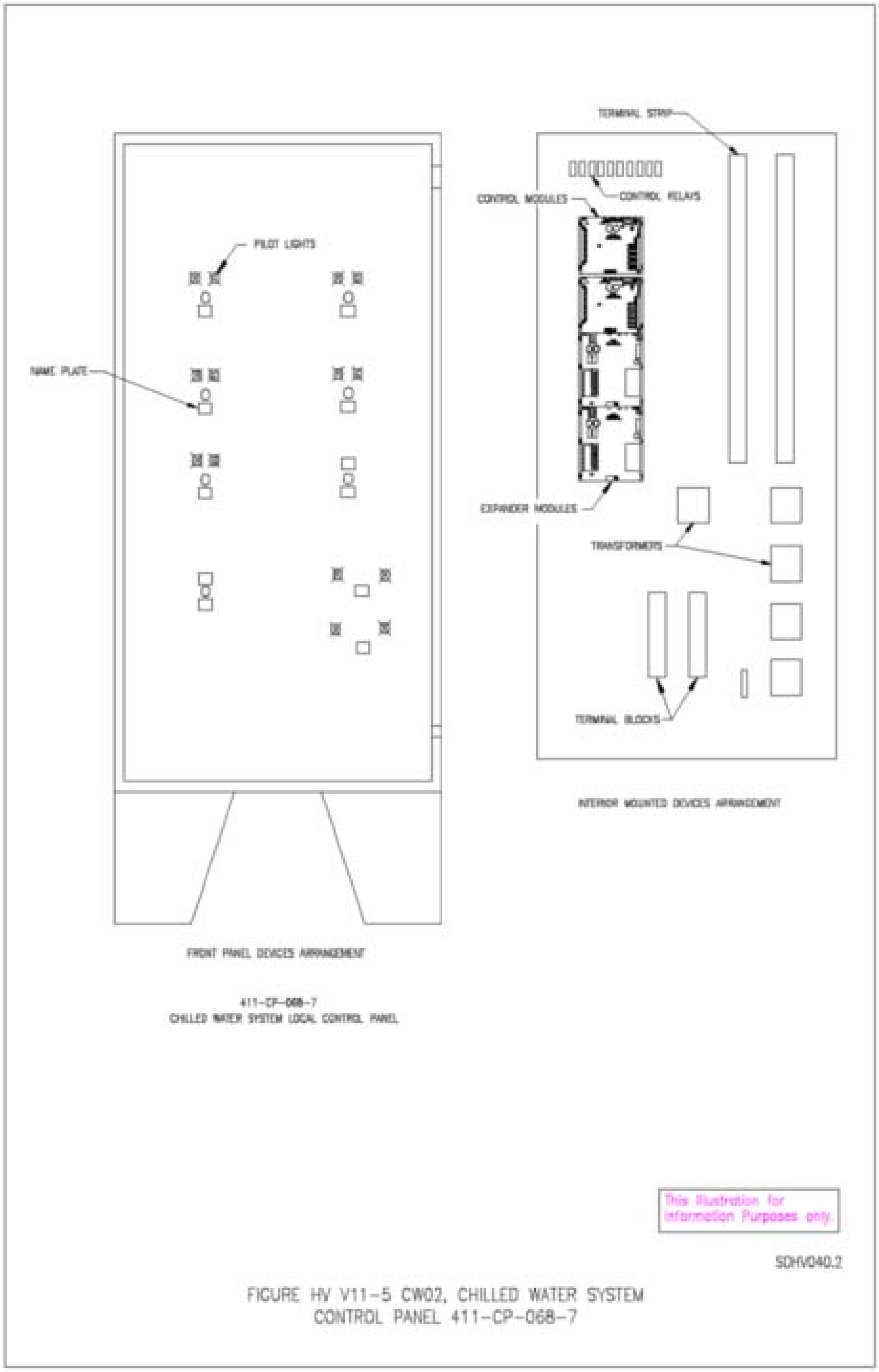


FIGURE HV VII-5: CW02 Chilled Water System Control Panel 411-CP-068-7 Layout

Chapter VIII

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APPENDICES

APPENDICES

STATEMENT OF INTENT

The appendices to this SDD are provided for information purposes only and do not form part of the controlled document.

Some of the data contained in these appendices may also appear elsewhere in controlled documents. Should a conflict exist between information in an appendix and that contained in a controlled document, the controlled document will always have precedence.

APPENDIX A

DEFINITIONS OF ACRONYMS

Acronym	Definition
AC	Alternating electrical current
A/D	Analog to digital (signal conversion)
AHU	Air Handling Unit
AMCA	Air Movement and Control Association
ANSI	American National Standards Institute
ARI	Air-Conditioning and Refrigeration Institute
ASD	Adjustable Speed Drive
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
ASME	American Society of Mechanical Engineers
BAS	Building Automation System
BTU	British Thermal Unit
ccw	counterclockwise
cfm	cubic feet per minute
cw	clockwise
CA00	Compressed Air System
CAM	Continuous Air Monitor
CAV	Constant Air Volume
CB	Circuit Breaker
CF00	Plant Buildings, Facilities and Miscellaneous Equipment System
CH	Contact Handled
CM01	Plant Monitoring and Communication System
CMR	Central Monitoring Room

Appendix A – Definitions of Acronyms

Acronym	Definition
CMS	Central Monitoring System
CVATs	Constant Volume Air Terminal Units
CW02	Chilled Water System
db	decibels
D/A	Digital to Analog
DBE	Design Basis Earthquake
DBT	Design Basis Tornado
DC	Direct Current
DDC	Direct Digital Control
DOE	Department of Energy
DP	Differential pressure
DWDI	Double Width Double Inlet
EB	Engineering Building
ED	Exhaust Damper
ED00	Electrical Distribution System
EFB	Exhaust Filter Building
EM00	Environmental Monitoring System
EOC	Emergency Operations Center
ERF	Exhaust/Return Fan
fpm	feet per minute
FP00	Fire Protection System Designator

Appendix A – Definitions of Acronyms

Acronym	Definition
gpm	gallons per minute
GC00	General Civil and Structural System
GPDD	General Plant Design Description
GUI	Graphical User Interface
HEPA	High Efficiency Particulate Air (Filter)
HP	Horsepower or High Pressure
HOA	Hand-Off-Auto
HVAC	Heating Ventilating and Air Conditioning
HV00	Heating, Ventilating and Air Conditioning System
Hz	Hertz, unit of frequency
I&C	Instrumentation and Control
I/O	Input/Output
kV	kilo Volt
kW	kilo Watt
LP	Low Pressure
LPU	Local Processing Unit
MCC	Motor Control Center
MOD	Moderate Efficiency filter
NC	Normally Closed
NEC	National Electric Code
NEMA	National Electric Manufacturers Association

Appendix A – Definitions of Acronyms

Acronym	Definition
NFPA	National Fire Protection Association
NO	Normally Open
O&M	Operations and Maintenance (manual)
OA	Outside Air
OD	Outside Damper
psig	pound per square inch, gauge
PDD	Pressure Differential Damper
PDT	Differential pressure transmitter
P&I	Piping & Instrumentation
P&ID	Piping & Instrumentation (Diagram)
PID	Proportional, Integral, and Derivative
PM	Preventive Maintenance
QA	Quality Assurance
rpm	revolutions per minute
RD	Return Damper
RH	Remote Handled
RM00	Radiation Monitoring System
SAR	Safety Analysis Report
SB	Support Building
SDD	System Design Description
S&E	Safety & Emergency Services Facility Building
SMACNA	Sheet Metal and Air Conditioning Contractors National Association

Appendix A – Definitions of Acronyms

Acronym	Definition
SWSI	Single Width Single Inlet
TMF	TRUPACT Maintenance Facility
U/G	Underground
UH00	Underground Hoisting System
UL	Underwriters Laboratory
UPS	Uninterruptible Power Supply
V	Volts
VAV	Variable Air Volume
VU00	Underground Ventilation System
wg	water gauge
WD00	Water Distribution System
WHB	Waste Handling Building
WH00	Waste Handling Equipment System
WIPP	Waste Isolation Pilot Plant
WP	Water Pumphouse
WS	Waste Shaft
W/S	Warehouse and Shops Building (453)

Appendix B – Room Operating Pressures in the WHB

APPENDIX B-1

ROOM OPERATING PRESSURES IN THE WHB

ROOM NO.	DESCRIPTION	PRESSURE IN. H_2O GAGE		
		MAX.	MIN.	NOM.
076	Stair #3			
077	Air Lock			0.00(4, 2)
078	Service Rm and Corridor			
079	Transfer Cell	-0.25(4)	-0.35(4)	-0.30(2,4)
086	Stair #3 Landing			-0.10
087	Service Room	-0.0(2)	-0.15(2)	-0.10(2, 4)
100	Air Lock	0.00(6, 2)	-0.05(6, 2)	
101	Air Lock	0.00(6,2)	-0.05(6,2)	
102	Air Lock	0.00(6,2)	-0.05(6, 2)	
103	Contact Handling Area	-0.09(6)	-0.12(6)	-0.11
104	Cask Receiving Area		Never more (-) than CH Bay	0.0(2,4) (Relative to CH Bay)
105	Stair #1			0.00(6, 2)
106	Air Lock			0.00(6, 2)
107	Air Lock	0.00(6)	-0.12(6)	0.00(2)
108	TRUPACT-III BAY	-0.09	-0.12	-0.11

REFERENCES:
1) 41-B-010-W1
2) 41-F-075-W1 to W5
3) 41-F-030-014
4) 41-F-076-W
5) 41-B-058-W
6) 41-F-059-W
7) 41-F-063-W

Appendix B-1 – Room Operating Pressures in the WHB

APPENDIX B -1

ROOM OPERATING PRESSURES IN THE WHB
(continued)

ROOM NO.	ROOM DESCRIPTION	PRESSURE IN. H_20 GAGE		
		MAX.	MIN.	NOM.
109	Overpack Personnel Change	+0.05[6]	+0.01[6]	+0.05[2]
110	Air Lock	0.00[6]	-0.05[6]	0.00
111	Small Equipment Decontamination	-0.13	-0.16	-0.15
112	Site Generated Waste	-0.01	-0.06	-0.03
113	Air Lock	0.00[6]	-0.09[6]	0.00[2]
114	Personnel Access Corridor (Air Lock)	-0.07[6]	-0.08[6]	-0.075[2]
115	Air Lock			0.00[2]
115A	Air Lock			
116	Cage Loading (Air Lock)	-0.12[6,3]	-0.18[6,3]	-0.15[1]
117	Shaft Entry	-0.075[3]	-2.75[3]	See VU00 SDD for W.H.T. Pressures
118	Shielded Storage Area	-0.12[6]	-0.18[6]	-0.15[2]
119	Stair #2			0.00[2,4]
120	Facility Cask Loading (Air Lock)	-0.19[4]	-0.23[4]	-0.20[2,3,4]
121	Vestibule	-0.03[4]	-0.07[4]	-0.05[5]

REFERENCES:
1) 41-B-010-W1
2) 41-F-075-W1 to W5
3) 41-F-030-014
4) 41-F-076-W
5) 41-B-058-W
6) 41-F-059-W
7) 41-F-063-W

Appendix B-1 – Room Operating Pressures in the WHB

APPENDIX B-1

ROOM OPERATING PRESSURES IN THE WHB
(continued)

ROOM NO.	ROOM DESCRIPTION		PRESSURE IN. H_20 GAGE MAX.	MIN.	NOM.
122	Access Corridor		0.0(4)	Never more (-) than CH	0.0(2,4) (relative to CH Bay)
123	Filter Gallery		-0.14(4)	-0.20(4)	-0.15(2,4)
124	Hot Cell		-0.4(4)	-1.1(4)	-0.7(2,4)
125	Air Lock				
126	Transport Cask Unloading	10-160B	-0.19(4)	-0.23(4)	-0.20(2,4)
		72B	0.00	-0.23	0.00
127	Air Lock				
128	Transfer Cask Chute (Air Lock)				
129	Air Lock		+0.07(4)	-0.02(4)	+0.05(2,4)
130	Assay System Control				
200	Mechanical Equipment				-0.10(2,7)
202	Air Lock				-0.20(2)
203	Access Aisle EL-126'				
204	W.H.Power Room/Operator Station				
205	Air Lock				0.00(2)
206	Air Lock				0.00(2)

REFERENCES:
1) 41-B-010-W1
2) 41-F-075-W1 to W5
3) 41-F-030-014
4) 41-F-076-W
5) 41-B-058-W
6) 41-F-059-W
7) 41-F-063-W

Appendix B-1 – Room Operating Pressures in the WHB

APPENDIX B-1

ROOM OPERATING PRESSURES IN THE WHB
(continued)

ROOM NO.	ROOM DESCRIPTION	PRESSURE IN. H_20 GAGE		
		MAX.	MIN.	NOM.
207	Air Lock			+0.05(2)
208	Mech. Vent Supply			+0.05(1,2,7)
209	Manipulator Repair	-0.14(4)	-0.20(4)	-0.15(2,4)
210	Air Lock			0.00(2,4)
211	Hot Cell Operating Gallery	-0.09(4)	-0.13(4)	-0.10(2,4)
212	Air Lock			
224	Air Lock			
225	Air Lock			
400	Access Corridor EL-142'			+0.05(2,3)
401	Landing EL-142'			
402	Crane Maintenance	-0.09(4)	-0.13(4)	-0.10(2,3,4)
403	Air Lock			
404	Air Lock			
600	Deflection Sheave	-0.075(3)	-2.75(3)	See VU00 SDD for W.H.T. pressures
800	Waste Hoist	-0.075(3)	-2.75(3)	See VU00 SDD for W.H.T. pressures

REFERENCES:
1) 41-B-010-W1
2) 41-F-075-W1 to W5
3) 41-F-030-014
4) 41-F-076-W
5) 41-B-058-W
6) 41-F-059-W
7) 41-F-063-W

Appendix B-2 – WHB Air Handling Unit Data Sheets

APPENDIX B-2

WHB AIR HANDLING UNIT DATA SHEETS

AHU 41-B-803 and AHU 41-B-804

General Service
Area Serviced: RH Area Outdoor Design Temp: Winter, 19 F Indoor Design Temp: Winter, 65 F
Location: Outdoor on WHB Roof Summer, 100/71 F Summer, 80 F

Unit Overall Capacity & Dimensions
Capacity: Outside air = 19,000 cfm; Return Air = 0 cfm Total = 19,100 cfm
Total Weight: 11,500 lbs Overall Dimensions: 23ft L x 10 ft W x 6 ft 10ins H

Electrical Heating Coil Section
Power Supply = 350 KW Air Temp Rise = 58F Air P.D. = 0.23" W.G.
Voltage Supply = 480 V 3, phase, 60 cycle Face area 24 sq ft Weight 300 lbs

Cooling Coil Section
Rated Output = 608,581 BTUH Water Temp in/out = 44/57F Flow = 105 GPM
Water side p.d. = 8.5 ft
Air Temp in = 100/71 F Air Temp out = 68/62 F Air side p.d. = 0.38 " W.G.
Coil Dimensions: Area 38.5 sq ft Rows = 4 F.V. = 500 F.P.M. Fins 6 FPI

Evaporative Air Cooler Section
Rated Output = 465,000 BTUH Air temp in = 100/71F Air Temp Out 74.5/71 F
Cooler Effcy = 88% Water flow Rate = 17.5 GPM Pump Motor HP = 0.25

AHU Supply Fan Section
Fan Type: Centrifugal Discharge: Up-blast Fan drive: V- belt
Discharge Velocity = 2,530 FPM Total static pressure = 6.0 ins W.G. Total Effcy = 78%
Wheel Dia = 27 ins Blade Type: Airfoil, with variable inlet vanes
DWDI : 41-B-803 = CCW , 41-B-804 = CW
Motor rating: HP = 30; RPM = 1750, Supply Voltage = 460 volt, 3 phase, 60 cycle

Appendix B-2 – WHB Air Handling Unit Data Sheets

APPENDIX B-2
WHB AIR HANDLING UNIT DATA SHEETS (continued)
AHU 41-B-812 and AHU 41-B-813

General Service
Area Serviced: CH Area — Outdoor Design Temp: Winter, 19 F — Indoor Design Temp: Winter, 65 F
Location: Indoor, Room 208 (Mech Room Annex) — Summer, 100/71F — Summer, 80F

Unit Overall Capacity & Dimensions
Capacity: Outside air = 19,350 cfm; Return Air = 0 cfm; Total = 19,350 cfm
Total Weight: 11,500 lbs — Overall Dimensions: 23ft L x 10 ft W x 6 ft 10ins H

Electrical Heating Coil Section
Power Supply = 350 KW — Air Temp Rise = 57F — Air P.D. = 0.23" W.G.
Supply Voltage = 480 V 3, phase, 60 cycle — Face area 24 sq ft — Weight 300 lbs

Cooling Coil Section
Rated Output = 577,660 BTUH — Water Temp in/out = 44/57^{o}F — Flow = 100 GPM
Water side p.d. = 8.4 ft
Air Temp in = 100/71F — Air Temp out = 68/61F — Air side p.d. = 0.39 " W.G.
Coil Dimensions: Area 36 sq ft — Rows = 4 — F.V. = 504 F.P.M. — Fins 6 FPI

Evaporative Air Cooler Section
Rated Output = 433,240 BTUH — Air temp in = 100/71F — Air Temp Out 75/71F
Cooler Effcy = 87% — Water flow Rate = 16 GPM — Pump Motor HP = 0.25

AHU Supply Fan Section
Fan Type: Centrifugal — Discharge: Up-blast — Fan drive: V- belt
Discharge Velocity = 2,566 FPM — Total static pressure = 6.2 ins W.G. — Total Effcy = 78%
Wheel Dia = 27 ins — Blade Type: Airfoil, with variable inlet vanes
DWDI: 41-B-812 = CCW; 41-B-813 = CCW
Motor rating: HP = 30; — RPM = 1750, Supply Voltage = 460 volt, 3 phase, 60 cycle

Appendix B-2 – WHB Air Handling Unit Data Sheets

APPENDIX B-2
WHB AIR HANDLING UNIT DATA SHEETS (continued)
AHU 41-B-861 and AHU 41-B-863

General Service
Area Serviced: Mech Equip Room Outdoor Design Temp: Winter, 19F
Indoor Design Temp: Winter, 40F
Location: Indoor, Room 208 (Mech Room Annex) Summer, 100/71F Summer, 95F

Unit Overall Capacity & Dimensions
Capacity: Outside air = 3,500 cfm Return Air = 0 cfm Total = 3,500 cfm
Total Weight: 6,200 lbs Overall Dimensions: 20ft L x 6 ft W x 4 ft 4ins H

Electrical Heating Coil Section
Power Supply = 23 KW Air Temp Rise = 21F Air P.D. = 0.28" W.G.
Supply Voltage = 460 V 3, phase, 60 cycle Face area 4 sq ft Weight 80 lbs

Cooling Coil Section
Rated Output = 98,712 BTUH Water Temp in/out = 44/55F Flow = 20 GPM
Water side p.d. = 1.0 ft
Air Temp in = 100/71F Air Temp out = 71/63F Air side p.d. = 0.28 " W.G.
Coil Dimensions: Area 8 sq ft Rows = 4 F.V. = 438 F.P.M. Fins 6 FPI

Evaporative Air Cooler Section
Rated Output = 85,216 BTUH Air temp in = 100/71F Air Temp Out 75/71F
Cooler Effcy = 88% Water flow Rate = 5 GPM Pump Motor HP = 1/15

AHU Supply Fan Section
Fan Type: Centrifugal Discharge: Up-blast Fan drive: V- belt
Discharge Velocity = 1,850 FPM Total static pressure = 3.6 ins W.G. Total Effcy = 62%
Wheel Dia = 13.5 ins Blade Type: Airfoil, with variable inlet vanes
DWDI: CCW
Motor rating: HP = 7.5; RPM = 1750, Supply Voltage = 460 volt, 3 phase, 60 cycle

Appendix B-2 – WHB Air Handling Unit Data Sheets

APPENDIX B-2
WHB AIR HANDLING UNIT DATA SHEETS (continued)
AHU 41-B-807

General Service
Area Serviced: Hot Cell Outdoor Design Temp: Winter, 19F Indoor Design Temp: Winter, 50F
Location: Indoor, RH Cask Receiving Area: Summer, 100/71F Summer, 104F

Unit Overall Capacity & Dimensions
Capacity: Outside air = 0 cfm; Room Air = 6,800 cfm; Total = 6,800 cfm
Total Weight: 1,900 lbs Overall Dimensions: 5 ft L x 6 ft W x 9 ft 4ins H

Cooling Coil Section
Rated Output = 195,325 BTUH Water Temp in/out = 44/54.8F Flow = 40 GPM
Water side p.d. = 2.8 ft
Air Temp in = 100/71F Air Temp out = 70/62F Air side p.d. = 0.35" W.G.
Coil Dimensions: Area 13.75 sq ft Rows = 4 F.V. = 435 F.P.M. Fins 6 FPI

AHU Supply Fan Section
Fan Type: Centrifugal Discharge: Up-blast Fan drive: V- belt
Discharge Velocity = 1,975 FPM Total static pressure = 3.5 ins W.G. Total Effcy = 71%
Wheel Dia = 18 ins Blade Type: Airfoil DWDI: CW
Motor rating: HP = 7.5; RPM = 1750, Supply Voltage = 460 volt, 3 phase, 60 cycle

Appendix B-2 – WHB Air Handling Unit Data Sheets

APPENDIX B-2
WHB AIR HANDLING UNIT DATA SHEETS (continued)
AHU 41-B-869

General Service & Dimensions

Area Serviced: Waste Hoist Tower	Outdoor Design Temp: Winter, 19F	
	Indoor Design Temp: Winter, 45F	
Location: Indoor, Hoist Room	Summer, 100/71F	Summer, 104^{o}F Air Flow + 5,500 lbs
Total weight + 580 lbs	Overall Dimensions = 39" L x 56" H x 53" W	

Evaporative Air Cooler Section

Rated Output = 69,983 BTUH	Air temp in = 100/71F	Air Temp Out 75/71F
Cooler Effcy = 88%	Water flow Rate = 5.5 GPM	Pump Motor HP = 1/15

APPENDIX C-1

PRIMARY INTERFACE LIST

Interfacing System	Interface Description and Top Level Requirements
CA00	Provide a supply of instrument quality compressed air to operate the pneumatic control systems and dampers required for the operation of HV00 systems and equipment. Provide backup local supplies of compressed air for use in the WHB in the event of loss of the normal site air supply system.
CF00	Provide space, support, embedment and weather protection for system HV00 components. These provisions should take account of accessibility for inspection, maintenance and equipment removal. Provide airlocks in the WHB and the EFB which allow the area differential pressures specified in Appendix C1 to be maintained by the operation of HVAC systems in those areas.
CM01	Provide control and monitoring of System HV00 parameters as defined in Section 3.7.1.2 of Chapter G. Alarm, status, log, history, and trend functions of these parameters should be provided as defined in the registers of CMS inputs (Docs 71-X-001-W and 71-X-002-W).
ED00	Provide normal and backup diesel power, lighting, grounding and cabling for system HV00 equipment. 480V, 3 phase backup power is required for the following loads: · WHB exhaust fans, 100 KW · CMR HVAC, 20 kW
EM00	Provide a seismic trip signal, following the occurrence of a DBE, which can be used to operate the tornado damper solenoid valves.
FP00	Provide the fire and smoke detection signals required to allow the HVAC systems to be reconfigured following detection of a fire.

UH00	Provide a flow path for downcast air to the waste handling shaft which can be utilized by system HV00 for the normal ventilation of the waste hoist tower. Provide a system of bypasses flow dampers, which will open automatically in the event of an excessive downcast air flow in the waste handling shaft, and so prevent damage to the waste hoist tower
WD00	Provide a supply of treated water to system CW02 for both initial fill and makeup.

APPENDIX C-2

SECONDARY INTERFACE LIST

Interfacing System	Interface Description and Top Level Requirements
ALL	HV00 provides the environmental conditions and associated heat removal for the operation of all systems located in WIPP surface buildings.
FP00	In all surface buildings system HV00 provides control of local air supply in the event of a fire. It also provides a purging capability for smoke and fire suppressants which may be discharged.
CM01	In the event of a radiological release system HV00 automatically supplies filtered air to the CMR and computer room as required to ensure habitability. Also, following such an event, the HVAC system for the EOC can be reconfigured to prevent direct ingress of outside air.
WH00	HV00 provides filtration of exhaust air from all waste handling areas in the surface facility to ensure that any contaminants released are properly contained and disposed of.
VU00	HV00 provides filtration of exhaust air from the EFB filter chamber which contains the two main filter units for U/G exhaust air.
UH00	HV00 provides a supply of conditioned air which can be used to ventilate the waste hoist tower and can then be downcast in the waste handling shaft.
RM00	Provide continuous air monitoring for radioactivity in the exhaust air-streams from CH areas, RH areas, the EFB and laboratory areas in the SB.

Working Copy

SDD: VU00
Revision Number: 19
Revision Date: 11/18/13

U.S. DEPARTMENT OF ENERGY
WASTE ISOLATION PILOT PLANT

UNDERGROUND VENTILATION SYSTEM DESIGN DESCRIPTION (SDD)

SDD VU00

Prepared by
Nuclear Waste Partnership LLC
Carlsbad, New Mexico

For

U. S. Department of Energy

Cognizant Engineer:	Jill Farnsworth	On File	10/16/13
	(Printed Name)	(Signature)	(Date)
Cognizant Manager:	Reymundo Carrasco	On File	10/16/13
	(Printed Name)	(Signature)	(Date)

UNDERGROUND VENTILATION
SYSTEM DESIGN DESCRIPTION

SDD VU00

SUBSYSTEM APPROVAL

VU01 - EXHAUST FANS AND FILTERS

Cognizant Engineer:	Jill Farnsworth	On File	10/16/13
	(Printed Name)	(Signature)	(Date)

VU02 - BOOSTER FANS & INSTALLED AUXILIARY FANS & DUCTS

Cognizant Engineer:	Jill Farnsworth	On File	10/16/13
	(Printed Name)	(Signature)	(Date)

VU03 - VENTILATION CONTROL, BULKHEADS

Cognizant Engineer:	Jill Farnsworth	On File	10/16/13
	(Printed Name)	(Signature)	(Date)

VU04 - LOCAL TEMPORARY VENTILATION

Cognizant Engineer:	Jill Farnsworth	On File	10/16/13
	(Printed Name)	(Signature)	(Date)

VU05 - AIR INTAKE AND EXHAUST

Cognizant Engineer:	Jill Farnsworth	On File	10/16/13
	(Printed Name)	(Signature)	(Date)

VU06 - REMOTE MONITORING AND CONTROL

Cognizant Engineer:	Jill Farnsworth	On File	10/16/13
	(Printed Name)	(Signature)	(Date)

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0	7/91	Section 1.0, 2.0, 3.0, & 3.3	ECP 1-VU91-27 ECO NO. 5632
1	2/92	Revised Sect.1.0, 2.0, 3.3, & App Added Sect. 3.0, 4.0, 5.0, 6.0, 7.0	ECP 1-VU91-27 ECO NO. 6378
2	1/95	All Sections	ECP 2-VU91-244 ECO NO. 5895 ECP 1-VU92-100 ECO NO. 6996 ECP 1-VU93-092 ECO NO. 6815 ECP 1-VU93-091 ECO NO. 6816 ECP 2-VU93-115 ECO NO. 6903 ECP 1-VU93-122 ECO NO. 6913 ECP 1-VU93-182 ECO NO. 7037 ECP 1-VU93-110 ECO NO. 7042 ECP 1-VU93-148 ECO NO. 7052 ECP 1-VU94-022 ECO NO. 7120 ECP 1-VU94-028 ECO NO. 7157 ECO No. 7184 ECP 2-VU94-026 ECO NO. 7272 ECP 1-VU94-057 ECO NO. 7323 ECP 1-VU94-075 ECO NO. 7348 ECP 1-VU91-005 ECO NO. 7360 ECP 1-AU94-044 ECO NO. 7450 ECO NO. 7521 ECO NO. 7585

2	8/95	Page 2-8, 2.3.4.2.2 Page 3-21, 3.3.7	ECP 1-VU94-028 ECO NO. 7157 ECP 1-VU94-022 ECO NO. 7120, ADD. #1
2	8/95	Page Section 2-5, 2-12 2.2.6.3, 2.8.2.1 (g) 2-13, 3-4 2.8.3.1, 3.1.6 3-11, 3-13, 3.2.6 3-13A, 3-70 3.5.6 3-74, 3-74A 3.5.6.3 3-122, 3-123 3.6.6 7-11, 7-11A 7.4.3.4, 7.4.6 7-12 7.4.6 7-13 7.5 APP-14 APPENDIX F-2 APP-28 APPENDIX S 3-73 3.5.6.1, 3.5.6.2 3-26 Figure 3.3.8-2 6-1 6.1.1 7-10, 7-11 Table 7.4-1 APP-25 APPENDIX P 2-9 Table 2.4-1 3-60, 3.5.3.4.1, 3-46 3.5.2.1.8 APP-25 APPENDIX P 3-62 Figure 3.5.3-7 3-64 3.5.3.4.2 3-47 3.5.2.1.16	ECP 2-VU94-115 ECO NO. 7620 ECP 2-VU95-018 ECO NO. 7707 ECP 1-GP95-049 ECO NO. 7717 ECP 2-VU94-041 ECP 1-AU95-054 ECO NO. 7749 ECO NO. 7611 ECP 2-VU95-029 ECO NO. 7622 ECO NO. 7826

3	6/97	All Sections	ECP 1-AU95-084 ECO No. 7938 ECO No. 7976 ECO No. 8174 ECO No. 8300 ECP 2-VU95-060 ECO No. 8071 ECP 2-ED96-026 ECO No. 8210 ECP 1-VU93-092 ECO No. 8217 ECP 1-VU97-008 ECO No. 8355 ECP 2-VU96-099 ECO No. 8455 ECP 1-RM96-021 ECO No. 8460 ECP 1-VU91-005 ECO No. 8485 ECP 2-VU97-010 ECO No. 8505 ECP 1-VU97-016 ECO No. 8539 ECP 2-VU93-15 ECO No. 8603
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4	03/98		ECP1-VU-96-055 ECO No. 8503 ECP N/A ECO No. 8748 ECP 2-VU97-085 ECO No. 8807 ECP 1-VU91-5 ECO No. 8815 ECP 1-GP97-109 ECO No. 8864

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8	09/04	VU00.G - Pages G-16; G-33; replace figures VU-G-3, -4, and -5 VU00.III - Page III-9 VU00.VI - Page VI-1 VU00.App - Add Appendix N, Conceptual Future Ventilation Configurations, containing five figures Table VU G	ECO 11037 Addendum 1

9	12/04	VU00.G Section 3.3.7	ECO 9758, Addendum 7
10	01/06	VU00 G Section 2.0, 2.4.7, 2.5.7, 2.10.3 VU00.S Summary VU00.G Sections 2.1.6, 2.1.8,2.4.1, 2.4.2, 2.4.4, 2.4.5 VU00.III Section 3.2 VU00.VI Section 3.2	ECO 11320 ECO 11354 ECO 11366
11	04/06	VU00.1 Section 3.6	ECO 11276
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13	06/09	VU00.G 2.3.2.1 VU00.III 3.5.1, 3.5.1.1, 3.5.1.2, 3.5.2, 3.5.4, 3.5.5	ECO 12305
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15	06/10	VU00.V1 Section 7.0	ECO 12620
16	06/10	VU00.G 2.8.2.1	ECO 12639
17	04/11	VU00.III 3.5.1, 3.5.1.2, 3.5.2, 3.5.4	ECO 12798
18	06/13	VU00.II 7.0	ECO 13224
19	Xx/xx	VU00.III 3.5.1.1, 3.5.2, 3.5.4	ECO 13314

SUMMARY

The underground ventilation system serves all underground facilities and provides a suitable environment for underground personnel and equipment during normal activities; confinement and channeling of potential airborne radioactive material in the event of an accidental release, or smoke and fumes in the event of an underground fire; and HEPA filtration of exhaust air to minimize any doses to the onsite personnel (within ALARA limits) and to minimize offsite releases. The Underground Ventilation system provides the equipment, controls and monitoring necessary to: 1) ensure that suitable underground air environment is present for underground personnel and equipment; 2) confine and channel potential airborne material resulting from an underground fire or release of radioactive material; and 3) provide HEPA filtration of the exhaust air if needed to minimize radiation dose to site personnel and to minimize offsite radiological release. Under normal operating conditions, the effluent exhaust is not filtered.

The air is supplied to the underground horizon, at 2,150 feet below the surface, through three shafts and exhausted through a single shaft by exhaust fans located on the surface. Standby HEPA filtration, also located on the surface, is engaged upon detection of radioactive particulates in the exhaust air stream.

The air drawn down the Air Intake Shaft (AIS) and the Salt Handling Shaft (SHS) is split into three separate air streams serving the construction, north area and waste disposal areas. The air drawn down the Waste Shaft (WS) serves the Waste Shaft station operation and is exhausted directly to the exhaust shaft station where it joins the exhaust streams of the other three areas. The combined exhaust streams are drawn up the Exhaust Shaft, and discharged directly to the atmosphere under normal operation or via the HEPA filtration system under certain off-normal conditions.

The status of the system equipment is continuously monitored, and the data is provided to the Central Monitoring Room, as well as local stations underground.

This SDD-VU00 includes six sub-systems which cover specific aspects of the Underground Ventilation System. These subsystems are:

- VU01 - Exhaust Fans and Filters
- VU02 - Installed Auxiliary Fans & Ducts
- VU03 - Ventilation Control, Bulkheads & Air Regulators
- VU04 - Local Temporary Ventilation
- VU05 - Air Intake Flow Paths and Exhaust
- VU06 - Remote Monitoring and Control

The organization of this SDD is shown in figure S-1.

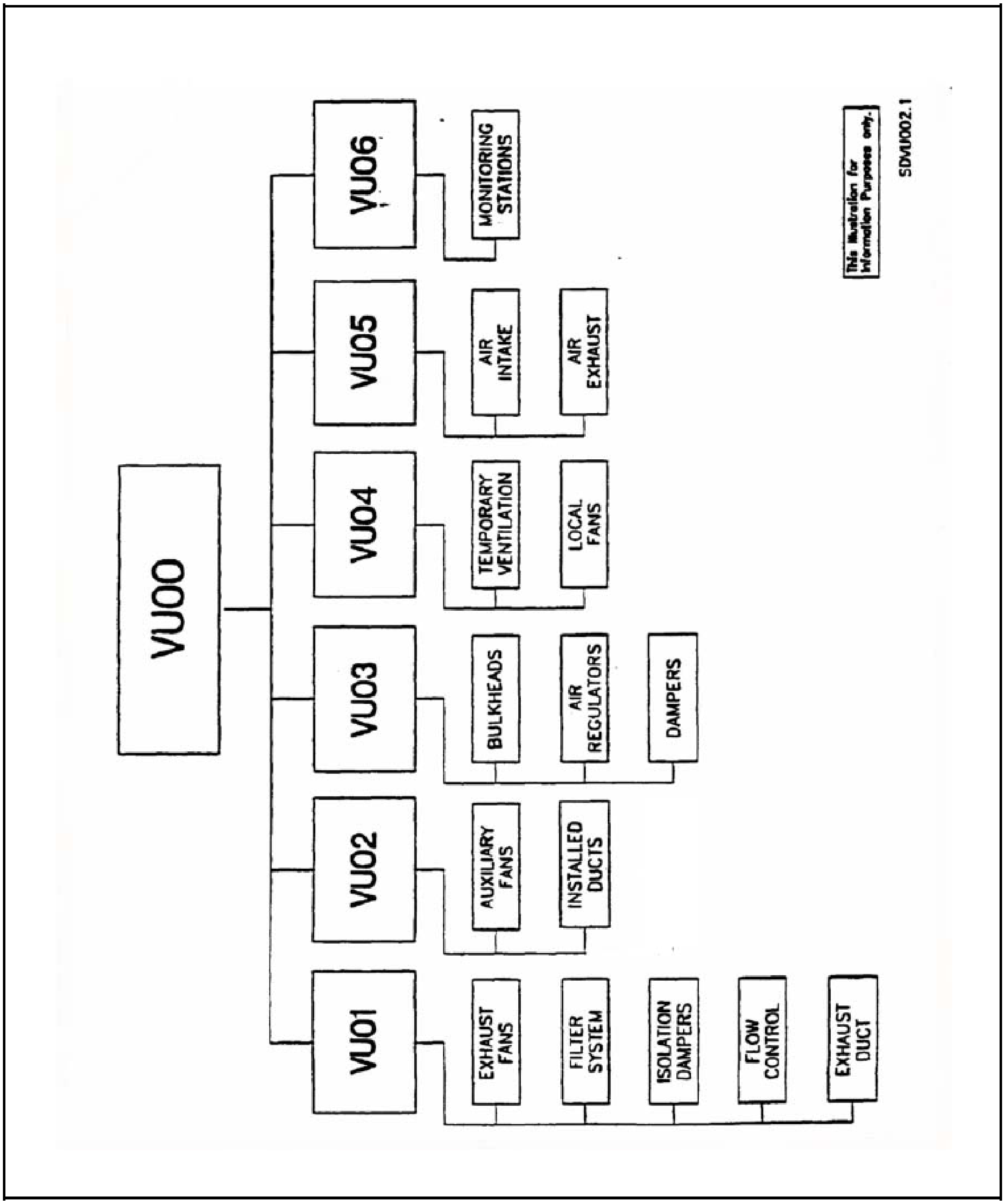

Figure S - 1 – Organization of SDD VU00

Chapter G
VU00 General Functions & Requirements
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Chapter G

UNDERGROUND VENTILATION SYSTEM

1.0 PRIMARY FUNCTIONS

1.1 Underground Ventilation System (UVS)

The UVS provides a continuous flow of fresh air to the array of underground drifts and rooms that constitute the operational disposal facility at WIPP.

1.2 The system provides a suitable environment for personnel and equipment operating underground during the normal site operations, and a life-sustaining environment during foreseeable operational occurrences and postulated waste handling accidents.

1.3 The system provides dynamic barriers that separate and control the flow of air to prevent the uncontrolled release of measurable amounts of radioactive material to the environment in the event that such material is released underground due to an internal accident or a severe natural phenomenon.

1.4 The system maintains a negative static pressure differential between the ventilated chambers underground and the above-ground environment such that all air flow is from the above ground environment.

1.5 Exhaust air containing measurable amounts of radioactivity will automatically be shunted through HEPA filters to remove the source of radioactivity before the air is released to the environment.

1.6 The air flow underground is divided into four separate flow paths having three supply sources and a common exhaust. One flow path supports the underground mining activities, one supports the north area activities, and the third supports the radioactive waste disposal operations. The mining and waste disposal circuits share a common exhaust downstream of the active disposal area. The fourth path supports the waste handling station. Pressure differentials are maintained between flow paths to assure that air leakage is always from areas of lower to higher contamination potential.

1.7 The system includes monitoring capability to show the operational status of all critical operating components of the system at the Central Monitoring Room (CMR).

2.0 DESIGN REQUIREMENTS

The functional classifications are defined in the Documented Safety Analysis (DSA) and the General Plant Design Description (SDD).

2.1 General

2.1.1 The UVS shall satisfy Order DOE 5480.1b (Reference 3) with regard to environment, health and safety requirements. It shall satisfy the requirements of the Mine Safety and Health Administration (MSHA), Title 30 CFR Part 57 (Reference 7) and the State of New Mexico Mine Safety Code for all Mines.

2.1.2 The UVS shall operate on a continuous basis to provide safe working conditions for personnel during normal operating conditions and a life sustaining environment during emergency conditions. The system shall be designed to operate under two modes of operation: Normal Mode (HEPA exhaust filtration system bypassed), and Filtration Mode (exhaust passed through HEPA filtration system).

2.1.3 All underground chambers shall be interconnected in a manner that allows circulation of air through the chambers. All chambers shall be located at a single level called the disposal horizon located about 2,150 feet below the surface.

2.1.4 The disposal horizon and surface shall be connected by four vertical shafts. The main air supply shall be brought down the Air Intake Shaft (AIS) with some air brought down the Salt Handling Shaft (SHS) and a relatively smaller amount of air flow shall be downcast through the Waste Shaft (WS) to preclude any potential contamination escaping through the WS and the Waste Hoist Tower to the atmosphere. Ventilation air from all underground areas shall be exhausted through the up-cast Exhaust Shaft (ES) by exhaust fans located on the surface, during Normal & Filtration Operations.

2.1.5 The system shall be designed to provide, with the AIS unobstructed, sufficient air to permit construction, waste handling and disposal, and north area operations to occur simultaneously on the same shift or shifts. With the AIS obstructed by the Galloway, there shall be sufficient air to permit construction and waste disposal operations to occur on separate shifts.

2.1.6 The fresh air flow from the UVS shall be divided into four separate streams. One stream supports construction (mining) activities, a second supports north area activity, and the third and fourth supports waste handling activities.

This separation shall commence as close to the Air Intake Shaft (AIS) Station and the Salt Handling Shaft (SHS) station as practical and be maintained through the air distribution streams to the Exhaust Shaft (ES) Station drift where all exhaust streams are combined.

2.1.7 A pressure gradient shall be established so that any air leakage is from the construction and north area streams to the waste handling areas.

2.1.8 The UVS shall have instrumentation and monitoring equipment to determine the status of specific components of the system on a continuous basis. The data shall be collected and monitored at a Central Monitoring Room (SDD CM00). Air quality shall be monitored locally with hand held equipment.

2.2 Subsystem Requirements

The Underground Ventilation System consists of six subsystems with separate subsystem designators. The subsystem-specific design requirements are presented in Section 2.2 within the SDD chapters identified in footnote G-1[1].

2.3 Operational Requirements

2.3.1 Normal Mode (Exhaust Filtration Bypassed)

The Normal Mode of ventilation shall be with the exhaust filtration system bypassed. Five different levels of Normal Mode ventilation can be established to provide five different air flow quantities. These five levels of air flow are achieved by the use of the various exhaust fans as follows:

- Normal Ventilation: Two of three main exhaust fans operating to provide 425,000 scfm unfiltered.
- Alternative Ventilation: Any one of the three main exhaust fans operating to provide 260,000 scfm unfiltered.
- Reduced Ventilation: Two of three filtration fans operating as ventilation fans to provide 120,000 scfm unfiltered.
- Minimum Ventilation: Any one of three filtration fans operating as a ventilation fan to provide 60,000 scfm unfiltered.

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[1] G-1

Chapter I:	Subsystem VU01; Exhaust Fans and Filters
Chapter II:	Subsystem VU02; Installed Auxiliary Fans and Ducts.
Chapter III:	Subsystem VU03; Ventilation Control, Bulkheads and Air Regulators.
Chapter IV:	Subsystem VU04; Local Temporary Ventilation.
Chapter V:	Subsystem VU05; Air Intake and Exhaust.
Chapter VI:	Subsystem VU06; Remote Monitoring and Control

- Maintenance Ventilation: Any one or two of the three main exhaust fans operating in parallel with one or two of the filtration fans to provide approximately 260,000 to 425,000 scfm unfiltered.

2.3.1.1 The UVS shall generally operate in the Normal Ventilation Mode with two of the three main exhaust fans operating, the HEPA filter bypassed, the HEPA inlet shutoff damper closed, and the underground flow divided into four flow streams.

2.3.1.2 After an event involving shutdown of the ventilation system, and the ventilation fans have been shutdown in excess of two hours, entrance of personnel to the underground shall be controlled by the requirements of 30 CFR Part 57.

2.3.2 Filtration Mode

2.3.2.1 The filtration mode of ventilation is designed to confine airborne radiological contamination released by a breached waste container in the underground, minimizing any release to the environment.

Filtration shall be automatically initiated by detection of radioactive airborne contaminants above the set point(s) as described in SDD RM00.

2.3.2.2 Upon receiving an activating signal, the controls shall:

- Automatically shutdown
- Block-in and isolate the main exhaust fans
- Close the bypass dampers
- Start a filter exhaust fan, open the isolation block valves in the HEPA filter exhaust system
- Open the shut-off damper in the filter inlet plenum inlet duct.

To achieve an adequate confinement boundary, at least one isolation damper on each of the 700 series fans must close, and both of the bypass dampers must close. Interlocks are used to ensure the proper sequencing of the associated SSC operations. Periodic testing of the shift to filtration function shall be performed to ensure appropriate system operation. The Filtration Ventilation Mode shall also be capable of being established by the Central Monitoring Room (CMR) operator or by an operator at the local control panel in the Exhaust Filter Building (EFB).

2.3.2.3 In the event of a power loss, the UVS shall shut down, and if determined necessary, the Filtration Ventilation Mode shall be initiated manually at the local control panel in the EFB. This includes starting one of the filtration fans utilizing backup power. Upon power loss, the UVS dampers located on the surface, automatically align for filtration.

2.3.2.4 The flow quantity for this mode shall be compatible with the capacity of the HEPA filter system. This quantity of air will be considerably less than for the Normal Mode and all other underground operations shall be curtailed.

2.3.3 Design Conditions

2.3.3.1 UVS designs shall be based on the following surface ambient conditions:

- Design summer dry bulb 100°F
- Design summer wet bulb 71°F
- Design winter dry bulb 19°F

2.3.3.1.1 The thermodynamic effects of air moving down the shafts and up the shafts shall be taken into consideration in design calculations.

2.3.3.1.2 Mechanical cooling or heating of the air is not needed to maintain acceptable working conditions.

2.3.3.2 Air flow quantity shall be determined as follows:

2.3.3.2.1 Provide 100% cfm for each piece of operating diesel equipment.

The MSHA certified rating for each piece of equipment shall be used to determine flow rate requirements. If the certification is not available, 125 cfm/BHP shall be provided.

2.3.3.2.2 Personnel access into various areas shall be determined by MSHA air quality listed in 30 CFR Part 57, Subpart D.

2.3.3.2.3 A minimum velocity of 60 FPM shall be maintained in the active disposal room where rooms are being prepared for disposal.

2.4 Structural Requirements

2.4.1 All underground materials shall meet 30 CFR Part 57 requirements.

2.4.2 Ventilation exhaust filters shall have UL or equivalent rating.

2.4.3 Ventilation doors shall comply with the requirements of 30 CFR 57 Subpart G.

2.4.4 All bulkhead frames shall be constructed of noncombustible material. Special purpose bulkheads, such as fire-rated or insulated, shall be provided as required for a specific room.

2.4.5 All components used to maintain the separation of the four ventilation streams shall be adequate to support the maximum pressure differential that may occur.

2.4.6 Underground structures, with proper inspection, maintenance and adjustment shall be designed and installed in such a manner that they can accommodate ground movement (creep) without loss of function.

2.5 General Arrangement & Essential Requirements

2.5.1 The main exhaust fans shall be in multiple parallel arrangement.

2.5.2 System operations shall be controlled through and monitored by the Central Monitoring System (CMS). The airflow regulators (dampers) can be controlled through the CMS or locally at the damper. This is determined by the position switch at the damper (local/remote).

2.5.3 The mobile equipment, mechanical shop, and the fuel station shall be located on air circuits which exhaust directly into the exhaust stream.

2.5.4 Fire protection of the system shall be in accordance with the Fire Protection System, SDD-FP00.

2.5.5 Electric power supply to the UVS is maximum 4.16kv, 3 phase, 60 Hz power as described in SDD-ED00, Electrical System Surface and Underground. The UVS surface dampers shall fail safe (i.e., underground systems shall fail as is, and the exhaust fans shall fail off and isolated).

2.5.6 Backup Power for the system shall be provided by the backup power system diesel generators, described in SDD-ED00.

2.5.6.1 Upon loss of offsite power, any one filtration exhaust fan shall have the capability of being manually switched to the backup power system to maintain minimum ventilation of underground areas.

2.5.6.2 The exhaust fans used for the normal operating mode are not required to be connected to the backup power system.

2.5.6.3 The power source(s) for the damper position indicators, the differential pressure indicators, and the air velocity indicators shall be protected by uninterruptible power and shall operate without data loss for 30 minutes after a power failure.

2.5.7 Capability for stopping the main exhaust fans, and starting and stopping the filtration fans shall be provided both locally and remotely from the Central Monitoring Room (CMR) reference SDD CM00.

2.5.8 The design of the ventilation system shall accommodate backfilling and waste retrieval operations in the waste disposal room and drifts.

2.5.9 Backfilling of the waste disposal rooms shall be performed in a manner which will minimize the quantity of salt dust suspended in the disposal exhaust air. Similar steps shall also be taken during waste retrieval operations.

2.5.10 Decommissioning may include disassembly of the system components and decontamination as required. Alternate decommissioning could entail mothballing all or portions of the system.

2.5.11 The exhaust filter building (EFB) chambers that are in the flow stream path shall be designed for a negative pressure to atmosphere. A high efficiency shut off damper shall be used upstream of the inlet plenum to prevent positive pressure spikes from reaching the filters when switching fans or ventilation modes.

2.5.12 The system shall be designed to minimize the effects of natural ventilation pressure (NVP) considering both positive NVP, and negative NVP.

2.5.13 The auxiliary air intake tunnel (AAIT) shall have pressure relief dampers at the inlet to provide over-pressure protection to the Waste Handling (WH) tower. These dampers shall be normally closed, fail as is, and shall be configured to prevent a pressure differential across the walls of the WH tower greater than -3.0 in W.G. with respect to the outside.

2.5.14 The UVS shall have local ventilation ducts and auxiliary fans which are locally installed and operated to increase the air circulation in specific work areas. The operating status of these fans is not required to be monitored by the CMS.

2.6 Maintenance Requirements

2.6.1 Standard commercial maintenance shall be performed in conformance with manufacturer's recommendations.

2.6.2 Additional maintenance as required shall be performed following routine inspection. Calibration of instruments shall be in conformance with manufacturer's recommendations unless mining practice dictates increased frequency.

2.6.3 All components shall be arranged so that they can be isolated for normal and emergency maintenance.

2.6.4 Filters shall be designed for contact handling during filter replacement. Adequate space shall be provided between filter banks to permit inspection and replacement of filters. Filter arrangements shall be such as to permit testing of each stage of HEPA filters in accordance with Reference 1.

2.6.5 Contaminated filters shall be bagged and sealed per procedure.

2.7 In-Service Inspection Requirements

2.7.1 Equipment instrumentation shall provide notification of off-normal operation.

2.7.2 Periodic inspection of system components shall be performed at intervals recommended by equipment manufacturers.

2.7.3 The accuracy and proper operation of instruments shall be checked on a schedule to be determined by the operating contractor.

2.7.4 Locally mounted instruments shall be provided to permit periodic monitoring of the system reliability and impending malfunctions which could impair operations.

2.7.5 Each bank of HEPA filters shall be tested prior to operation and periodically thereafter to verify efficiency of 99.95 percent. Testing shall be in conformance with Reference 1.

2.7.6 A means to measure the static pressure drop due to airflow in the air intake shaft will be provided.

2.8 Instrumentation and Control Requirements

The Underground Ventilation System instrumentation and controls for the WIPP facility shall be designed in accordance with the requirements of 30 CFR Part 57 Subpart K as appropriate.

2.8.1 The UVS instrumentation and controls shall be designed to:

A. Control the start and stop of the UVS equipment to provide the required underground environmental conditions for normal operations.

B. Actuate valves, dampers and main regulators that control the flow of air underground.

C. Provide local controls for major components with limited manual and automatic controls at the Central Monitoring Room.

D. Provide regulators, bulkhead doors, local fans etc., as needed to balance and regulate the overall underground flow between working areas.

E. Initiate the automatic operation of the fans, dampers and shut off valves in the filtration system when off-normal concentrations of airborne radioactivity are indicated by continuous air monitors (CAMs) located in the underground.

F. Reconfigure the UVS following notification of underground fire, so as to restrict and redirect the spread of smoke resulting from the spread of fire and assist in the evacuation of underground personnel. This operational sequence shall not be automatic. It requires a considered decision by Operations.

G. Monitor the status of valves, dampers, motors, filters, doors, differential air pressures across bulkheads, air flow velocities and psychrometric conditions at selected stations.

H. Provide alarms in the event of unacceptable operating conditions.

2.8.1.1 The overall accuracy and repeatability of the instrumentation shall be as stated in appendix C "Instrument List" of this SDD.

2.8.1.2 Power assisted, spring loaded, pneumatic actuators shall be provided for isolation valves. The controls of these valves shall be designed so that the valves will fail closed or open as required in the event of the loss of electrical power and/or plant air.

2.8.1.3 Instrumentation installed into the underground ventilation system shall be designed and/or selected so that the manufacturers recommended operating conditions for temperature, relative humidity and pressure fall within the expected ambient range(s) of conditions in the repository.

2.8.1.4 Unless otherwise indicated, the instrumentation equipment shall be designed and installed to withstand the conditions that its related equipment has been designed to accommodate.

2.8.1.5 In-line instruments shall meet the design code of the components of the UVS or subsystem into which they are installed.

2.8.1.6 Underground ventilation air flow shall be controlled by the variable pitch inlet vanes of the centrifugal exhaust fans and by adjusting the air regulators at strategic locations underground.

2.8.1.7 Exhaust filtration can be initiated from the CMS or Local Control Panel.

The central monitoring system (CMS) monitors the ventilation system. Measurement and equipment status signals are connected to local panel and Local Processing Units (LPUs) in various locations, and data are passed between the LPU and the CMS via a data highway. Where required, control functions are fitted to the LPUs. See Plant Monitoring and Communication System SDD-CM00.

2.8.2 The following items shall be monitored:

- Flow rate quantities
- Differential pressure across each filter bank
- Differential pressure across selected bulkheads underground
- Psychrometric data for air intaking and exhausting each shaft
- Access doors in selected bulkheads (open or closed)
- Ventilation doors and regulator status
- Isolation valve and damper position status
- Fan operating status (on and off)
- Bypass or filtration mode
- Main fan vibration levels

2.8.2.1 Major underground and surface air regulators and ventilation doors shall be capable of being monitored and operated remotely from the Central Monitoring System (CMS) in the Support Building. In addition, underground control stations shall be provided so that air regulators can be adjusted locally. Manual overrides shall be provided, where appropriate.

2.8.2.2 Air flow quantity shall be monitored and displayed in the CMR and locally.

2.8.2.3 An unacceptable operating condition of the ventilation system shall result in automatic notification to the CMS.

2.8.2.4 For fire protection controls see Fire Protection Systems, SDD-FP00.

Operating status of major equipment, flow at central locations, pressure differentials across HEPA filters and pressure differentials between critical points shall be monitored.

2.9 Interface System Requirements

The interfacing systems are divided into primary and secondary interfaces defined as follows:

A. Primary System Interfaces

The primary system interfaces are requirements placed on other systems by the Underground Ventilation System.

B. Secondary System Interfaces

The secondary system interfaces represent requirements placed on the Underground Ventilation System by other systems.

System VU00 is the primary system in interfaces with the systems listed below. A brief description of each primary interface is provided in section 3.7 of each VU subsystem chapter.

System	Title
AU00 U/G	Facilities and Equipment
CA00	Compressed Air System
CF00	Plant Buildings, Facilities & Misc. Equipment
CM00	Plant Monitoring and Communication System
ED00	Electrical Distribution System
EM00	Environmental Monitoring System
FP00	Fire Protection System
GC00	General Civil and Structural
PC00	Plant Communications System
RM00	Radiation Monitoring
UH00	Underground Hoisting System

System VU00 has a secondary interface with the systems listed below. A brief description of each secondary interface is included in section 3.7 of each VU subsystem chapter.

System	Title
AU00 U/G	Facilities and Equipment
CF00	Plant Buildings, Facilities & Misc. Equipment
CM00	Central Monitoring System
EM00	Environmental Monitoring System
FP00	Fire Protection System
RM00	Radiation Monitoring
UH00	Underground Hoist System

2.10 Quality Assurance Requirements

2.10.1 To assure that the required quality is achieved for all aspects and activities of the WIPP, A comprehensive Quality Assurance program shall be implemented and controlled in conformance with 10 CFR 830.120, and General Plant Design Description (GPDD) as set forth in the U.S. Department of Energy Carlsbad Area Office (DOE-CAO) *Quality Assurance Program Description* CAO-94-1012.

2.10.2 Design specifications, equipment specifications, technical specifications, and drawings for the system, its components and equipment, structures, and services related thereto shall contain Quality Assurance (QA) program requirements appropriate to the item or scope of work being defined or specified. These specifications shall also define quality assurance practices such as inspections, examinations, and tests appropriate to the specified item or service.

2.10.3 A graded approach for application of QA requirements shall be used. Application of the requirements as specified in 2.10.1 shall be determined in a manner consistent with the relative risk and functional importance of the item or service involved.

2.11 Codes and Standards Requirements

The design, construction, and operation of the UVS shall be in accordance with the following documents, using the latest issues or revisions in effect at the time of contract placement:

Title 30 CFR Part 57	"Safety and Health Standards - Underground Metal and Non-Metal Mines"
10 CFR 830 §A	"Quality Assurance Requirements"
DOE Order 420.1B	*Facility Safety*
DOE Orders 430.1B	*Real Property Asset Management*
DOE-STD-3020-2005 Contractors	Specification for HEPA Filters Used By DOE
ANSI N509	*Nuclear Power Plant Air-Cleaning Units and Components*
ANSI N510 Systems	*Standards for Testing of Nuclear Air Treatment*
AWS Welding Code	(D1.1, D1.3, D9.1, etc....)

UBC	Uniform Building Code
AISC M011	*Manual of Steel Construction*, 8th Edition

2.12 Reliability Requirements

2.12.1 All components of the underground ventilation system, with appropriate maintenance, shall have A design life of 25 years.

2.12.2 The filtration exhaust fans for filter mode operation shall have 200 percent redundancy (three fans with 100% capacity each).

2.12.3 Any two of the three main exhaust fans can be operated in parallel. The loss of a main exhaust fan can place operational restrictions on underground activities.

2.12.4 During a loss of offsite power, the exhaust filter system shall fail safe. The bypass valves and main exhaust fan isolation valves shall fail closed, and the HEPA filter isolation valves and shutoff damper shall fail open.

2.12.5 The exhaust filtration fans shall be electrically connected to permit manual switching to backup power. At least one of three filtration fans can be run on backup power.

2.12.6 The underground air flow regulator motorized dampers shall fail as is.

3.0 DESIGN DESCRIPTION

3.1 Summary

The Underground Ventilation System (UVS) provides safe and effective ventilation to the personnel and equipment in the underground facilities of the WIPP.

Air is drawn into the underground works through three vertical shafts, distributed throughout the underground horizon, drawn up through the exhaust shaft, filtered if necessary, and returned to the atmosphere by the exhaust fans.

Figure VU G-1 is a pictorial diagram of the underground ventilation of the WIPP facility. This figure illustrates the split of the fresh air into separate air streams to supply the waste disposal area, the construction (mining) area and the north area, and the Waste Shaft (WS) station.

Figure VU G-2 is a simplified isometric drawing of the underground air flow system. This illustrates the physical relationships of the main parts of the system.

Air is drawn down through the Air Intake Shaft (AIS) and the Salt Handling Shaft (SHS), split into three air streams to feed the waste disposal area, the construction area and the north area. These three air streams converge and are drawn up by the fans on the surface.

Additional air is drawn through the Auxiliary Air Intake Tunnel (AAIT) and down the WS to supply the unloading station at the base of the WS and exhausted directly to the ES.

Air flow dampers and regulators provide the capability to adjust the absolute and relative air flow rates in any of the air flow streams.

System VU00 has six subsystems which act in concert to provide the complete underground air system.

Refer to section 3.1 of the subsystem chapters (see footnote G-1) for subsystem-specific summary design descriptions.

3.2 Detailed System Description

The six subsystems of the underground ventilation system together provide safe, effective and controlled ventilation to the underground operations of the WIPP facility.

The WIPP underground has been mined with nearly all drifts and rooms running north to south or running east to west. Locations in the underground are identified with a coordinate system centered on the Salt Handling Shaft. A drift which runs north-south and is located 300 feet east of the SHS is identified as E300. A location in drift E300 which is located 90 feet south of the SHS is identified as E300/S90. The ES is located at S400/E475 and the AIS is located at N0/W625.

Refer to section 3.2 of the subsystem chapters (see footnote G-1) for subsystem-specific detailed design descriptions.

3.3 Performance Characteristics

There are multiple operational modes for underground ventilation depending on which equipment is available and whether off-normal conditions exists, such as a radiation release. The operational modes can be identified as:

1. Normal Modes - Surface Fans Without Filtration

1a)	Normal	Two Main Exhaust Fans
1b)	Alternate	One Main Exhaust Fan
1c)	Reduced	Two Filtration Fans
1d)	Minimum	One Filtration Fan
1e)	Maintenance	One Main Exhaust and One or Two Filtration Fans

2. Filtration Mode - Filters + One Filtration Exhaust Fan

3.3.1 Air Flow Surface/Underground

Air flow values for the underground in this section are given in actual local flow values. The air is compressed as it moves down the shafts by 6% to 10% so that the volumetric flow at the disposal horizon is smaller by that same percentage than the free air at the surface. The air is heated or cooled as it passes through the underground, resulting in additional volumetric flow changes. The air stream distribution values given are not completely independent measurements because of air leakage past bulkheads.

Therefore, in general, the sum of the air stream distribution values will not match the shaft air flows.

Filtration and Minimum Flow Modes are special cases. The Natural Ventilation Pressure effects, combined with leakage, result in the air flow in the AIS and SHS being undefined in the tables except that the net flow is the difference between the WS and ES flows.

3.3.2 Air Pressure Limits

The air pressure differential limitations arise from the nuclear requirements not from the mining requirements.

The handling of radwaste in the underground begins as it is unloaded from the Waste Hoist at the Waste Shaft Station. From there it is moved east through S400 to E140, then south through E140, then east or west through the cross drift leading to the active disposal panel and stored in a waste disposal room. All of this area is potentially a source of airborne radioactivity if an off-normal event occurs.

The fresh air from the WS flows through S400 to the ES with some diverted into E140 and returned to S400 by ducts and fans. Fresh air from the AIS and the SHS flows south through W30 with no possibility of direct contamination until this stream is split at W30/S1000. The waste disposal air stream splits off at W30/S1000, flows through E140, into the active disposal panel, through the active disposal room and returns to the ES via E300. The mining air is further split into two parts. Air used to ventilate the working face (where the continuous miner is excavating salt) is routed to the ES via E300 where it merges with the disposal area air. Air not used to ventilate the face is routed via W170 to the ES.

The potential for contamination and the air flow patterns define the following areas as the Radioactive Materials Area (RMA):

A. The S400 drift

B. The E140 drift south of S90 along with open side drifts

C. The E300 drift south of S90

D. The waste disposal panels

E. S90 drift between E140 and E300

Operationally it is important to ensure that leakage between air streams does not transport contamination to areas outside the Waste Handling Area. During forced flow it is required that the mining airflow side be 0.05 inch wg positive with respect to the Waste Handling Area side where the potential for contamination exists. This is monitored and regulated at locations as described in chapter VI, section 3.5.

3.3.3 Normal Ventilation

Full ventilation is the normal operating condition for the facility. Normal ventilation uses two of the three main exhaust fans with all other fans isolated.

3.3.3.1 Air Flows

Operation of any two of the three main exhaust fans results in underground airflows substantially in excess of the minimum requirements defined in section 2 and allows simultaneous operations at the design level in all areas.

NOTE

The airflow distribution down-casting the three (3) intake shafts does vary according to changes in the surface ambient psychrometric conditions. The total quantity up-casting the exhaust shaft does not vary significantly. For the typical airflow quantities refer to the most recent version of the document "Testing and Balancing of the Underground Ventilation System at the WIPP facility" and the WIPP drawing 54-W-001-W latest Revision.

The main air flow pattern of the underground distribution for this mode is illustrated on figure VU G-3. Approximate air flows in the different air streams are shown in table VU G-1.

Table VU G - 1– Underground Full Ventilation Air Stream Distribution

Disposal Area	170,000 ACFM
Construction Area	140,000 ACFM
Waste Shaft Station	70,000 ACFM
North Area	80,000 ACFM
	460,000 ACFM

Refer to the current version of the Mine Ventilation Plan, Document 00CD-0001 for air stream configuration.

3.3.3.2 Air Pressure Levels

For typical flow conditions in normal full ventilation the air pressure differential requirement is met. Hot surface air (100°F or greater) could cause the differential pressure from drift W30 at S400 to the waste shaft station to decrease and the differential pressure constraint might be violated. The pressure chamber in drift S400 will be activated, if necessary to maintain desired differential pressure, during waste handling operations in the waste shaft and/or waste shaft station area. See section 3.5.3 of VU03. The pressure is maintained in the chamber until waste handling operations in the waste shaft and/or the waste shaft station area is completed. With pressure in the pressure chamber at least 0.05 inch wg above that at the WS station, no leakage from the Waste Shaft Station into W30 will occur.

3.3.4 Alternate Ventilation

Alternate operation has one main exhaust fan operating and conveying all air flow from the underground. This produces approximately 260,000 CFM total flow. All other fans are isolated. See note 1 in section 3.3.3.1.

3.3.4.1 Air Flows

The alternate ventilation mode results in reduced airflows in each circuit except the North Area. Underground operations are restricted to utilization of the air flow present. The operational effect of this is a limit on the operation of diesel powered equipment.

The main air flow pattern of the underground distribution for this mode are the same as figure VU G-3. The magnitude of the air flows in the different air streams are shown in table VU G-2.

Table VU G - 2 – Underground Alternate Ventilation Approximate Air Stream Distribution

Disposal Area	100,000 ACFM
Construction Area	60,000 ACFM
Waste Shaft Station	50,000 ACFM
North Area	80,000 ACFM
	290,000 ACFM

3.3.4.2 Air Pressure Levels

With the lower air flows associated with alternate ventilation mode the differential pressures between circuits is reduced. The differential pressure between W30 and the WS Station may fall below the minimum acceptable level on hot days. The pressure chamber operation will protect this point during waste handling operations in the waste shaft and/or waste shaft station area.

3.3.5 Reduced Ventilation

Two of the three filtration exhaust fans are operated in parallel to achieve 120,000 CFM with the bypass dampers open. The three main exhaust fans, the remaining filtration exhaust fan and the HEPA filters are isolated. See note 1 in section 3.3.3.1.

3.3.5.1 Air Flows

The main air flow paths of the underground distribution for this mode are the same as figure VU G-3. Approximate air flows in the different air streams are shown in table VU G-3.

Table VU G - 3 – Underground Reduced Ventilation Approximate Air Stream Distribution

Disposal Area	42,000 ACFM
Construction Area	41,000 ACFM
Waste Shaft Station	14,000 ACFM
North Area	25,000 ACFM
	122,000 ACFM

3.3.5.2 Air Pressure Levels

With the lower air flows associated with reduced ventilation mode the differential pressures between circuits are reduced. The differential pressure between W30 and the WS Station may fall below the minimum acceptable level on hot days. The pressure chamber operation can maintain differential pressure at this location as required.

3.3.6 Minimum Ventilation

One of the three filtration exhaust fans is in operation to achieve 60,000 CFM with the bypass dampers open. The three main exhaust fans, the remaining filtration exhaust fans and the HEPA filters are isolated. The normally open doors in the bulkhead in E300 at S350 are closed and the regulators in the bulkhead in S1000 at E20 are closed. These two changes in the underground regulation, which are performed automatically in the transition to filtration mode, are performed manually for this mode. See note 1, section 3.3.3.1.

3.3.6.1 Air Flows

At this level of air flow the distribution between the air supply shafts is radically different from full ventilation. If no change is made in the underground air regulation, the bulk of the flow comes down the WS and goes directly over to the ES. A small amount of flow from the AIS and the SHS will pass through the remainder of the underground. Note that at this level of air flow, the actual air flow values are strongly influenced by surface temperatures; see the discussion of Natural Ventilation Pressure below. Underground operations are restricted to utilization of the air flow present. The operational effect of this is a limit on the operation of diesel powered equipment.

The minimum ventilation underground distribution is illustrated on figure VU G-4. The air flows in the different air streams are as shown in table VU G-4.

There is very little air flow in the active disposal panel in this mode unless an administrative decision is made to divert flow. This can be accomplished by locally opening the air lock in E140 to allow air flow from the WS Station to go south through E140. Simultaneously closing the air regulators in S400 at E300 forces nearly all the WS flow into E140, through the disposal panel and back to the ES.

Table VU G - 4 – Underground Minimum Ventilation Approximate Air Stream Distribution

Disposal Area	10,000 ACFM
Construction Area	0 ACFM
Waste Shaft Station	50,000 ACFM
North Area	0 ACFM
	60,000 ACFM

Note: Disposal Area flow may be increased to 60,000 CFM by diverting the WS flow.

3.3.6.2 Air Pressure Levels

With the low flows of minimum ventilation the differential pressures would be reduced. With the bulkheads in E300 and S1000 closed to isolate the north and mining areas from the ES, there is no problem with leakage. The S400 and E140 drifts will be running at a reduced pressure close to the ES Station pressure and will prevent leakage from the Waste Handling Areas. If flow is diverted through the disposal area, E140 pressure is still acceptably low.

3.3.7 Filtration Ventilation

Filtered operation is only used when the underground CAMs signal that radiation has been detected in the underground or when deemed necessary by the Central Monitoring Room Operator.

The system dampers on the surface are set so that the air from the ES is ducted into the inlet plenum of the HEPA filter banks. One of the three filtration exhaust fans is in operation to achieve 60,000 CFM flow through the underground and the HEPA filters. The normally open doors in the bulkhead in E300 at S350 are closed, the regulators in the bulkhead in S1000 at E20 are closed, and the regulators in the bulkhead in E300 between the Construction Circuit and the Waste Handling Circuit are closed. These three changes in the underground regulation are performed automatically in the transition to filtration mode. See note 1 in section 3.3.3.1.

3.3.7.1 Air Flows

The bulk of the flow which comes down the WS goes directly to the ES. A small amount of flow from the AIS and the SHS will pass through the remainder of the underground. Note that at this level of air flow, the actual air flow values are strongly influenced by surface temperatures; see the discussion of Natural Ventilation Pressure below. Underground operations are restricted to utilization of the air flow present. The operational effect of this is a limit on the operation of diesel powered equipment.

The filtered ventilation underground distribution is illustrated on figure VU G-5 and table VU G-5.

Table VU G - 5 – Underground Filtration Ventilation Approximate Air Stream Distribution

Disposal Area	0 ACFM
Construction Area	0 ACFM
Waste Shaft Station	60,000 ACFM
North Area	0 ACFM
	60,000 ACFM

There is very little air flow in the active disposal panel in this mode unless an administrative decision is made to divert flow. This can be accomplished by locally opening the air lock in E140 to allow air flow from the WS Station to go south through E140. Simultaneously closing the air regulators in S400 at E300 forces nearly all the WS flow into E140, through the disposal panel and back to the ES. The result is an airflow distribution as shown in table VU G-5.

3.3.7.2 Air Pressure Levels

The differential pressures are the same as for the case of Minimum Ventilation.

3.3.8 Natural Ventilation Pressure

The air flow in the underground is driven by the negative pressure induced by the exhaust fans. There is a second pressure resulting from the difference in density of the air in the various air shafts. This is called the natural ventilation pressure (NVP) and is a consequence of different air densities in the intake and exhaust shafts.

3.3.8.1 Hot Weather NVP

During hot weather, the air going down to the underground is warmer and less dense (lighter) than the air returning from the underground. Hence in hot weather there is an NVP which opposes the fan pressure.

This reduces the flow and reduces the differential pressures between the Waste Handling Area and the other areas. The air in the WS will be cooler than that in the AIS and SHS which further reduces the WS Station to W30 differential.

3.3.8.2 Cold Weather NVP

During cold weather, the air going down to the underground is colder and more dense (heavier) than the air returning from the underground. Hence in cold weather there is an NVP which augments the fan pressure. The positive NVP reduces the fan (constant flow control) suction pressure, increases the downcast air flow in one or more air shafts and increases the differential pressure between the Waste Handling Area and other areas.

The air feeding the WS comes partly from leakage from the auxiliary air intake tunnel, partly from leakage into the waste hoist tower and partly from the waste handling building. The result is that the air feeding the WS is warmer than the surface air feeding the AIS. The consequences of this are a reduction in flow down the WS and even reverse flow in the WS. Administrative action is required to adjust the underground regulators to avoid reverse flow in the WS.

Lower flow velocities in the SHS compared to the AIS in cold conditions can cause the SHS flow to reverse. This causes no problem.

3.3.9 Dynamic Pressure Effects

The underground ventilation system is basically a steady state system. When it becomes necessary to make change in operating mode there are dynamic pressure changes which must be considered. These are primarily only significant when the two main exhaust fans are started or shut down. Changes in ventilation, such as a shift to filtration may cause temporary localized pulses. The magnitude and location of these may be affected by NVP and the proximity to the shafts.

3.3.9.1 Startup of Main Fans

The ES is in much closer proximity to the WS in flow path length than the SHS or the AIS. Consequently, when the main exhaust fans are started it is possible to momentarily create a significant negative pressure in the WS and the WS tower.

The WS tower is built to withstand a differential pressure of -3 inch wg. To ensure that the pressure capability of the WS tower is not exceeded, a set of pressure relief dampers is installed in the inlet to the Auxiliary Air Intake Tunnel. These dampers are normally closed and will start to open when the pressure differential reaches -2.25 inch wg. The dampers will swing fully open before the limiting differential of -3 inch wg is reached. The additional air flow prevents the WS tower differential from being exceeded. The dampers must be manually closed if they swing full open. The open status of the dampers is indicated in the CMR by the failure to reach the normal pressure in the S400 drift.

There is a differential pressure sensor in the Waste Hoist Tower. If the allowable differential pressure is exceeded the CMS will shut down the main fans.

Administrative controls can be initiated to prevent excessive waste tower pressure during main fan startup.

3.3.9.2 Shutdown of Main Fans

When the main exhaust fans are shut down the associated isolation dampers are designed to close slowly to minimize any pressure pulse back through the system.

3.4 System Arrangement

The VU00 system is divided into six subsystems, VU01 through VU06. These subsystems are outlined on figure S-1 and defined in greater detail in section 3.1 of the subsystem chapters.

3.4.1 Physical Arrangement

Figure VU G-2, Underground Air Flow Isometric, illustrates the overall physical arrangement of the complete system. The Air Intake Shaft, the Salt Handling Shaft and the Waste Shaft are vertical shafts which are used to convey surface air down to the disposal horizon 2,150 feet below the surface. The Exhaust Shaft is a vertical shaft which is used exclusively to return air from the disposal horizon to the surface level. The underground workings are used by system VU00 to convey the air between the air intake shafts and the exhaust shafts and distribute air as required for operations.

Bulkheads and their associated doors and flow regulators are used throughout the disposal horizon to direct the underground air flow as required. The exhaust duct connects the ES to the exhaust fans and the Exhaust Filter Building.

3.4.2 Surface Arrangement

Figure VU V-1, WIPP Surface Plot Plan - VU00 Surface Facilities, illustrates the arrangement of the air shafts, exhaust fans and ducts, and the EFB relative to other surface facilities.

The AIS is located in the northwest quadrant of the facility. The ES is located in the southeast quadrant. The SHS and WS are located on a north-south line near the center of the facility. The exhaust equipment, ducts, fans and filters are located on the east side of the facility north of the ES.

Figure VU I-1, Exhaust flow diagram - Surface Equipment, illustrates the arrangement of the exhaust ducts, fans, flow regulators, filters and fans. The main exhaust duct connects the ES to the filter outlet plenum.

There are two large branch ducts to the east to the main exhaust fans. There is a smaller duct, branching to the west, to the filter inlet plenum. The HEPA filter system is located between the inlet and outlet plena. Three ducts connect the outlet plenum to the filtration fans, which are then connected to the filtered effluent duct.

3.4.3 Underground Arrangement

Figure VU III-1, Underground Horizon Plan View, illustrates the arrangement of the air shafts relative to the total underground workings. All four air shafts are located in a zone called the Shaft Pillar Area. They are interconnected by multiple drifts running east-west and north-south. The air shafts are connected to the north area and to the disposal and construction areas by multiple drifts.

The AIS is located at N0/W625. The SHS is located at N0/E0 and is the reference point for underground locations. The WS is located at S400/E25. The ES is located at S400/E475. The WS and the ES are located along a common drift, S400, and are 450 feet apart. The AIS and SHS do not share a common drift and are 1500 feet apart through the drifts around three turns. This difference influences the dynamic behavior of the system (see section 3.3.10)

3.5 Component Design Description

Refer to section 3.5 of the subsystem chapters (see footnote G-1) for subsystem component design descriptions.

3.6 Instrumentation and Control

Refer to section 3.6 of the subsystem chapters (see footnote G-1) for subsystem instrumentation and control requirement descriptions.

3.7 System Interfaces

System interfaces are of two kinds:

Primary Interfaces – Those requirements imposed on other systems by this system, Underground Ventilation, in order for this system to perform its function.

Secondary Interfaces – Those requirements imposed on this system, Underground Ventilation, by other systems in order for the other systems to perform its function.

Primary Interfaces

System Providing Service | Service to be Provided

AU00 Provide a method for transporting equipment for the Ventilation System underground.

Secondary Interfaces

ED00 Provide the environmental conditions and the associated heat removal required for operation of equipment of System ED00 underground.

FP00 Provide isolation of underground fuel stations.

4.0 OPERATIONS

Refer to the WIPP Site Mine Ventilation Plan and to the Controlled Operating Procedures for normal and off-normal operating modes.

The installation, wiring, piping, ductwork and functions are verified by completion of detailed acceptance tests.

The procedure is based on a system that is known to be operational, with all calibrations up to date and pre-operational testing complete. If maintenance has been performed then any necessary retest has been successfully completed.

Whenever a significant change in the underground ventilation flow is to be made, the underground personnel must be notified. This permits operational restrictions to be imposed or lifted and other necessary responses to be made.

Whenever a flow control setpoint is changed while a fan is operating, the change shall be made slowly enough that the flow does not noticeably lag the setpoint value.

5.0 SYSTEM LIMITATIONS, SETPOINTS, AND PRECAUTIONS

5.1 Introduction

This section describes or refers to the location of operating limits, setpoints, alarms, interlocks, and precautions as related to the operation of the Underground Ventilation System. Consideration is given to general personnel safety, equipment safety and performance, and the overall performance of the entire ventilation system. The information reiterates the limits, setpoints, and precautions imposed either implicitly or explicitly by the system operations described in sections 4, 6, and 7.

WIPP has established conditions for operation of the Underground Ventilation System. These are:

A. Underground Radioactive Material Area (Waste Handling Area) to non-Waste Handling Area differential pressure requirements

B. The operability of the above ground exhaust air filtration system (fans, dampers, and HEPA filters). More detail on UVS related conditions for operation can be found in section 2.3 of G chapter.

5.2 Operating Limits

The operating limits which define the ambient design limits and the system and component limits are listed in table VU G-6. Proper system and component operation cannot be assured if these limits are exceeded.

Table VU G - 6 – Operating Limits

PARAMETER	LIMIT
Design Outside Temperature - Dry Bulb	19°F - 100°F
Design Outside Summer Temperature - Wet Bulb	71°F
Exhaust Filter Building Temperature	50°F - 80°F
Maximum Mine Temperature	110°F
Minimum Mine Temperature	38°F
Minimum Ventilation Flow	57 KSCFM
Maximum Ventilation Flow	450 KSCFM
Maximum HEPA Filter Flow (per filter)	37 KSCFM
Maximum HEPA Filter Housing Pressure	±20 IWG

Maximum HEPA (Astrocel) ΔP	3 IWG
Maximum Prefilter (MOD) ΔP	1.8 IWG
Maximum Prefilter (HIGH) ΔP	2.5 IWG
U/G Non-Waste Handling Area Pressure Higher than Waste Handling Area - Minimum	0.05 IWG
Waste Hoist Tower Vacuum - Maximum	3.0 IWG

Note: °F = Degrees Fahrenheit
KSCFM = Thousand Standard Cubic Feet per Minute
IWG = Inches Water Gage

5.3 Setpoints and Alarms

The major setpoints involved in the controls of the Underground Ventilation System are listed in table VU G-7 and the system alarms are listed in table VU G-8. The hundreds of system status and alarm signals provided to the CMR via the CMS are controlled by Engineering. There are no priority 3 (Urgent) alarms; the priority 2 are listed in table VU G-8 along with the local alarms.

The set points listed in tables VU G-7 and VU G-8 for the exhaust fans flow control point, low fan air flow alarm and the filter differential pressure alarm have no criteria stated as safety requirements.

The filter differential pressure alarms indicate that filter replacement is needed and does not indicate that immediate failure will occur. The alarm point for filter replacement is therefore only 30% of the maximum design pressure of 10.2" H^2O.

These instruments are selected and installed based on standard industry practice for ventilation systems. Current maintenance procedures require calibration of the pressure differential alarm modules and the transmitters to plus or minus 1.0%. The loop accuracy is plus or minus 2.0%.

The normal underground air flow rate is established to satisfy the requirements of the Mine Safety and Health Administration and the State of New Mexico Mine Safety Code for all mines. The only function of the subsystem VU01 (Exhaust fans and filters) is to provide air flow in response to the requirements of the other four systems comprising system VU00.

Since there is no regulatory accuracy requirement, the achievable performance of the flow control system is that which can be obtained through standard commercial type instrumentation.

The accuracy of flow indication has been established in the calibration procedures and plus or minus 5.0% of reference pitot traverse, and the accuracy of flow control is plus or minus 5.0% of set point.

The low flow alarms are non-urgent and indicate that there is a problem requiring investigation by the operators. The low flow alarm does not indicate a specific failure.

Table VU G - 7 – Control Setpoints

PARAMETER	FUNCTION	SETPOINT
Exhaust Fan A Flow (1 Fan Running)	Damper Control	260 KSCFM
Exhaust Fan A Flow (2 Fans Running)	Damper Control	212 KSCFM
Exhaust Fan B Flow (1 Fan Running)	Damper Control	260 KSCFM
Exhaust Fan B Flow (2 Fans Running)	Damper Control	212 KSCFM
Filtration Fan A Flow	Damper Control	60 KSCFM
Filtration Fan B Flow	Damper Control	60 KSCFM
Filtration Fan C Flow	Damper Control	60 KSCFM
Waste Hoist Tower Negative Pressure	Stop Exhaust Fan A	2.5 IWG
Waste Hoist Tower Negative Pressure	Stop All Exhaust Fans	2.75 IWG
*Pressure Chamber activated	Fan(s) On Low alarm manual	0.2 IWG
*Pressure Chamber activated	Fan(s) off High alarm manual	2.10 IWG
*Pressure Chamber inactivated	Fan(s) off High-High alarm automatic	2.5 IWG
HEPA Filter Inlet Plenum	Open 004 Damper	-0.5 IWG

* Pressure chamber to be activated only during waste handling operations in the waste shaft and/or waste shaft station area when the differential pressure falls below 0.2 inches water gage.

Note: KSCFM= Thousand Standard Cubic Feet per Minute
IWG = Inches Water Gage

Table VU G - 8 – Alarms

PARAMETER	FUNCTION	SETPOINT
Waste Hoist Tower Negative Pressure (Priority one alarm)	2.25 IWG	CMR
Fan 700A Low Air Flow	187 KSCFM	MFCP, CMR
Fan 700B Low Air Flow	187 KSCFM	MFCP, CMR
Fan 700C Low Air Flow	187 KSCFM	MFCP, CMR
Fan 860A Low Air Flow	50 KSCFM	FFCP, CMR
Fan 860B Low Air Flow	50 KSCFM	FFCP, CMR
Fan 860C Low Air Flo	50 KSCFM	FFCP, CMR
HEPA-856 MOD Pre-Filter CLOGGED	1 IWG	FFCP, CMR
HEPA-856 HIGH Pre-Filter CLOGGED	1 IWG	FFCP, CMR
HEPA-856 FIRST HEPA Filter CLOGGED	3 IWG	FFCP, CMR
HEPA-856 SECOND HEPA Filter CLOGGED	3 IWG	FFCP, CMR
HEPA-857 MOD Pre-Filter CLOGGED	1 IWG	FFCP, CMR
HEPA-857 HIGH Pre-Filter CLOGGED	1 IWG	FFCP, CMR
HEPA-857 FIRST HEPA Filter CLOGGED	3 IWG	FFCP, CMR
HEPA-857 SECOND HEPA Filter CLOGGED	3 IWG	FFCP, CMR
Pressure Chamber Press. Above Waste Handling Area Press.	0.20 IWG (1)	PCCP, CMR
Pressure Chamber Press. Above Waste Handling Area Press.	2.10 IWG (1)	PCCP, CMR
Pressure Chamber Press. Above Waste Handling Area Press.	2.50 IWG (1)	PCCP, CMR
S-1300/E-140 ΔP	0.12 IWG (2)	DPCP, CMR*
(3) HEPA Filter Status	NA	CMR
(3) Exhaust Fan Status	NA	CMR
(3) Filtration Setup Mode Info.	NA	CMR
(3) Ex. Fan Protective Relay Status	NA	CMR
(3) Pos. of 18 Above-Ground Dampers	N/A	CMR

Notes:

CMR = Central Monitoring Room
DPCP = Diff. Press. Control Panel
FFCP = Filtration Fan Control Panel
IWG = Inches Water Gage
KSCFM = Thousand Standard Cubic Feet/min
MFCP = Main Fan Control Panel
PCCP = Pressure Chamber Control Panel
* = CMS calculated

(1) The non-Waste Handling Area pressure always should be higher than the Waste Handling Area pressure. (The waste shaft and the waste shaft station area is a Waste Handling Area only during waste handling operations in the waste shaft and/or the waste shaft station area.)

The low alarm activates as non-Waste Handling Area-to-the-Waste Handling Area ΔP drops to the alarm set point (0.20 IWG) and continues as the ΔP reduces or until corrective action is taken.

The high alarm activates as the non-Waste Handling Area-to-the-Waste Handling Area ΔP increases to the alarm set point (2.50 IWG) and initiates high pressure fan system shut down.

(2) The non-Waste Handling Area pressure always should be higher than the Waste Handling Area pressure. The alarm sounds as non-Waste Handling Area-to-the-Waste Handling Area ΔP drops to the alarm set point and continues as the ΔP is reduced.

(3) This additional status information is provided to the CMR and classified as "Alarm Priority 2" For a complete listing, see appendix H.

5.4 Interlocks

The logic diagrams for the exhaust and filtration fan controls are shown in Figures VU I-12 and VU I-17, respectively. The logic diagrams for the exhaust and filtration fan isolation dampers are shown in figures VU I-15 and VU I-17, respectively. The fans and isolation dampers are so interlocked that fan motors cannot be energized when isolation dampers are closed and isolation dampers cannot be closed when fan motors are energized. The two fan systems (exhaust and filtration) are interlocked to ensure that filtration takes precedence over exhausting.

Figure VU I-18 shows the control logic diagram for the HEPA filtration isolation damper. When in automatic, the isolation damper cannot be opened unless at least one isolation damper on each main exhaust fan is closed, the HEPA bypass dampers are closed, and at least one filtration fan is running. It is also required that the HEPA filter inlet plenum pressure (Table VU G-7) be at negative pressure gage. The requirement for one isolation damper on each exhaust fan to be closed can be bypassed by closing the maintenance bypass key switch for the associated fan. This bypass allows the filtration function to occur even if control power to one or more of the main exhaust fans is locked out.

The underground airlock door operation logic diagram is shown in figure VU III-7. The two airlock doors are interlocked to prevent both doors from being open at the same time.

5.5 Precautions

The following special precautions shall be observed during all Operations, Off-Normal Events, and Maintenance activities in the Underground Ventilation System:

1. Surface and Underground Services must always be coordinated and informed of actions which affect the other.

2. Mine exhaust air HEPA filtration must always be available when waste is being moved underground.

3. Always keep the underground Waste Handling Areas area 0.05 IWG less pressure than the non-Waste Handling Areas area.

4. Never let the pressure in the Waste Hoist Tower get less than (more negative) ---2.25 IWG.

5. If there is any potential of release of radioactive contamination following an incident, shift ventilation to filtration.

6. Except in an emergency, never operate underground doors, dampers, fans, etc., from remote (i.e., non-visible) locations. Dampers may be operated remotely when authorized.

7. Exhaust and filtration fans are not to be run at the same time, except when operating in maintenance mode.

8. Three filtration fans should not be operating at the same time.

9. From an electrical standpoint, only one fan should be started sequentially.

10. Three main fans shall not be operated at the same time.

6.0 OFF-NORMAL EVENTS AND RECOVERY

An off-normal event is defined as an off-normal system or plant condition which could affect the safety of off-site or on-site personnel or a condition which could affect the integrity or proper functioning or operation of the system or plant. There are two off-normal events defined for VU00 that if not properly handled have the potential to affect the safety of on-site and off-site personnel. In addition, there are events which affect the proper functioning of the system or plant. These off-normal events will be discussed under "Safety Impactive Events" and "System/Plant Impactive Events."

6.1 Off-Normal Events

Operational sequences required to mitigate and control off-normal events and recovery are documented in the WIPP Site Controlled Operating Procedures.

- Loss of Differential Pressure in the Underground
- Inoperability of the Diversion to Exhaust Filtration System

6.1.1 Loss of Differential Pressure in the Underground

System VU00 is required to maintain a pressure differential between the underground Waste Handling Areas and the non-Waste Handling Areas of at least 0.05 inches of water such that air flow is always toward the Waste Handling Areas. The Waste Handling Areas shall always have the lesser pressure. For Waste Handling Considerations, the differential pressure is measured at two primary locations as follows:

- Across bulkhead 324 in S1300 at E130
- Across bulkhead 308 in S400 at E300

In addition, the pressure chamber just west of the waste shaft in S400 at W05 has its own differential pressure monitor. This monitor is used to measure the pressure drop from the interior of the pressure chamber to the waste shaft.

There are several ways to lose the differential pressure in the underground. The most likely way would be loss of operation of the main ventilation fans such as from loss of electric power. Other ways would be by certain bulkhead doors, regulators or dampers being in the open position when they should be closed. Similarly, certain dampers, regulators or doors being closed when they should be open can cause the required differential pressure to be lost.

6.1.2 Inoperability of the Diversion to Exhaust Filtration System

There are two normal methods of diverting to the Exhaust Filtration System. One of these is the automatic; the other is the remote diversion to filtration function. One or both controlled methods of transferring from the unfiltered to the filtered mode of operation may become inoperable. Additionally, HEPA filter banks and/or isolation dampers may become inoperable.

6.1.3 Loss of Electric Power

Electric power may be lost by several means. Among these are the interruptions of the incoming power to the WIPP Site and on-site interruptions of power.

6.1.4 Design Basis Seismic Event/Tornado

There are no designed mitigation features for these events. Should the Underground Ventilation System experience either of these events, operation should continue only after careful review and inspection of the system and repair of any critical damage.

6.2 Recovery from Off Normal Events

6.2.1 Recovery from Loss of Differential Pressure

Loss of differential pressure is recovered as described in the operating procedure for the Underground Ventilation System.

6.2.2 Recovery from Inoperability of the Exhaust Filtration System

Complete Inoperability of the filtration system is considered unlikely given the redundancy of the system (three filtration fans, two filter banks, isolation dampers in series). In the event of Inoperability of the filtration system, the system can be completely isolated (stopping all underground airflow and thus mitigating the contamination to the environment) until such time as the filtration system can be made operational.

6.2.3 Recovery from Loss of Electrical Power

At least one filtration fan may be operated on backup power.

6.2.4 Recovery from DBT/DBE

The duct elbow as well as the building housing the filters are rated to withstand a design basis event. There are no recovery features other than the design rating.

7.0 Maintenance

In accordance with DOE requirements, the maintenance program "--shall contain provisions sufficient to preserve, predict, or restore the availability, operability, and reliability of plant structures, systems, and components important to safe and reliable operation of the --- facility." This is the guiding requirement and basis for the following material.

Since the Underground Ventilation System is involved with conditions for safe operations for the WIPP site, maintenance must be coordinated with waste handling operations. Waste handling must be suspended if certain underground differential pressures or exhaust air filtration capabilities do not exist.

The maintenance program for the underground ventilation system shall follow the guidelines of the DOE 4330.4B and 430.1 for the Maintenance Management Program.

7.1 Maintenance Approach

The maintenance program will ensure that the property is maintained in a manner which promotes operational safety, work health, environmental protection and compliance, property preservation, and cost-effectiveness while meeting the programmatic mission. In carrying out this program, a graded approach shall be taken by line management in the development and implementation of the maintenance program. By a graded approach, it is intended that the depth of detail required and the magnitude of resources expended for a particular maintenance function be commensurate with the functions important to safe and reliable operation, environmental compliance, safeguards and security, programmatic mission, facility preservation, and/or other facility specific requirements.

In general, all maintenance on the buildings, facilities, equipment shall be performed using "contact handling or contact maintenance" techniques. This involves direct personnel contact with the equipment vs. the use of remote manipulators or robots.

Maintenance efforts on the Underground Ventilation System will be in the following order of preference:

1. Clean, adjust, repair equipment in place.

2. Remove and replace with available spare; repair original; requalify original and retain as spare.

3. Remove, repair, requalify, and return to service.

7.2 Corrective Maintenance

Corrective maintenance on all subsystems in the Underground Ventilation System will generally follow the above stated preference of in-place, replace, or remove and repair maintenance. For some of the major above ground exhaust equipment such as selective butterfly isolation valves, the time of loss of active mine exhausting will have to be a major consideration. The loss of active mine exhausting will require suspension of underground operations. Most above ground ventilation components can be isolated from the mine air exhaust stream and maintained in place.

The Underground Ventilation System requires very little maintenance. A generic corrective maintenance procedure would basically be as follows:

A. Obtain the proper work permits per procedures.

- WO - Work Order
- RWP - Radiation Work Permit (for HEPA filters, etc.)
- SWP - Safety Work Permit (confined space inside duct work)

B. Consider the consequences of removing from service (mine ventilation, etc).

C. Shutdown per Operating Procedures and/or component manuals.

D. De-energize electrically and/or pneumatically. Tag-lock out.

E. For work inside of air flow ducts, ensure no sudden change in air flow by total fan tag out or by adjacent isolation valve tag out.

F. Perform corrective maintenance as necessary using manufacturer's literature and expertise.

G. Use portable ventilation blower for work inside of duct work.

H. After completion of corrective maintenance, perform acceptance tests and alignments as necessary to ensure that component and system will perform their intended function. This includes the information and control signals transmitted to and from the CMR.

7.3 Preventive Maintenance and Predictive Maintenance

The preventive and predictive maintenance program discussion in this section follow general mining experience for underground equipment; NFPA-70B, *Electrical Equipment Maintenance*, 1990 edition for surface electrical equipment; and ANSI/ASME N510-1989, *Testing of Nuclear Air Treatment Systems*, for HEPA filter testing. The atmosphere or environment in which this equipment operates effects its operating capabilities and the degree of maintenance required. Temperature, moisture, dirt, and salt are the main factors which contribute to this equipment deterioration. The recommended preventive and predictive maintenance frequency discussed in this section should be followed for at least four maintenance cycles, unless undue failures dictate a shorter cycle. Specific manufacturer's recommendations on the type of maintenance and the periodicity of preventive maintenance must be considered. Neither the vendors' manuals for the equipment nor national standards factor into the graded approach used in this system.

Preventive and predictive maintenance will be performed more frequently on critical items and less frequently on the same equipment used in less critical applications. As equipment history is accumulated, preventive and predictive maintenance items and frequency should be altered, to result in the maximum benefit to the overall goal.

Tables VU G-9 provides a summary for preventive and predictive maintenance of the different types of major equipment employed in this system.

Table VU G - 9 – Preventive Maintenance

Item
Main Exhaust Fan Motor
Main Exhaust Fan
Variable Pitch (Vortex) Inlet Vanes-Main
Filtration Fan Motor
Variable Pitch (Vortex) Inlet Vanes-Filtration
Filtration Exhaust Fan
Control/Balance (Louver) Damper-Manual
Filter Isolation Dampers-Half Doors
Filter Fan Isolation (Louver) Damper-Pneumatic
Isolation (Butterfly) Damper
HEPA Filter
U/G Auxiliary Fans-Small
U/G Auxiliary Fans-Large
U/G Air Ducts
Ruskin Tornado (pressure relief) Damper
Local Temporary Ventilation
Air Intake and Exhaust
Instrument Calibration

7.4 In-Service Inspection

The in-service inspection for the Underground Ventilation System is generally performed without disturbing the mechanical system or components; however, the instrumentation system periodic alignment check are included here. A comprehensive inspection program can reduce the corrective and preventive maintenance down time by anticipating performance problems from systematic observation and recorded instruments. The following inspections are recommended. See table VU G-10.

Table VU G - 10 – In-Service Inspection

Item
Exhaust and Filtration Fan Flow Control
Fans and CMS Interface
Damper Pressure Control
Damper and CMS Interface
Major Air Flow Ducts and Dampers
U/G Ducts
Doors, Regulators, and CMS Interface
Bulkheads and Doors
Ruskin Tornado (pressure relief) Dampers
Probe and Instrument Cleaning/Dusting
Local Temporary Ventilation
Air Intake and Exhaust

7.3 - 7.4 Technical Cross Reference

Refer to section 7.3 and section 7.4 of the subsystem chapters (see footnote G-1) for subsystem-specific preventative maintenance and in-service inspection requirements.

The Underground Ventilation System is instrumented to provide operating inspection. All continuously required information is provided to the CMR.

For the above ground exhaust fans, filters, and dampers, the CMR is provided with the following:

- Fan run status
- Fan air flow and low flow alarms
- Fan operating mode selected
- Exhaust fan protective relay status, vibration, and vibration alarms
- HEPA filter stage differential pressure and alarms
- All damper positions (open/closed)

For the underground bulkheads, air regulators, and instrumentation, the CMR is provided with the following information for inspection:

- Door NOT CLOSED signals
- Air regulator shaft position signals
- Air regulator control local/remote status
- Differential pressure signals underground and in the waste hoist tower
- Air quantity flow velocity signals
- Mine weather station signals

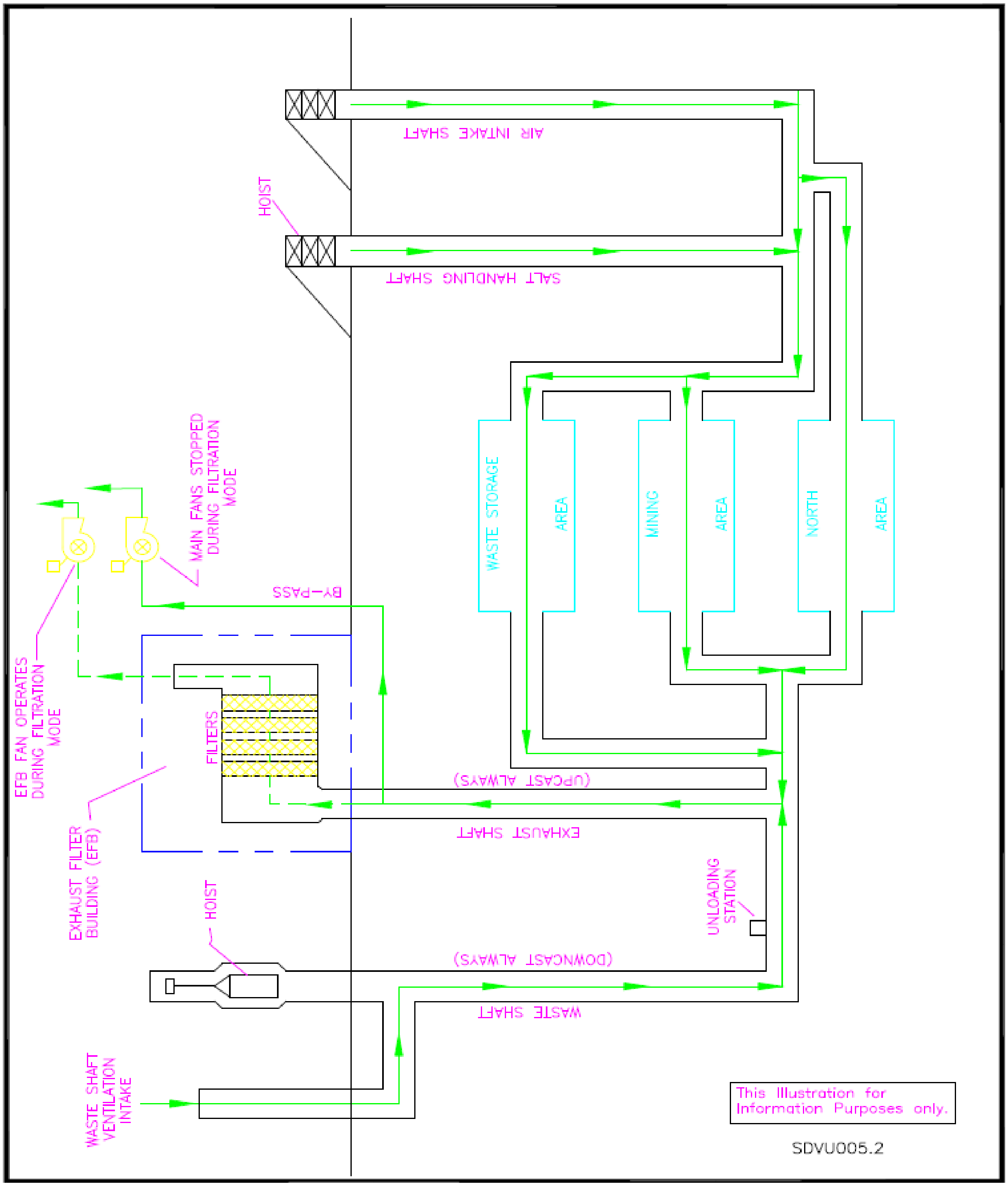

Figure VU-G - 1 – Underground Air Flow Paths – Pictorial

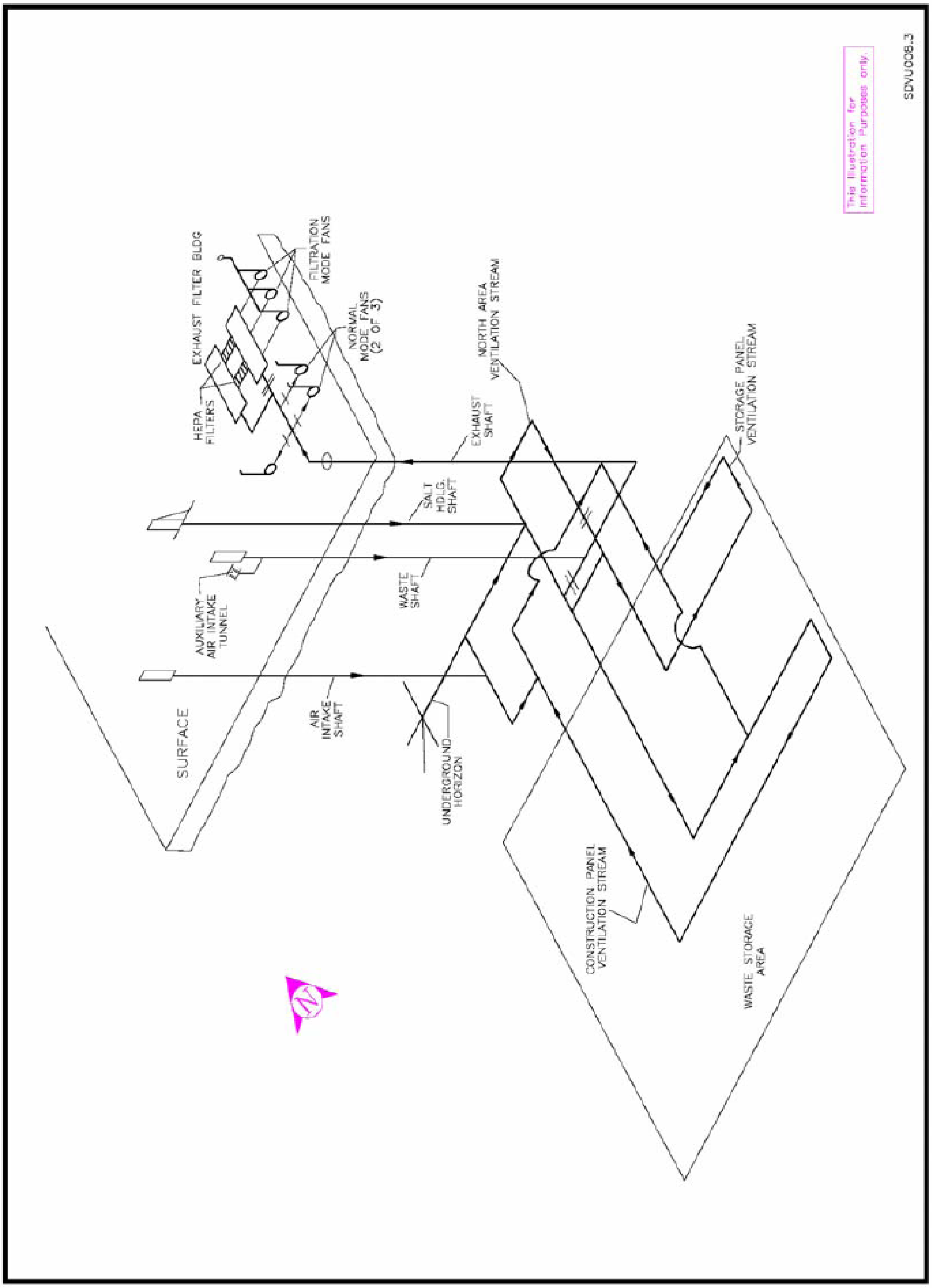

Figure VU-G - 2 – Underground Air Flow Isometric

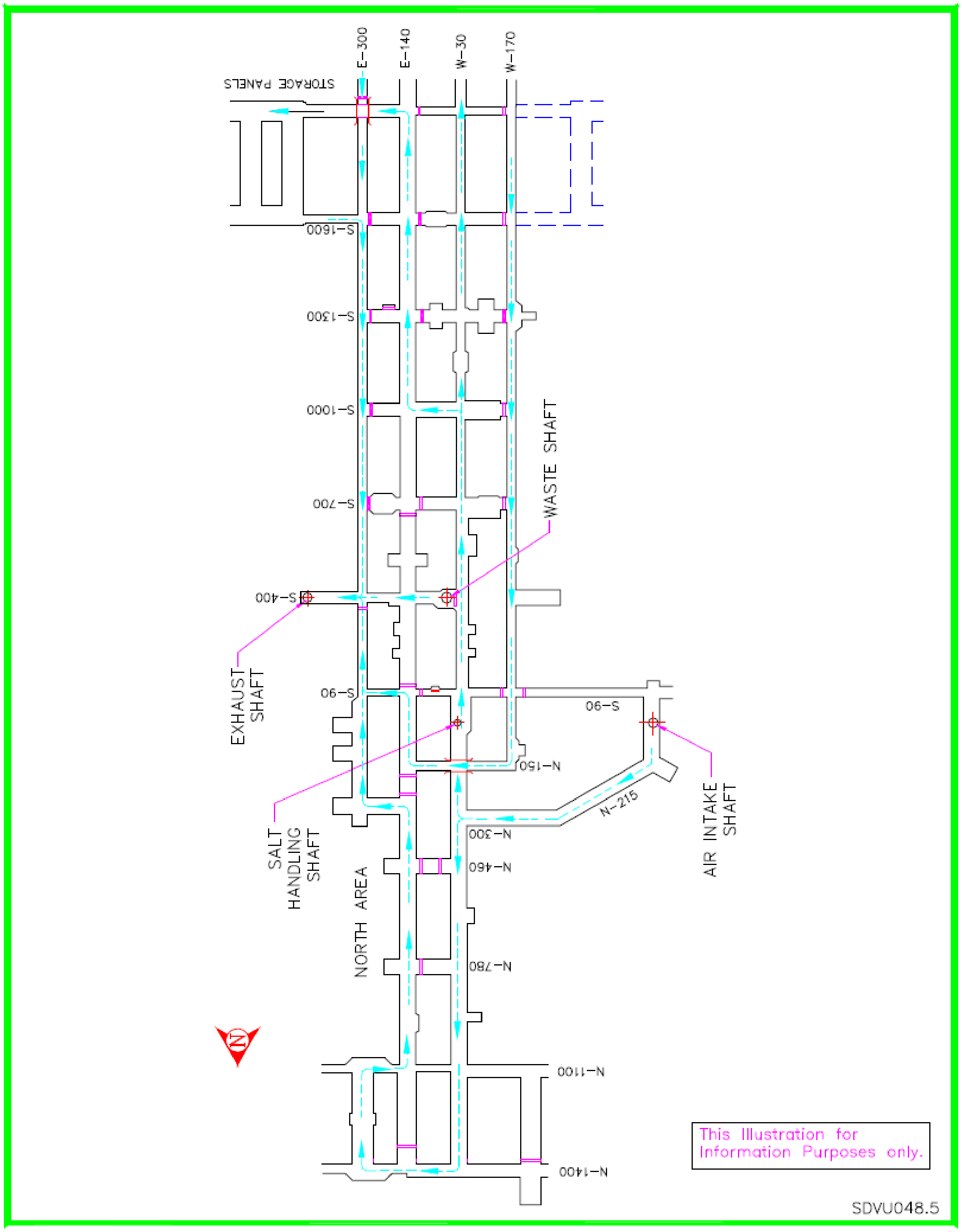

Figure VU-G - 3 – Normal Ventilation Main Flow Distribution

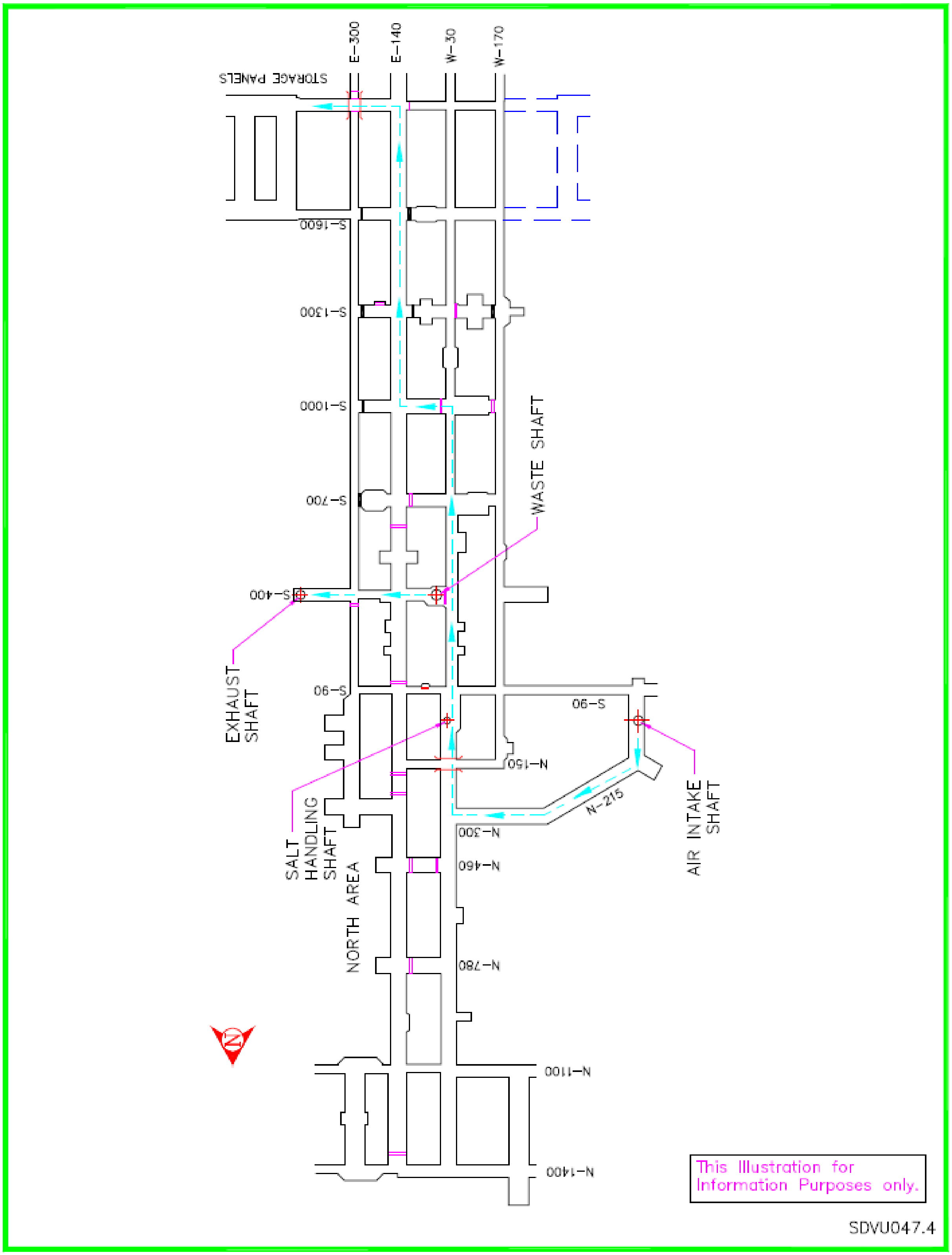

Figure VU-G - 4 – Minimum Ventilation Main Flow Distribution

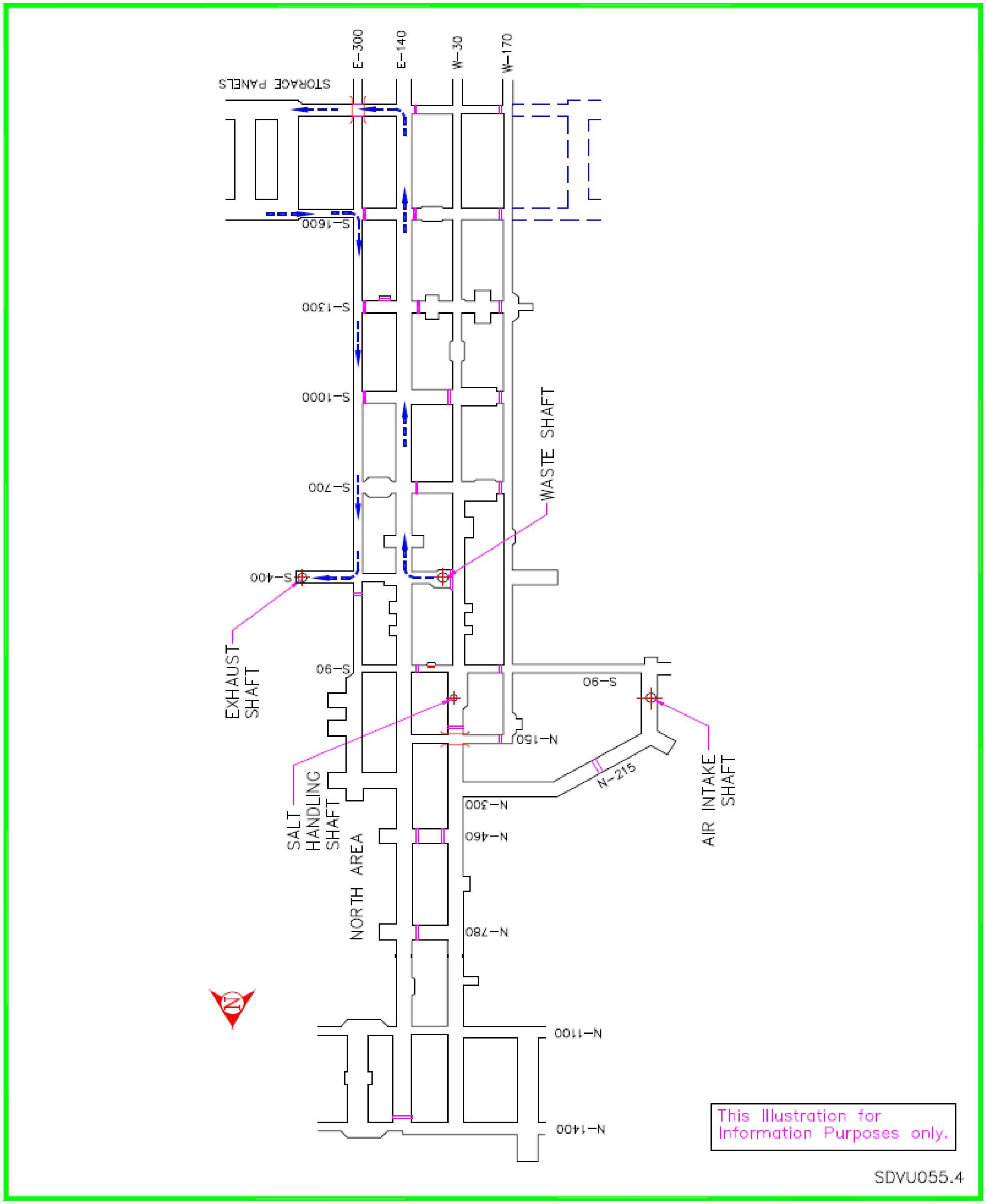

Figure VU-G - 5 – Filtration Ventilation with Diversion Main Flow Distribution

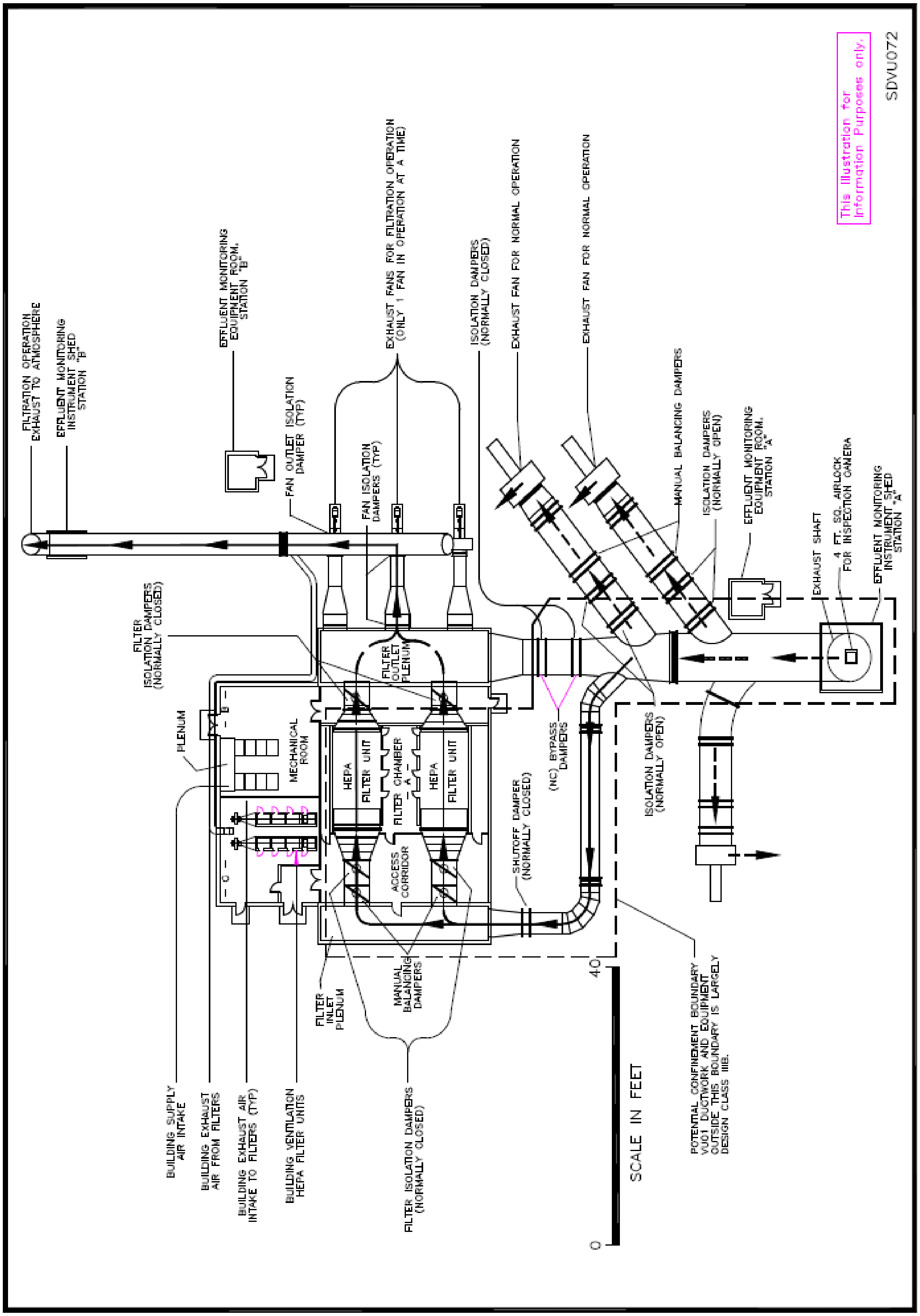

Figure VU-G - 6 – Confinement Boundary

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Subsystem VU01 - Exhaust Fans and Filters

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Chapter I

Subsystem VU01 - Exhaust Fans and Filters

1.0 PRIMARY FUNCTIONS

The primary functions for the exhaust fans and filters are presented in section 1.0 of chapter G.

2.0 DESIGN REQUIREMENTS

2.1 General

The general design requirements for the exhaust fans and filters are presented in section 2.1 of chapter G.

2.2 Subsystem Requirements

2.2.1 Exhaust Fans shall be located outdoors on the surface. For the normal ventilation mode maximum air quantity requirements, three 212 ks cfm exhaust fans shall be located outdoors on the surface in a parallel arrangement.

Three 100% capacity (60 ks cfm) filtration fans shall be provided in a parallel arrangement.

Fans shall be suitable to operate in salt dust laden air.

2.2.2 Two HEPA filter units, each of fifty percent capacity, shall be provided for post accident mitigation. Each filter unit shall consist of one moderate efficiency pre-filter bank, one high efficiency pre-filter bank and two HEPA filter banks. The filter banks shall be made up of filter cells each rated at 1,500 cfm and arranged with a maximum of three filter cells high. The HEPA filter units are located in the Exhaust Filter Building (EFB) which provides a common inlet and common outlet plenum for the filter units.

2.2.3 Isolation and block valves and flow control dampers shall be provided on all surface fans to facilitate automatic transfer from the normal to the filter mode of ventilation. Isolation valves shall be provided at the inlet and outlet of the HEPA filter units. A shut off damper shall be provided at the inlet to the HEPA filter inlet plenum.

2.2.4 Those areas of the Exhaust Filter Building (EFB) which have the potential to become contaminated, shall operate at a negative pressure to atmosphere, and the associated building exhaust air shall be monitored for radioactivity.

2.3 - 2.12 Technical Cross Reference

Refer to section 2.3 to section 2.12 of chapter G for general requirements applicable to each of the following topics:

- 2.3 Operational Requirements
- 2.4 Structural Requirements
- 2.5 General Arrangement & Essential Requirements
- 2.6 Maintenance Requirements
- 2.7 In-Service Inspection Requirements
- 2.8 Instrumentation and Control Requirements
- 2.9 Interface System Requirements
- 2.10 Quality Assurance Requirements
- 2.11 Codes and Standards Requirements
- 2.12 Reliability Requirements

3.0 DESIGN DESCRIPTION

3.1 Summary

Refer to section 3.1 of chapter G for the Underground Ventilation System summary design description.

Subsystem VU01 provides the fans, ductwork, dampers and, when needed, filters, required to pull air through the underground facility. All VU01 equipment is located on the surface.

3.2 Detailed System Description

The location of the VU01 equipment is on the east side of the facility. See figure VU V-1. The subsystem starts at the collar of the Exhaust Shaft (ES), Facility #351, and extends north through the Exhaust Filter Building (EFB), Building #413, and includes the duct work, air flow regulators, isolation dampers, and exhaust fans. The equipment is shown in greater detail in figure VU I-1.

There are six fans connected by ducting to the underground exhaust shaft so that they can draw air through the Exhaust Shaft in accordance with the operating modes.

Any two of three main exhaust fans, 41-B-700A, 41-B-700B, and 41 B-700C working together, provide the normal air flow of 425,000 SCFM through the underground. Any of the three filtration exhaust fans, 41-B-860A, 41-B-860B or 41-B-860C, can provide 60,000 CFM air flow directly or through the HEPA Filters in the Exhaust Filter Building.

OPERATING MODES

Normal	2 Main Fans
Alternate	1 Main Fan
Reduced	2 Filtration Fans
Minimum	1 Filtration Fan
Filtration	1 Filtration Fan and Flow through HEPA Filters
Maintenance	1 Main Fan and 1 or 2 Filtration Fans

The main exhaust air duct runs from the Exhaust Shaft (ES) to the HEPA filter outlet plenum. Three branches from the main duct connect with the main fans. A fourth branch connects to the HEPA filter inlet plenum. Three separate ducts connect the HEPA filter outlet plenum to the filtration exhaust fans. The filtration fan outputs are combined into a single exhaust duct. Air flow regulators and shutoff dampers are provided so that the exhaust air flow path can be fully controlled, from the ES through to the release to the atmosphere.

Descriptions and nomenclature for the various air flow operating modes are provided in section 3.3. In normal operation two of the three main exhaust fans are running and all of the filter exhaust fans are shut down and isolated. This provides unrestricted underground operation to the design level in all three areas simultaneously.

In the event that only one main exhaust fan (of three) is available, the other fans are isolated and ventilation is provided by the remaining main fan. Underground operations may proceed with further limitations on the use of diesel driven equipment.

If all three main exhaust fans are unavailable, they are isolated, and ventilation is supplied by operating one or two of the filtration exhaust fans. To accomplish this the bypass dampers are opened which permit air to flow from the main exhaust duct direct to the filter outlet plenum.

The isolation dampers for the filtration exhaust fan(s) to be operated are opened and the selected fan(s) turned on. Underground operations are substantially limited in this mode of operation.

Underground CAMs at the exhaust side of the active room, will signal if allowable radiation levels are exceeded. Subsystem VU01 will then switch to the filtration mode.

To accomplish this, the main exhaust fans are stopped and isolated, the isolation dampers are opened which allow air flow to pass through the HEPA filter banks, the isolation dampers for the selected filtration exhaust fan are opened and the fan turned on. This transfer to the filtration mode is initiated by both the automatic system and by CMS.

3.3 Performance Characteristics

3.4 System Arrangement

3.3 -- 3.4 Technical Cross Reference

Refer to section 3.3 to section 3.4 of chapter G for general requirements applicable to each of the following topics:

3.5 Component Design Description

The VU01 subsystem controls and channels the exhaust air flow from the collar of the Exhaust Shaft (ES) until it is released to the atmosphere. See figure VU I-2 for the airflow schematic diagram of VU01.

3.5.1 Exhaust Duct

3.5.1.1 Main Exhaust Duct

The exhaust duct begins with a 14 ft diameter elbow bolted to the collar of the ES. The exhaust duct is a rib-reinforced round steel structure that channels the exhaust air from the ES to the Exhaust Filter Building (EFB). There are three branch ducts that lead to the main fans. There is a filter inlet branch duct from the main exhaust duct to the inlet plenum of the EFB. There is a separate exhaust duct that carries the air from the outlet plenum of the EFB to the discharge elbow at monitoring Station B. See figure VU I-3 for the VU01 air flow paths. The length of the duct from ES centerline to the EFB is 117 feet.

The main exhaust duct and shaft head elbow is 14 feet in diameter up to the expansion bellows.

The exhaust duct system centerline is elevated approximately 14 feet above ground level, with a slight downward slope toward the EFB. See figure VU I-4 for the exterior vertical profile of VU01.

The exhaust duct system is supported on structural steel supports with saddles that are welded to the duct, and that have sliding contact pads at the support interfaces. The design allows limited movement, see figure VU I-5 to account for thermal expansion/contraction.

Metal bellows and fabric expansion joints are used to accommodate the thermal expansions imposed on the ducts due to changes in temperature. One end of each duct section and branch are anchored to the ground. Expansion and contraction of the main duct is accommodated by a metallic bellows located between the main fan branch connections.

3.5.1.2 Main Duct to EFB

The main exhaust duct is extended downstream of the main fan ducts and the filter inlet duct to connect to the filter exhaust plenum. This provides the ability to bypass the filters and use the filtration fans for underground ventilation when the filters are not required.

The main exhaust duct diameter reduces from 14 feet diameter at the bellows joint to 10 feet diameter at the section containing the two isolation dampers. These two Bypass Dampers are 10-foot diameter butterfly valves operated remotely by pneumatic cylinders. The dampers are closed by springs. The bypass dampers fail closed on loss of air pressure. A second means is provided to manually open the dampers should the pneumatic system be unavailable. Position indicators are provided. The isolation dampers are normally closed. Access points are provided to allow removal of salt buildup in the ducts.

A 14 foot square transition piece is provided between the main duct and the EFB outlet plenum.

3.5.1.3 Main Fan Ducts

The eastern two main fan ducts are about 68 feet long, 10 feet in diameter, and intersect the main duct at a 50 degree angle in plan, and a minus 8 degree angle in elevation. The slope of these ducts is necessary to accommodate the bend radius of the shaft head elbow without having to elevate the main fans. The western main fan duct is approximately 70 ft long, 10 ft in diameter, and intersects the main duct at approximately 45 degrees. The duct includes an elbow to direct the duct westward.

There are two isolation dampers, and a manual balancing damper in series in each of the branch ducts upstream of the main fans. See figures VU I-2 and VU I-3. The isolation dampers are normally open, and close automatically when the main fans are shut down. The manual balancing dampers are manually set and remain in a fixed position.

The manual balancing dampers in the main fan branch ducts are 10 foot square housings with louver type vanes on horizontal shafts. All vanes are ganged together and positioned by a manual hand wheel.

The six isolation dampers associated with the main (non-filtered) air ducts are 10 foot diameter butterfly valves with horizontal pivots. All are operated automatically by a pneumatic cylinder; however, they also have a manual hand wheel and engaging clutch. The clutch is normally disengaged. Position indicators are provided to physically show the status of the dampers (open or closed). The status is also indicated at the local control panel in the EFB and at the CMR.

3.5.1.4 Filter Inlet Duct

The filter inlet duct is 6 feet in diameter, and intersects the main exhaust duct at a 45 degree angle. See figure VU I-3. It is fully automatic and will only open under the conditions specified in Section 5.4, Interlocks, of the general section. The centerline of this duct is horizontal. There is a 45 degree elbow just downstream of the duct intersection, and a 90 degree elbow to turn the flow toward the EFB. The transition section from the duct to the EFB inlet plenum goes from the 6 foot diameter to an 8-foot square.

The high efficiency (low leakage) shut off damper in the filter inlet duct is a 6 foot diameter butterfly valve with a horizontal pivot and a pneumatic operator. It is located immediately upstream of the transition section. It is fully automatic and will only open with a negative pressure in the filter inlet plenum on filtration fan energized, Bypass Dampers closed and main fans off. It is normally closed, but will fail open.

There are two metallic bellows in the filter building inlet supply duct. These will accommodate both axial changes in the duct, and differential expansions between the filter mode inlet duct and the filter bypass main duct.

3.5.1.5 Outlet Plenum Exhaust Duct

The duct work from the EFB to the filtration fans are square, measuring 8 feet on a side, and terminating in a 56 3/4 inch diameter inlet to the fan.

There are isolation dampers upstream of each filtration fan at the exits of the filter outlet plenum. There are also isolation dampers immediately downstream of each filtration fan. All of these fan isolation dampers are louver type with horizontal pivots, pneumatic operator, manual hand wheel and clutch. The isolation dampers are normally closed, and the upstream and downstream dampers of any one fan are opened before the fan is placed in service. The clutch is normally disengaged. Position indicators are provided to physically show the status of the dampers (open or closed).

The status and operation of the dampers are monitored and controlled at the local control panel in the EFB and at the CMR.

The fan isolation dampers will fail closed on loss of offsite power; however, at least one fan can be operated on backup power.

The filtered exhaust duct is 6 feet in diameter and about 115 feet long. The transition sections from the filtration fans to the duct are rectangular in cross section with approximate internal dimensions of 42 inches by 59 inches. The transitions intersect the bottom of the duct at a 45 degree angle (in elevation).

There is a metal bellows located in the filtered air exhaust duct immediately downstream of the last filtration fan discharge duct connection. This accommodates axial expansions and contractions that occur between the fan connections and monitoring Station B.

The filtered air exhaust duct has a special inlet just upstream of the expansion bellows to accept air being discharged from the EFB ventilation system. This assures that the building ventilation air is being monitored at Station B before being discharged to the atmosphere.

3.5.1.6 Inspection and Access

An inspection hatch is provided on the main exhaust elbow, centered above the Exhaust Shaft. This inspection hatch provides passage for the borehole camera used for inspection of the exhaust shaft.

Two inspection and access ports are provided in each of the eastern two main fan ducts. One port is on the north side near the junction with the main exhaust duct and the other port is on the opposite side between the dampers and the fan. Two ports are also provided on the western main fan duct, both on the south side of the duct. One port is immediately downstream of the first isolation dampers, while the other is immediately downstream of the balance damper.

One inspection and access port is provided in the filtered exhaust duct between the last in-flow and the exit. An inspection and access port is provided in each of the three ducts from the filter outlet plenum to the filter fans.

3.5.2 Exhaust Fans

3.5.2.1 Main Exhaust Fans

The three main exhaust fans are of the centrifugal type, each having a rated capacity of 300,000 scfm with 4.16 kV, 3 phase, 60 hz, 600 HP motors, variable pitch inlet vanes and exhaust mufflers. The field performance curves are shown on figure VU I-6.

A sketch of a typical main fan is shown in figure VU I-8. Each main fan is bolted onto a concrete pad foundation. The support pedestal is metal and backfilled with concrete at the site. The backfill provides stability and sound dampening. The motor, with its air cooling shroud, is mounted on the lower deck of the pedestal.

The fan housing is supported by I beams from the base and from the high end of the pedestal. Each fan has a bearing mounted on each face of the housing to support the shaft. The shaft extends through the rotor and housing to connect to the motor shaft by a mechanical coupling. A bolted removable sector of the fan housing is provided to allow removal and replacement of the fan rotor. An inspection access opening is provided in the removable segment for rotor and shaft inspection.

The 125 KVAR power factor correction capacitor is mounted on the foundation pad just outboard of the motor. Vibration sensors are located on the inboard and outboard bearings of the fan motor of both main fans.

3.5.2.2 Filtration Exhaust Fans

The three filtration exhaust fans are of the centrifugal type, each having rated capacity of 70,000 scfm with 460 v, 3 phase, 60 hz, 235 HP motors, and variable pitch inlet vanes. The shop performance curves are shown on figure VU I-7.

A sketch of a typical filtration fan is shown in figure VU I-9. Each main fan is bolted onto a concrete pad foundation. The support pedestal is metal and backfilled with concrete at the site. The backfill provides stability and sound dampening. The motor is mounted on the lower deck of the pedestal.

The fan housing is supported by angle iron from the base and from the high end of the pedestal. Each fan has a bearing mounted on each face of the housing to support the shaft. The shaft extends through the rotor and housing to connect to the motor shaft by a mechanical coupling. An access door is provided into the fan housing for inspection as well as removal and replacement of the rotor. The 35 KVAR power factor correction capacitor is mounted on I beams, clear of the foundation pad, just outboard of the motor.

3.5.2.3 Duct to Fan Joints

There are fabric flexible joints at the inlets of all main and filtration fans. There are flexible joints at the outlets of the three filtration fans. The fabric joints accommodate expansion and prevent the fan vibrations from being transmitted to the duct work. The joints at the main fan inlets accommodate an approximate 8 degree downward slope of the branch ducts where they connect to the level mounted fans.

3.5.3 Exhaust Filtration

3.5.3.1 Exhaust Filter Building (EFB)

The exhaust filter building (413), houses the HEPA filters, filter inlet and outlet plena, the building ventilation equipment, the backup compressed air system for pneumatic operation of the various dampers and the equipment control panels.

Selected areas of the EFB building operate at a negative pressure, and the building air is passed through separate HEPA filters (Heating and Ventilation System) before being discharged to the atmosphere in the unlikely event that an air release from the main exhaust HEPA filters might occur. The air exhaust is through the filtered exhaust duct and is thus sampled at Station B.

3.5.3.2 Filtration

The two parallel HEPA filter units are walk-in type units. Each unit has one series bank of moderate efficiency prefilters (roughing filters), one series bank high efficiency prefilters and two series banks of HEPA filters. Each filter unit has a rated air flow capacity of 30,000 SCFM, providing a total capacity of 60,000 SCFM. The filters are mounted in parallel between a common inlet plenum and common outlet plenum.

The overall layout of the filter units, ductwork and dampers can be seen on figure VU I-1.

Figure VU I-10 illustrates one of the two filter units. Each filter unit is approximately 17 feet wide by 27 feet long and 8 feet tall. Each filter bank contains 21 filters, clamped into frames, seven filters wide and three filters high.

An individual prefilter element is a Varicel or equivalent filter 24 inches wide, 24 inches high and 12 inches deep. An individual HEPA filter element is an Astrocel or equivalent filter 24 inches wide, 24 inches high and 12 inches deep. These filters all use a pleated fiberglass media, folded and separated by metal spacers in a metal frame.

The first prefilter bank of filters contains 60% efficient filter units. The second prefilter bank of filters contains 90% efficient filter units. The HEPA filter banks contain filters with a 99.97% (0.3μ) efficiency. The efficiency of the prefilters is determined by tests prescribed by ASHRAE while the efficiency of the HEPA filters is determined by aerosol tests.

The filter banks are designed so that the individual filters can be bagged out to minimize spread of contamination. Aerosol distribution sampling manifolds are provided ahead of each HEPA filter bank so that these filters can be routinely tested.

The rectangular duct work from the inlet plenum to the filter units contain a balancing damper followed by an isolation damper assembly. The rectangular ductwork from the filter units to the outlet plenum contain an isolation damper assembly. The filter isolation damper assemblies are configured to be normally closed and fail open. The filter isolation damper assemblies are normally operated by pneumatic cylinders and can also be operated using manually engaged clutches and handwheels. A ladder is required for access to the manual controls.

Each of the HEPA filter inlet ducts from the inlet plenum is 8 ft wide and 6 ft high. Each has a flow balancing damper (from the South and North Filters) which is manually set and fixed in position.

Immediately downstream of the flow balancing dampers are filter inlet isolation dampers. Each damper unit is 4 ft by 6 ft in size, filling half the duct. Two units are used side by side to close off each inlet duct.

Isolation dampers similar to those in the filter inlets are used at the filter outlets. All filter isolation dampers are pneumatically operated and will fail open on loss of offsite power. All dampers have hand wheels operators and clutches for manual operation.

The HEPA filters discharge into an outlet plenum that has three outlet ducts leading to the three filtration fans. These outlets are 8 foot square.

3.6 Instrumentation and Control

This subsystem consists of the six exhaust fans, the exhaust filters and the associated exhaust dampers and exhaust duct work located at the east side of the site. See figure VU I-1.

The controls for the VU01 equipment are located on four panels, all located in the mechanical equipment room at the north end of the Exhaust Filter Building (EFB). See figure VU I-1.

The system design is based on control actions utilizing these four control panels. Some of the control functions can also be actuated from the CMR via the Local Processing Unit (LPU) of the CMS.

Drawings are identified in the Appendices which provide the details of the logic diagrams, schematics, wiring diagrams, instrument loop diagrams, process and instrument diagrams, panel layouts and electrical supply.

This section describes the control capabilities of the instrumentation and control circuits. The outline of the control procedures is contained in section 4 of this SDD.

3.6.1 Main Exhaust Fans

The three main exhaust fans, are controlled from a panel located in the EFB. These fans can be stopped but not started from the CMR.

3.6.1.1 Main Fan Electrical Supply (see also SDD ED00)

The 4.16 KV Fan motor power supply is provided by a dedicated transformer located in Substation 7. The transformer feeds three motor starters also located in Substation 7. See SDD ED00 for details.

The starters utilize vacuum contactors operated by a magnetic relay. The starter relays are energized by a circuit described in the next section. System and equipment protection includes current limiting fuses and a solid state relay system which trips on ground, phase sequence, over current and thermal faults. The fan housing and motor case are grounded.

Each main fan motor has a power factor correction shunt capacitor of 125 KVAR.

The main fan motors can only be started from the local position at the Panel. The logic diagram for the three main exhaust fans controlled from this panel is shown on figure VU I-11.

The fans can be started in either manual or automatic mode from the local panel.

In the manual mode the main fan isolation dampers must be opened manually by setting the OPEN/CLOSE/AUTO switch to OPEN and by selecting MANUAL on the MAN/AUTO fan control mode selector. Then selecting START on the START/STOP selector energizes the fan motor start-up circuit. The logic for the isolation dampers is shown on figure VU I-12.

In the automatic mode the dampers are opened automatically when the fan is energized. The automatic mode is initiated by selecting AUTO on the OPEN/CLOSE/AUTO mode selector switch for the dampers and selecting AUTO on the MAN/AUTO fan control mode selector. Then selecting START on the START/STOP selector energizes both the damper opening and fan motor start-up circuits.

A red pilot light for each isolation damper indicates that the damper is open. A green pilot light indicates that the damper is closed. The pilot lights are located on the panel above the OPEN/CLOSE/AUTO switches.

A red pilot light for each fan indicates that the fan is running. A green pilot light indicates that the fan is not energized. The pilot lights are located on the panel above the START/STOP switches.

The fans can be shut down by selecting STOP on the START/STOP fan switch, selecting STOP on the graphic display in the CMR or by pushing the red emergency pull-ON/push-OFF button located at the north side of the fan motors.

A filtration mode ON signal will always automatically deactivate both main exhaust fans whether the control mode selector is in the AUTO or MANUAL control position.

There is a differential pressure transmitter located in the WS hoist tower which measures the differential pressure between the inside and outside of the WS hoist tower. The output goes to the CMS which will take the following actions at the set levels:

Delta Pressure Level	Action Taken
25 in. wg	CMS Alarm (refer to VU05 for further action)
-2.5 in. wg	STOP a fan if two are running. (Go to Alternate Mode if in Normal Mode)
-2.75 in. wg	Stop all Fans

Other actions are described in section V.

3.6.1.2 Main Fan Flow Control

Dynamic flow control for each of the fans is accomplished by adjusting the inlet control dampers (vortex vanes).

There is a manually adjustable flow regulating damper in each main fan duct. These are used for long term trim. These dampers are only adjustable by means of a handwheel.

3.6.1.3 Main Fan CMS Interface

The following main exhaust fan measurement and status signals are transmitted to the CMS from the local LPU in the exhaust filter building.

Parameters

Fan Flow Rate
Fan Motor Axial Shaft Vibration
Fan Motor Outboard Bearing Vibration
Fan Motor Inboard Bearing Vibration
Fan Outboard Bearing Vibration
Fan Inboard Bearing Vibration

Electrical Supply

Transformer 25P-TR15/7 Malfunction
Breaker 25P-SWG05/7-1 Trip Status
Fan 41-BM-700A MPR Relay Alarm
Fan 41-BM-700A MPR Protection Trip
Fan 41-BM-700B MPR Relay Alarm
Fan 41-BM-700B MPR Protection Trip
Fan 41-BM-700C MPR Relay Alarm
Fan 41-BM-700C MPR Protection Trip

Fan Status

Fan 41-B-700A Low Flow
Fan 41-B-700A Status (Run/Stop)
Fan 41-B-700B Status (Run/Stop)
Fan 41-B-700C Status (Run/Stop)

The following functionally active output signals are transmitted from the CMR to the exhaust filter building by way of the local LPU.

Stop Fan 41-B-700A from CMS
Stop Fan 41-B-700B from CMS
Stop Fan 41-B-700C from CMS

3.6.2 Filtration Exhaust Fan Motors

The three filtration exhaust fan motors, 860 A, B, and C can be controlled from a panel located in the exhaust filter building. See figure VU I-13. These fan motors can also be controlled from the CMR graphics display. See SDD CM00.

3.6.2.1 Filtration Fan Electrical Supply (See also SDD-ED00)

The 480v fan motor power supply for fan 860-A is provided from BUS A of Substation 3. This bus is supplied by a transformer in Substation 3 or from a Diesel Generator 503. The 480V fan motor power supply for fans 860-B and 860-C is provided from BUS B of Substation 3. This bus is supplied by a transformer in Substation 3 or from Diesel Generator 504. BUS A and BUS B are normally isolated by a NO breaker. Closing of this breaker can be used to feed a filtration fan from the alternate sources. This configuration is shown on figure VU I-14.

The 480v fan motors are started directly on-line through 480V circuit breakers located in Substation 3. The circuit breaker operating coils are energized as described in the next section. Protection is provided by a solid state relay system which trips on over current and ground faults. The fan housing and motor case are grounded.

Each filtration fan motor has a power factor correction shunt capacitor of 35 KVAR.

3.6.2.2 Filtration Fan Start-up and Shutdown Controls

Control of the filtration fan motors can be exercised either from the local panel, in the exhaust filter building or remotely from the CMS graphics display. Figure VU I-15 is a logic diagram for the filtration fan and damper controls. Control from the CMR must be enabled at the local panel.

A key operated LOCAL/REMOTE selector switch allows the operator to select between local control and CMR (REMOTE) control. This one switch controls the operating mode for all three fans.

Each fan has its own key operated three way MANUAL/OFF/AUTO control mode selector switch. When any of these switches is placed in the AUTO position, the corresponding fan will stop if the filtration signal is energized. This is needed when a filtration fan is running with the filtration bypass dampers open. In the MANUAL position of the switch, the filtration signal is ignored.

To start and stop the filtration fans refer to WIPP Controlled Operating Procedures.

3.6.2.3 Filtration Fan Flow Control

Dynamic flow control for each of the fans is accomplished by adjusting the inlet control dampers (vortex vanes). This adjustment is manual, at the fan. Refer to NWP Controlled Drawings for the 860 fan and damper assignments and alignment.

3.6.2.4 Filtration Fan CMS Interface

The following filtration exhaust fan measurement and status signals are transmitted to the CMS from the local LPU in the exhaust filter building.

Local Panel BYPASS/FILTRATION Selection

- Initiation of FILTER MODE FROM LP
- Initiation of BYPASS MODE FROM LP

The following functionally active output status signals are transmitted from the CMR to the exhaust filter building by way of the local LPU.

- Initiation of FILTRATION from CMR
- Initiation of BYPASS MODE from CMR
- START/STOP of each Filtration Fan

3.6.2.5 Filtration Mode Controls

The filtration exhaust fans are not energized during normal operation. Their function is to provide filtration mode operation when the shaft exhaust is diverted through the HEPA filters and the main exhaust fans are shutdown. The circuitry which initiates filtration ON is described in section 3.6.10.2.

Manual initiation of filtration can be carried out locally or at the CMR based on the position of the LOCAL/REMOTE selector switch on the filtration fan control Panel. To accommodate filtration mode operation, one of the filtration fans must be left with the AUTOMATIC mode selected on its control mode selector switch. A filtration mode initiation signal from whatever source will close contacts in the control circuits of the fan with the AUTOMATIC mode selected. This will open the isolation dampers on that fan and start-up the fan as previously described.

3.6.2.6 Ventilation Mode Controls

It is possible to use the filtration fans as ventilation fans when the main exhaust fans are shutdown. See the control logic, figure VU I-15.

In this mode the HEPA filter shutoff and isolation valves remain closed but the bypass dampers are opened. The FILTRATION/BYPASS selector switch is used to select BYPASS and the START/STOP switch of one or two of the two filtration fans on normal mode can be switched to START. The fan(s) selected would then start up as previously described. Note that one filtration fan MUST remain in the AUTO mode to retain the capability for a FILTRATION mode.

If the FILTRATION mode is initiated when one or two of the filtration fans are being used as ventilation fans, the fans will shut down, the bypass dampers will close, the HEPA shutoff and isolation dampers will open and the filtration fan placed in AUTO will start after the 15 to 30 second time delay to allow damper positioning.

3.6.3 Flow Measurements and Controls

Flow control in each of the six exhaust fans (three main exhaust and three filtration exhaust fans) is manual.

Flow measurement is accomplished for the main fans (41-B-700A, B, C) by the use of ultrasonic flow sensors with local indications in panels adjacent to the respective duct. These indications are in both Actual Cubic Feet per Minute (ACFM) and Standard Cubic Feet per Minute (SCFM). In addition, the flow signal is sent to the CRM for remote indication for each fan.

Flow measurement is accomplished for the filtration fans (41-B-860A, B, C) by the use of hot-wire type sensors at Station B with local indications in a panel in Building 413B. The flow signals are sent to the CMR for remote indication.

3.6.4 Main Fan Isolation Dampers

Each main exhaust fan has two isolation dampers located in the inlet duct upstream of the fans. These dampers are pneumatically opened and spring closed when the solenoid operated actuator valves are de-energized.

3.6.4.1 Main Fan Damper Control System

The logic diagram for the operation of these dampers is shown on figure VU I-12. The dampers for each main fan are controlled by two three position, OPEN/CLOSE/AUTO, selector switches, on a panel B in the exhaust filter building. Each switch controls both dampers for one fan. The status of each damper is indicated by red (open) and green (closed) lamps on the panel.

Refer to NWP Controlled Operating Procedure for Main Fan isolation damper control sequences.

3.6.4.2 Main Fan Damper CMS Interface

The following main fan isolation damper status signals are transmitted to the CMS from the local LPU.

Fan No.	Damper Number	Status
41-B-700A	413-HD-307-003A	CLOSED/OPEN
41-B-700A	413-HD-307-003B	CLOSED/OPEN
41-B-700B	413-HD-307-002A	CLOSED/OPEN
41-B-700B	413-HD-307-002B	CLOSED/OPEN
41-B-700C	413-HD-307-004A	CLOSED/OPEN
41-B-700C	413-HD-307-004B	CLOSED/OPEN

3.6.5 Filtration Fan Isolation Dampers

Each filtration fan has an inlet and an outlet isolation damper. These dampers are pneumatically operated and are slaved to the status of the fan with which they are associated. These damper units are designated as follows:

Fan	Damper Inlet	Damper Outlet	Status
413-BM-860A	413-HD-056-OlOA	413-HD-056-OlOB	Closed/Open
413-BM-860B	413-HD-056-OllA	413-HD-056-OllB	Closed/Open
413-BM-860C	413-HD-056-012A	413-HD-056-012B	Closed/Open

Each filtration fan inlet isolation damper is located just outside the EFB in the large square duct section leading to the fan. Each filtration fan outlet isolation damper is located in the segment of exhaust duct attached to the fan outlet.

3.6.5.1 Filtration Fan Damper Control System

When a filtration fan receives an initiation signal, the inlet and outlet isolation dampers receive a signal to open. When the isolation dampers are fully open, they close contacts which enable the fan control to complete the startup of the fans.

3.6.5.2 Filtration Fan Damper CMS Interface

Filtration fan isolation damper status signals are transmitted to the CMS from LPU 805.

3.6.6 Bypass Dampers

Two bypass dampers are in series to block flow between the main exhaust duct and the outlet plenum for the filter system. See figure VU I-1. When opened, these dampers provide the means for bypassing filtration when the filtration exhaust fans are in use as ventilation fans. Under normal operating and filtration ON conditions these dampers are closed.

3.6.6.1 Bypass Dampers Control

These dampers are pneumatically open and spring closed when de-energized. A single manual three position CLOSE/OPEN/AUTO selector switch is used to control both dampers in conjunction with the REMOTE/LOCAL selector switch on the same panel. See figure VU I-13. The logic diagram for these dampers is shown on figure VU I-17.

Refer to WIPP Controlled Operating Procedures for bypass isolation dampers operations.

The top six indicator lights on the control panel indicate the status of the bypass dampers. See figure VU I-13. The red lamp of each pair indicates open and the green lamp closed.

3.6.6.2 Bypass Dampers CMS Interface

The bypass dampers status (open/closed) are transmitted to the CMS by way of the local LPU.

3.6.7 HEPA Filter Instrumentation

Pressure drops are measured across each of the four series filter banks in each of the two HEPA filter units, by a differential pressure (DP) transmitter located on the walls adjacent to each HEPA filter unit.

From each of these transmitters a signal is transmitted to a control panel where the signals are displayed on vertical indicators.

The pressure differential output signals are also supplied to circuit boards which generate an alarm signal when the differential exceeds preset limits, indicating a fully loaded (clogged) filter.

These clogged filter alarms are brought up on the second row of annunciator lights on a panel as shown in figure VU I-13, marked as an Engraving. An audible horn signal is also activated on the front of the panel. The alarm is acknowledged by pressing the acknowledge button on the panel. This action de-energizes the horn and switches the window illumination to a flashing mode. A reset button is used to deactivate the alarm window.

3.6.7.1 HEPA Filter Pressure Differential CMS Interface

Pressure Differential measurement and status signals are transmitted to the CMS from the local LPU in the exhaust filter building for each filter bank.

3.6.8 HEPA Filter Isolation Dampers

Each of the two filter systems, has one pair of isolation dampers. One damper for each filter is located at the inlet, in the duct between the common inlet and the filter chamber inlet. The other damper is located at the outlet of the filter, in the duct between the filter chamber outlet and the common outlet plenum. See figure VU I-1.

3.6.8.1 Control System

The HEPA filter isolation dampers are pneumatically closed. They are designed to revert to the open position when de-energized. Refer to WIPP Controlled Operating Procedures for HEPA filter isolation dampers.

3.6.8.2 CMS Interface

The open/closed status signals related to the operation of the HEPA Filter dampers are transmitted to the CMS by way of the local LPU.

3.6.9 Inlet Plenum Isolation Damper

The inlet plenum isolation damper is located in the branch exhaust duct from the main exhaust duct to the inlet plenum in the EFB. See figure VU I-1. The purpose of the inlet plenum isolation damper is to isolate the inlet plenum of the HEPA filters from the main exhaust duct under normal operating conditions.

This is a pneumatically closed, spring opened damper. It is designed to revert to the fully open position when de-energized. Refer to WIPP Controlled Operating Procedures for the inlet plenum isolation damper.

3.6.9.1 For this damper to open, the following must occur:

1. A filtration fan must be running.

2. The bypass dampers must be closed.

3. One isolation damper in each Main Fan string must be closed.

4. There must be negative pressure on the filter building side of the damper.

When all of the above occurs, the solenoid is de-energized and the damper opens.

There is a latch in the circuit to seal in the pressure switch (item 4 above) when the damper is open.

There are three maintenance bypass switches to allow work on the 700 fan control circuits without affecting the shift to filtration. These switches bypass their respective fan damper indication contacts in the shift to filtration logic.

3.6.10 Filtration/Bypass Control Circuitry

The exhaust fan system can be switched from the normal or bypass mode of operation to the Filtration Mode in which the underground exhaust air is passed through an arrangement of HEPA filters as described in section 3.3.7, chapter G.

3.6.10.1 Control Equipment

The logic used for filtration and bypass is illustrated in figure VU I-19. Alarm indications are shown on figure VU I-13.

The system can be placed in the Filtration Mode in any of the ways in the WIPP Controlled Operating Procedures for filtration mode operational sequences.

3.6.10.2 Filtration ON Test

A test circuit is provided in the local panel which allows the local operator to carry out a partial test of the filtration ON circuitry.

The operator switches the key operated test switch TS-l on the front of the panel to the TEST position and then selects the LOCAL position on the REMOTE/LOCAL switch on the panel and the FILTRATION position on the BYPASS/FILTRATION switch on the panel. This will energize the FILTRATION latching relay and an auxiliary relay. The auxiliary relay closes if the main latching relay contacts are closed and the test switch blocks the circuit beyond to prevent the completion of the transfer to FILTRATION. There is a blue light above the test switch which indicates that these relays have closed. When the test is in process, a yellow indicator light on the panel will indicate that the auto filtration system has been disabled due to the disconnection of relay R2.

3.7 System Interfaces

Primary Interfaces

System Providing Service	Service to be Provided
CA00	Provide instrument air and operator air for valves, variable pitch vanes and adjustable louvers.
	Provide Exhaust Filter Building and ductwork confinement.
CM00	Provide monitoring of the UVS.
	Provide backup signals to change the configuration of the UVS when needed by an emergency, or a change in mode of ventilation.

Primary Interfaces

System Providing Service	Service to be Provided
ED00	Provide electric power to 4.16 kV, 60 Hz, 3-phase power to the main exhaust fans. Provide electric power to 480v, 60 Hz, 3-phase and backup power to the Filtration fans.
FP00	Provide automatic fire protection to the Exhaust Filter Building and the HEPA filters.
GC00	Provide the Exhaust Filter Building and supports for the exhaust ducts.
RM00	Upon detection of radio nuclides above the setpoint in the underground air streams, provide an alarm to System CM00 which in turn provides a signal to VU00 to reduce the airflow and divert the airflow through the HEPA filters automatically (filtration mode). Continuously sample the effluent air downstream from the HEPA filters for radio nuclides.

Secondary Interfaces

No Secondary Interfaces to VU01.

4.0 OPERATIONS

Refer to section 4.0 of chapter G for VU00 system integrated operations information.

5.0 SYSTEM LIMITATIONS, SETPOINTS, AND PRECAUTIONS

Refer to section 5.0 of chapter G for system-subsystem performance limitations, setpoints, and precautions.

6.0 OFF NORMAL EVENTS AND RECOVERY

Refer to section 6.0 of chapter G for system-level off normal events and recovery.

7.0 MAINTENANCE

Refer to section 7.0 of chapter G for information relating to the Underground Ventilation System maintenance approach, corrective maintenance, preventative maintenance and inspection program requirements.

Presented are VU01 specific maintenance items which shall be considered and included in the VUS controlled maintenance procedures.

For the above ground portion of the underground mine ventilation system the equipment is:

- Main Exhaust Fan Motor
- Main Exhaust Fan
- Variable Pitch (Vortex) Inlet Vanes - Main
- Filtration Exhaust Fan Motor
- Filtration Exhaust Fan
- Variable Pitch (Vortex) Inlet Vanes - Filtration
- Flow Control/Balance (louver) Dampers (Manual)
- Filter Isolation Dampers - Half Door
- Filter Fan Isolation (Louver) Damper - Pneumatic
- Isolation (Butterfly) Damper
- HEPA Filters

7.1 In-Service Inspection

In-service inspection program shall address the following inspection requirements:

- Exhaust and Filtration Fans
- Dampers
- HEPA Filters
- Major Air Flow Ducts and Dampers

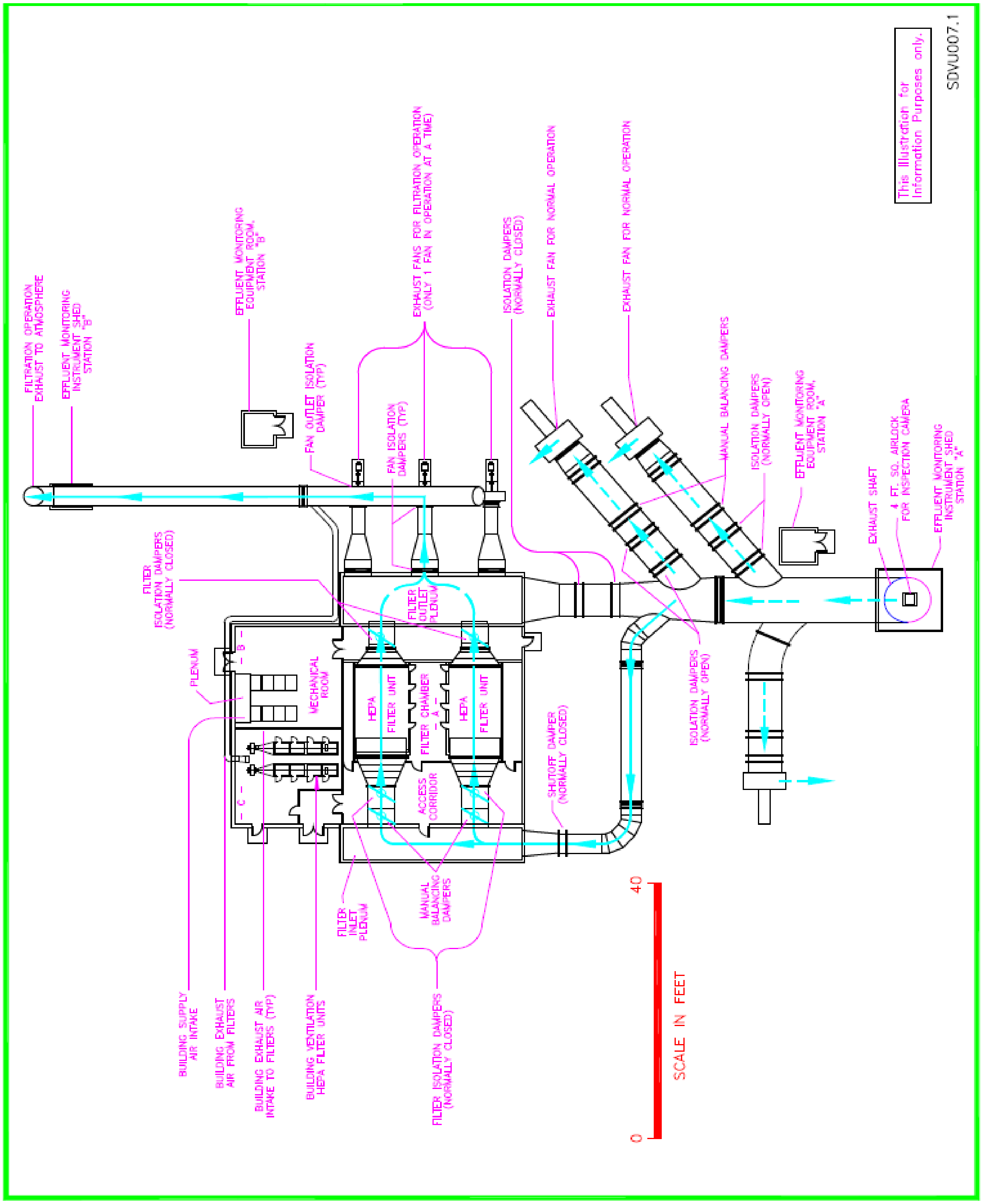

Figure VU I - 1 – Exhaust Flow Diagram – Surface Equipment

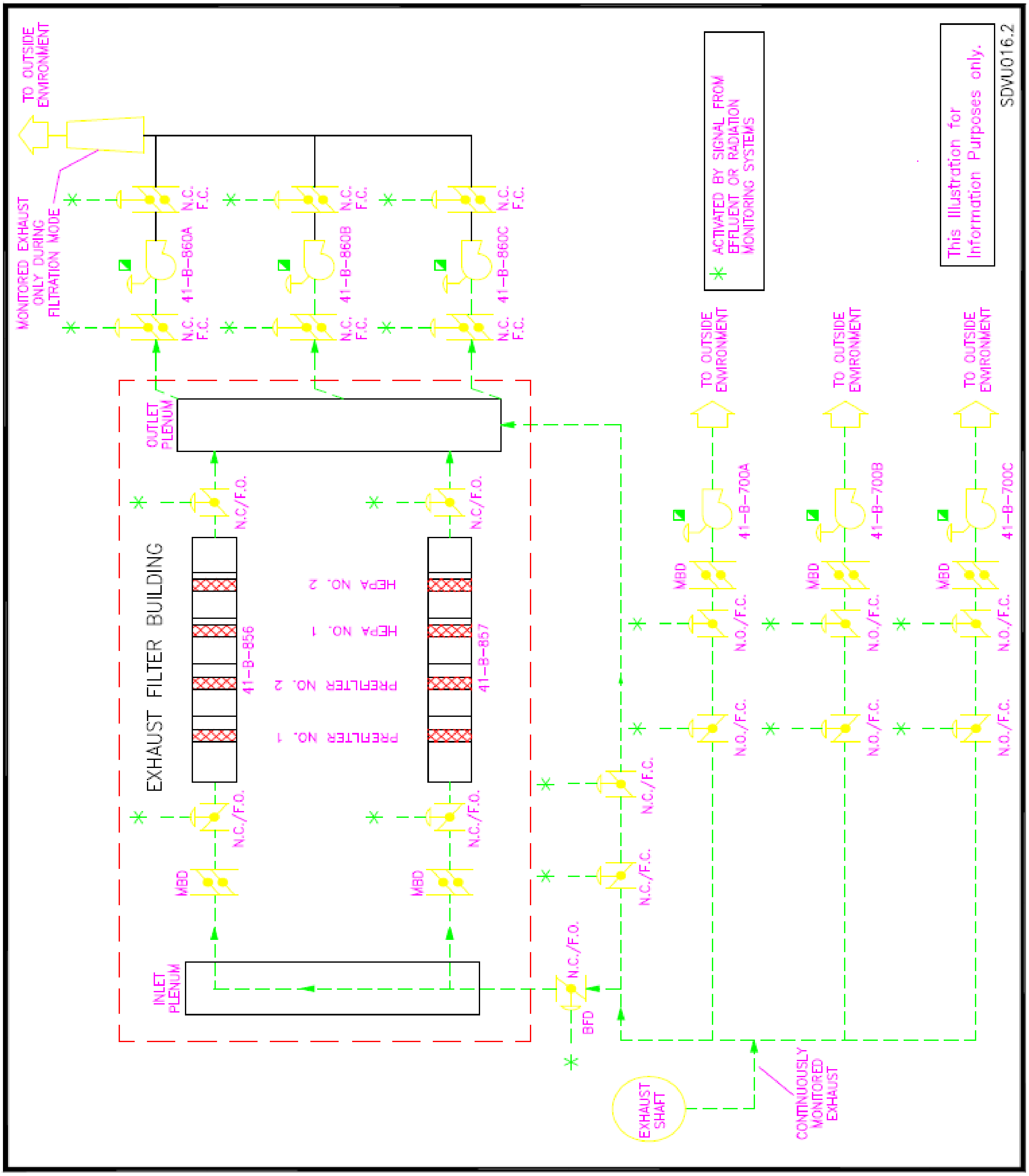

Figure VU I - 2 – VU01 Air Flow Schematic

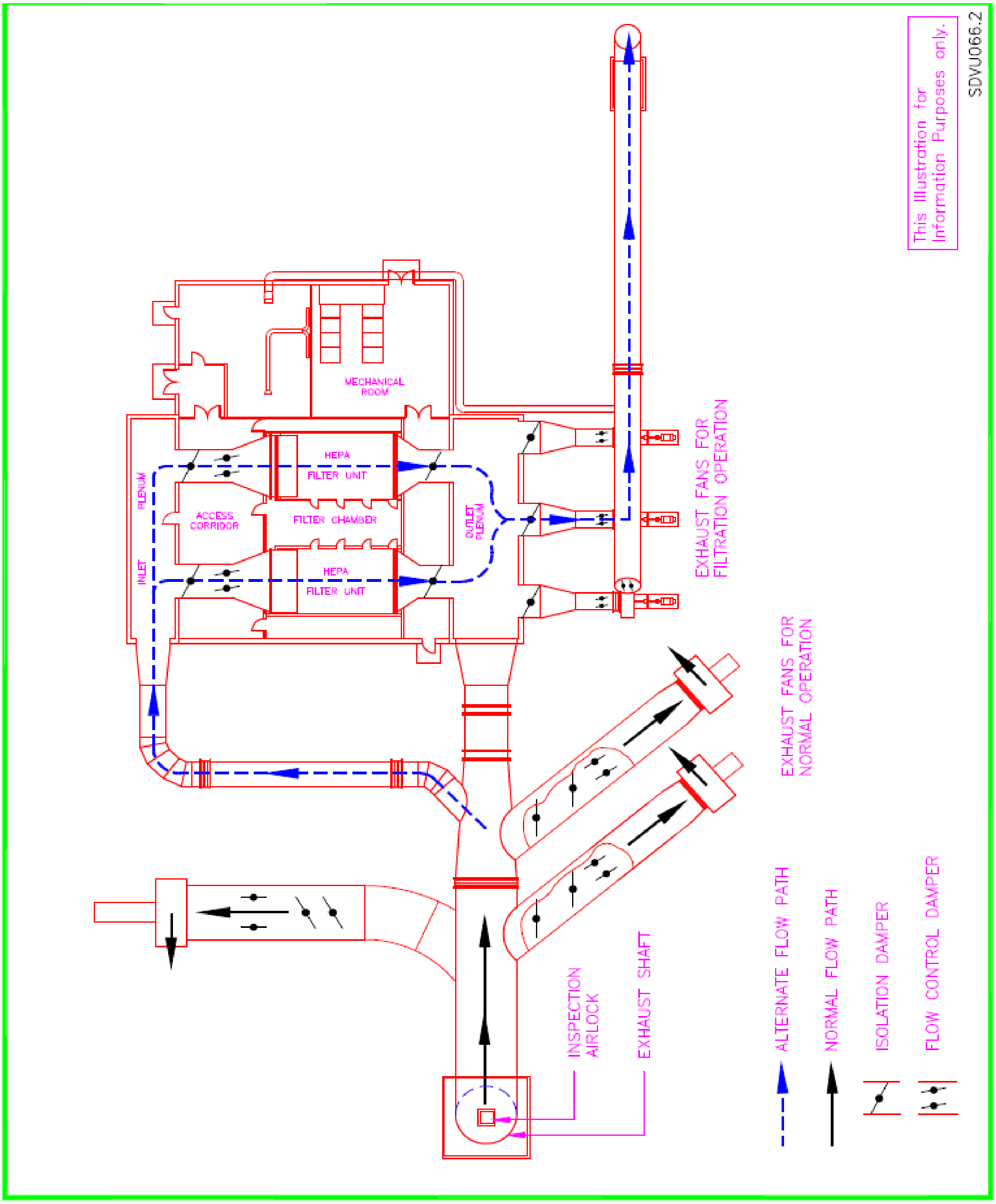

Figure VU I - 3 – VU01 Air Flow Paths

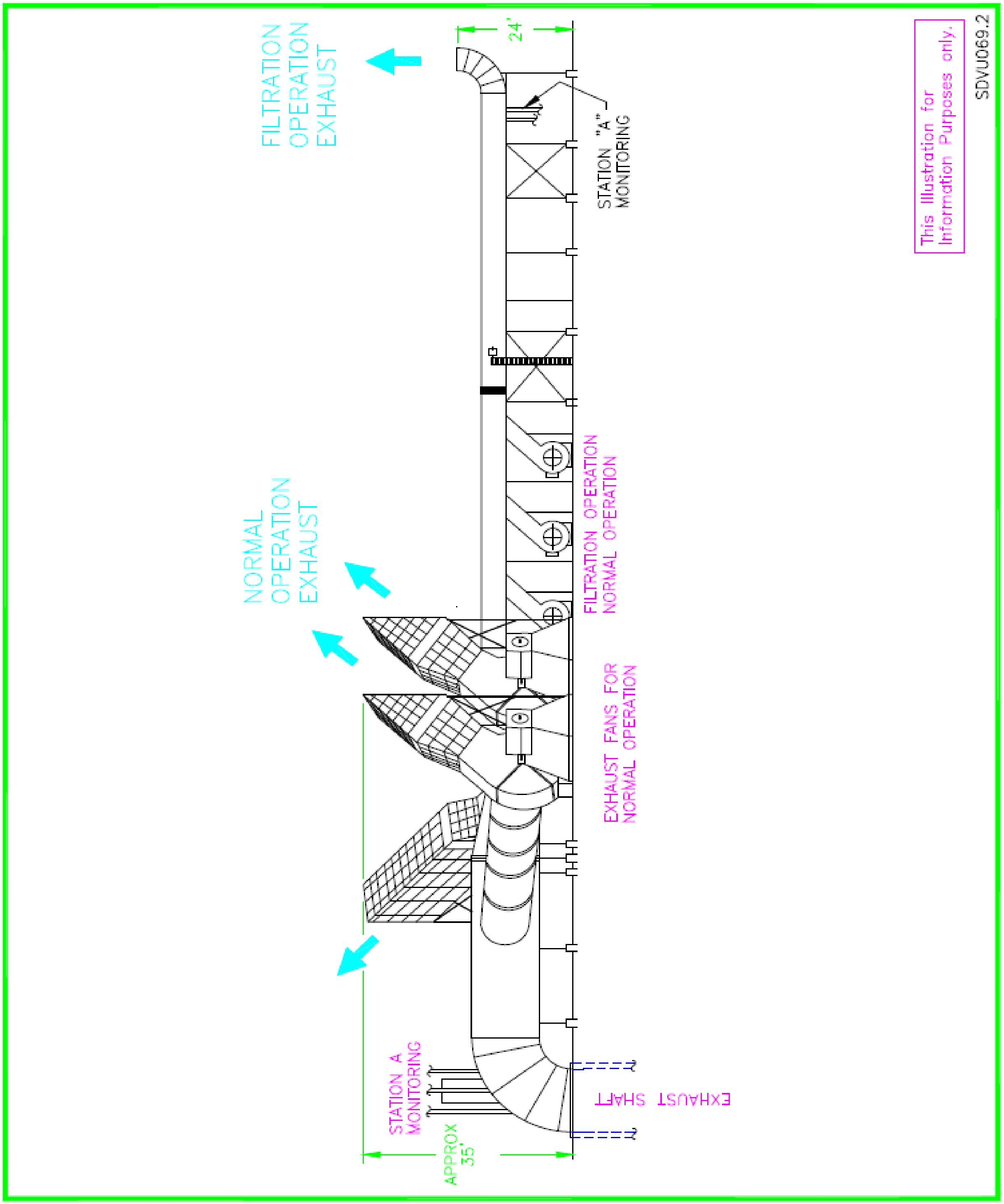

Figure VU I - 4 – VU01 External Vertical Profile

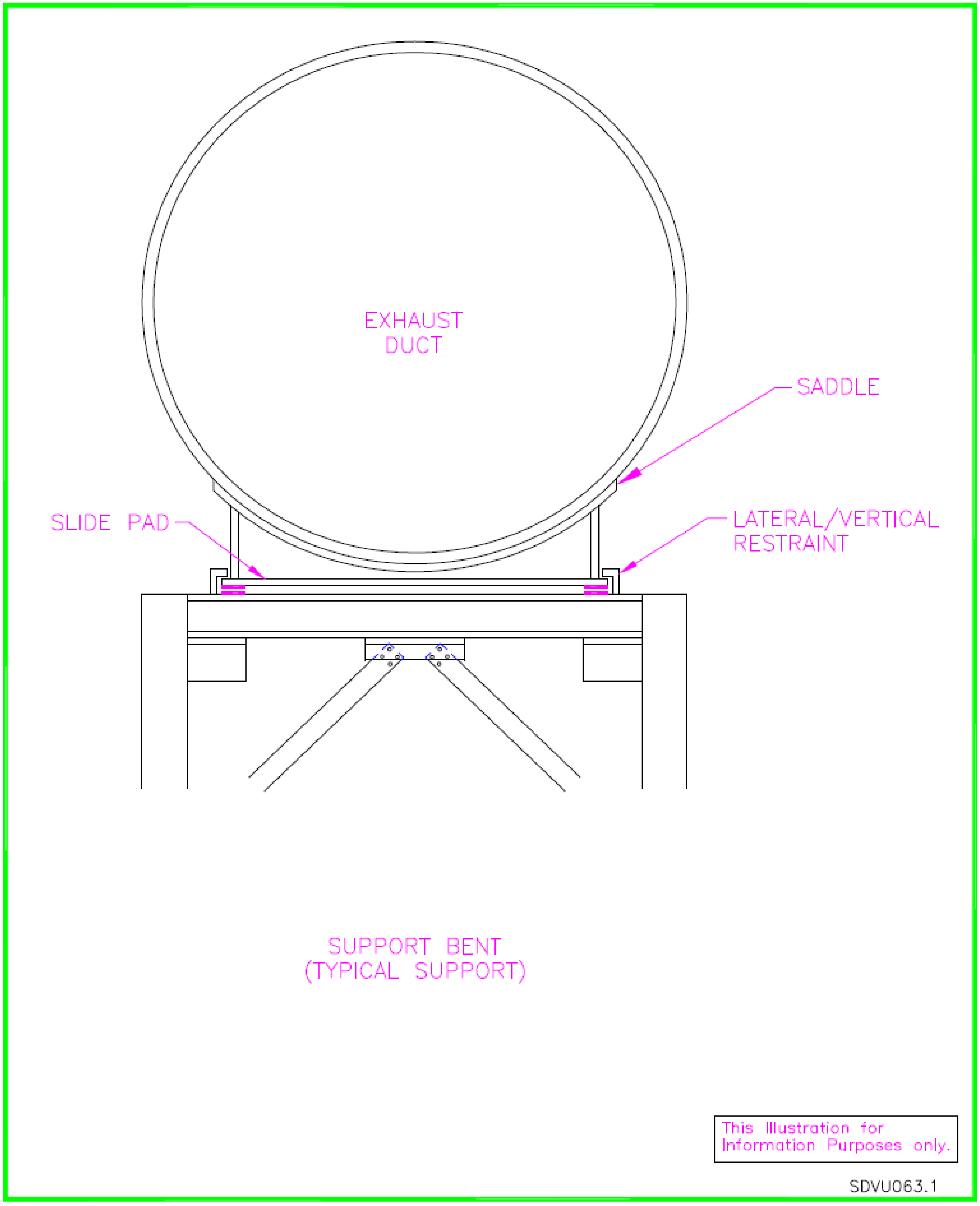

Figure VU I - 5 – Exhaust Duct Support System

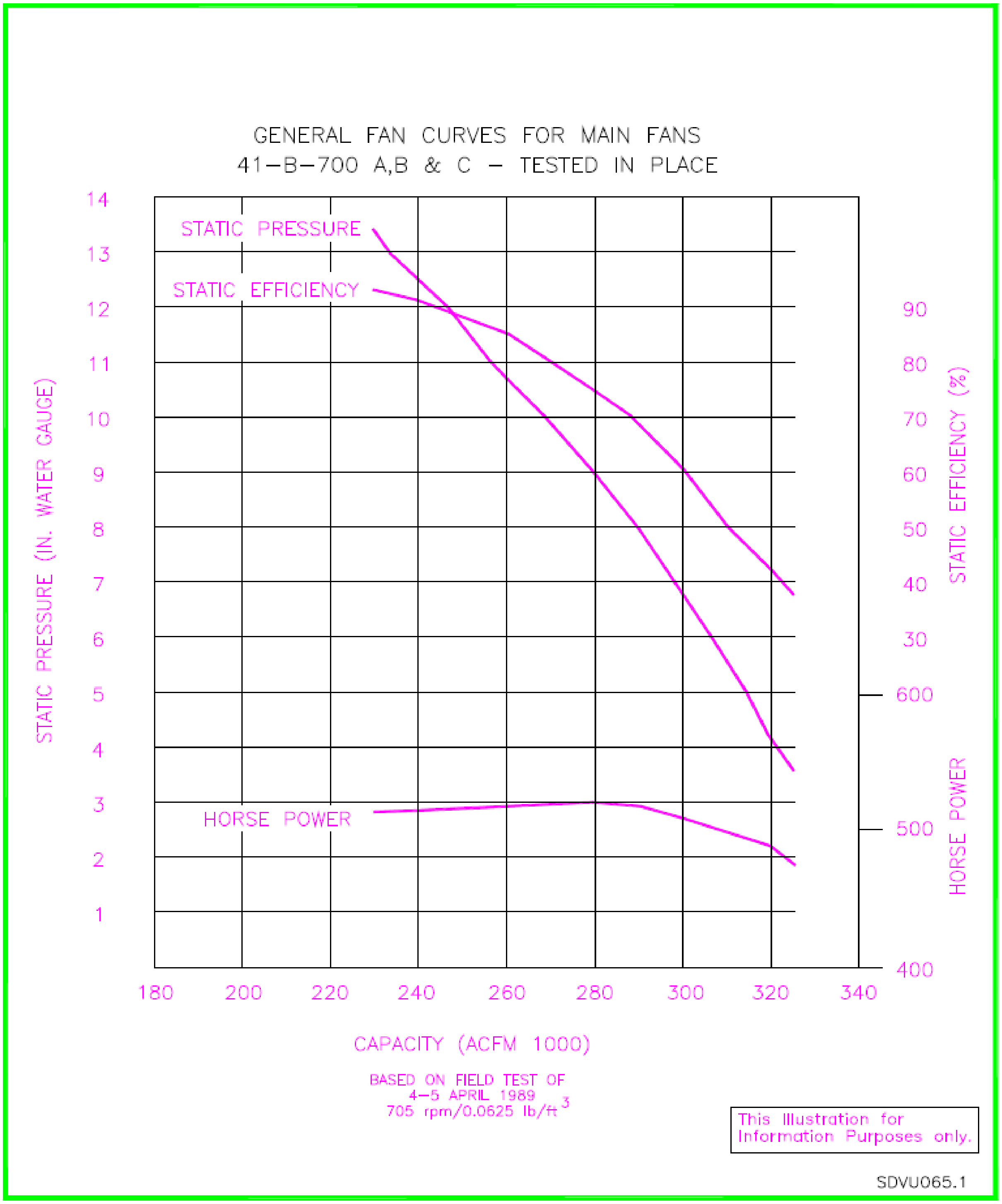

Figure VU I - 6 – Performance Curves, Exhaust 41-B-700 AB

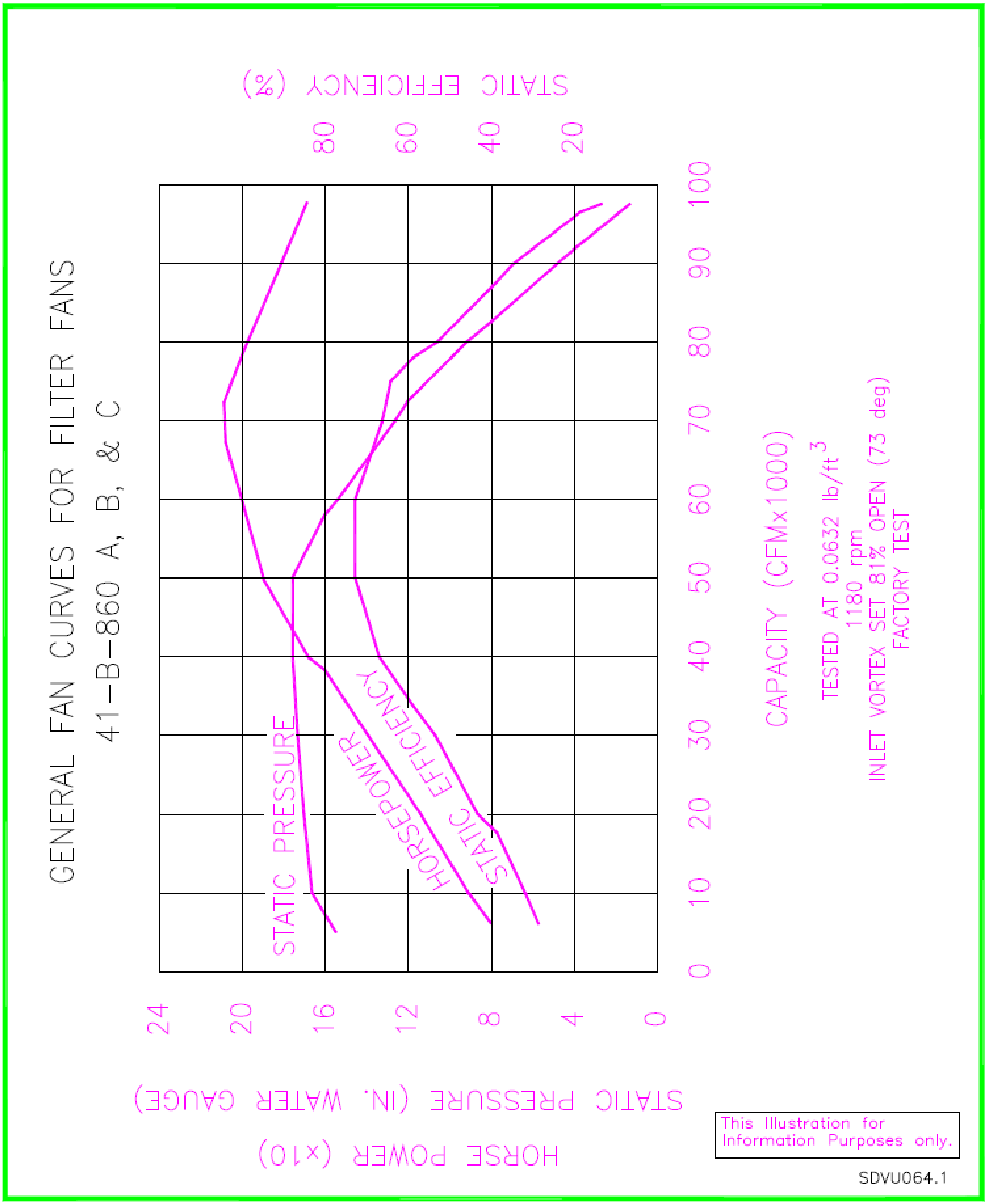

Figure VU I - 7 – Performance Curves, Exhaust 41-B-860 ABC

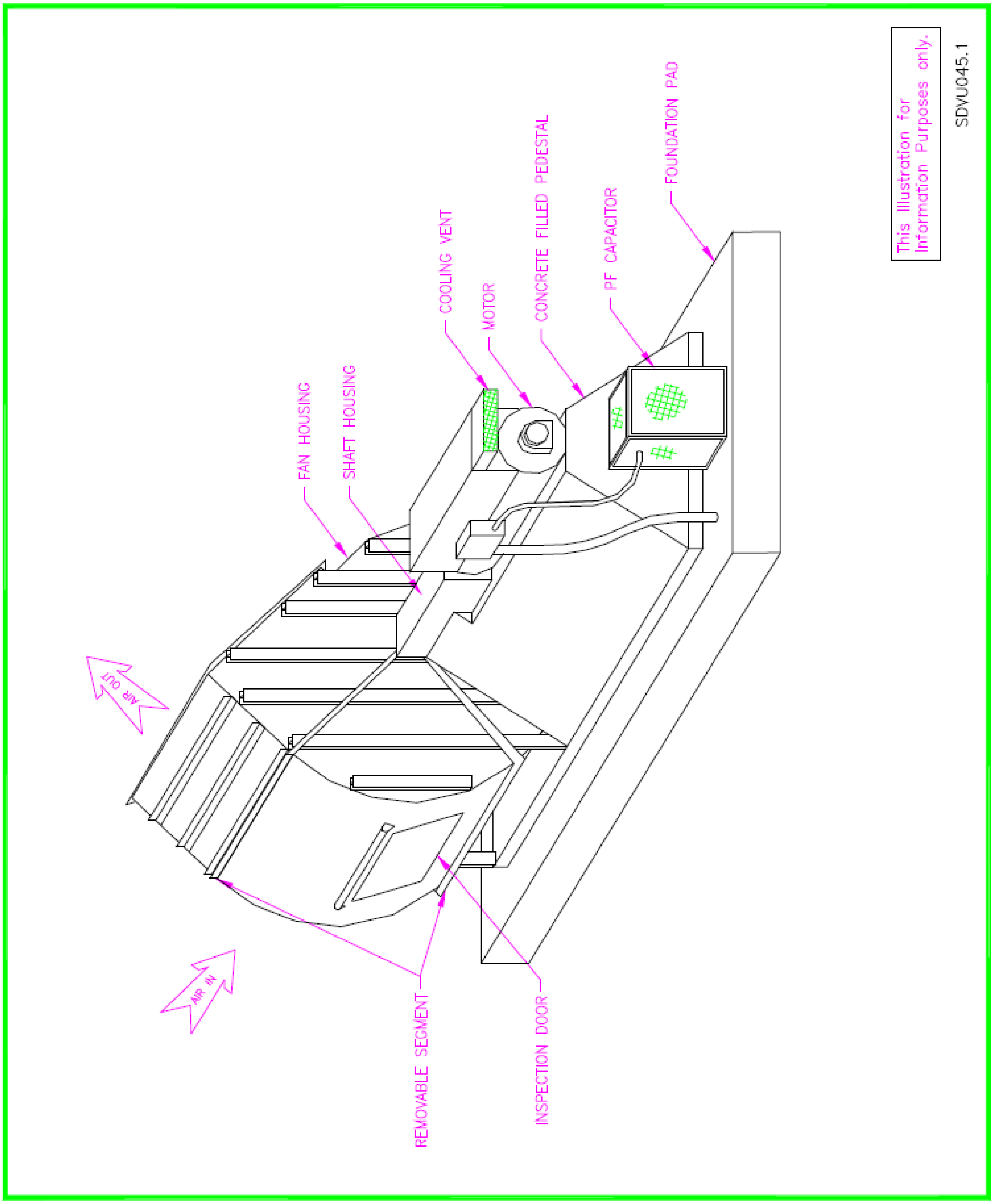

Figure VU I - 8 – Main Exhaust Fan

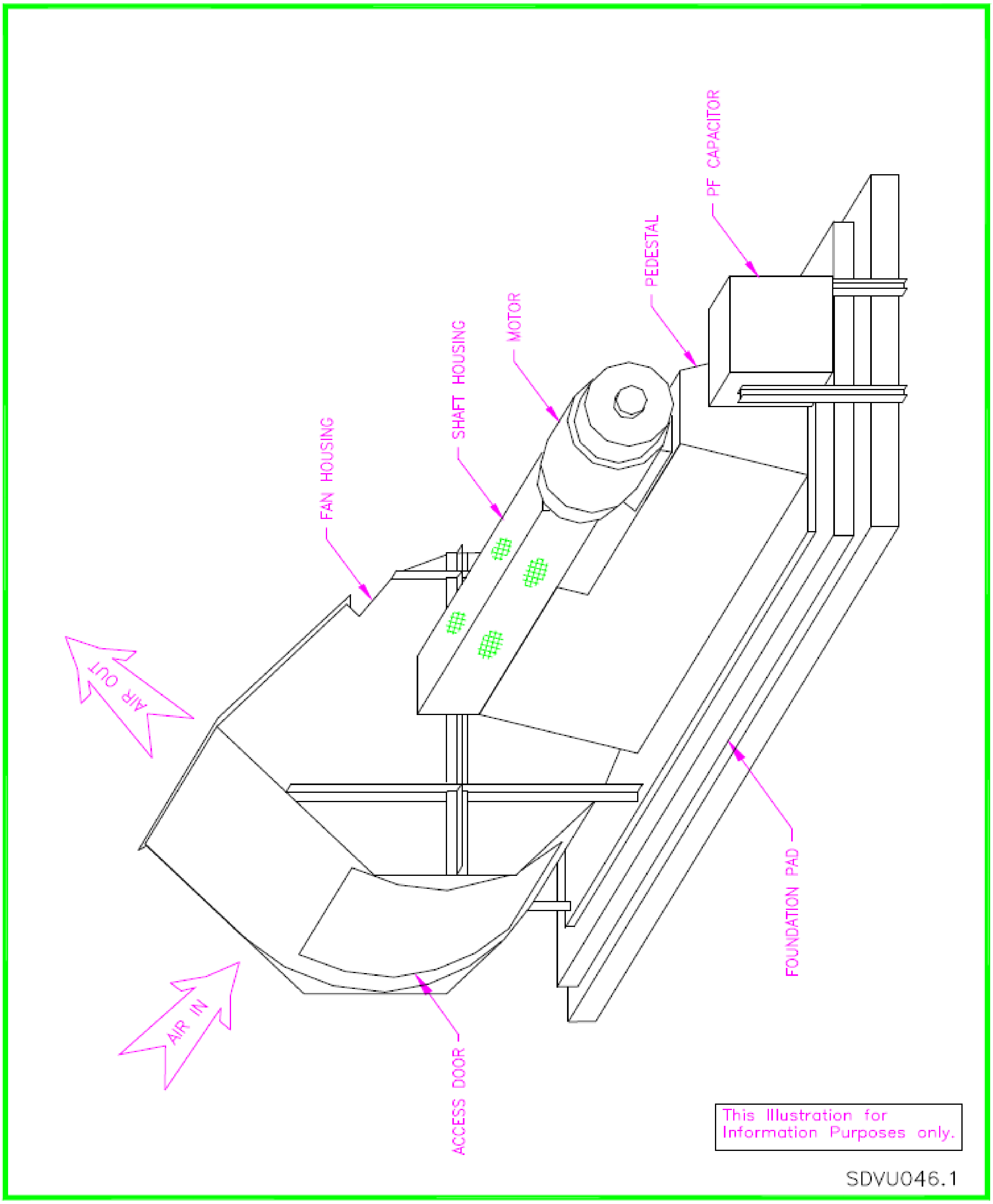

Figure VU I - 9 – Filtration Exhaust Fan

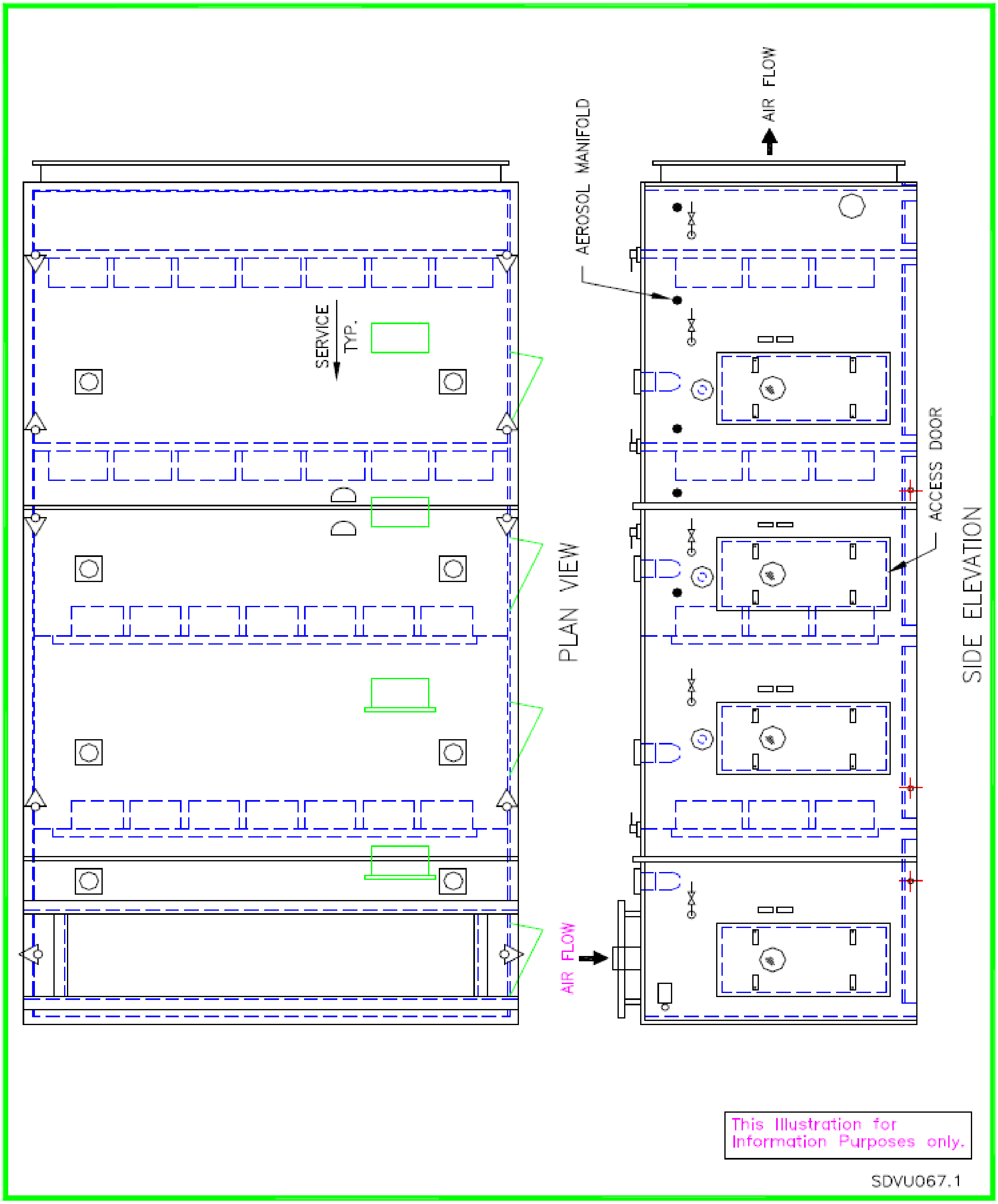

Figure VU I - 10 – Main Filter Units in Exhaust Filter Building

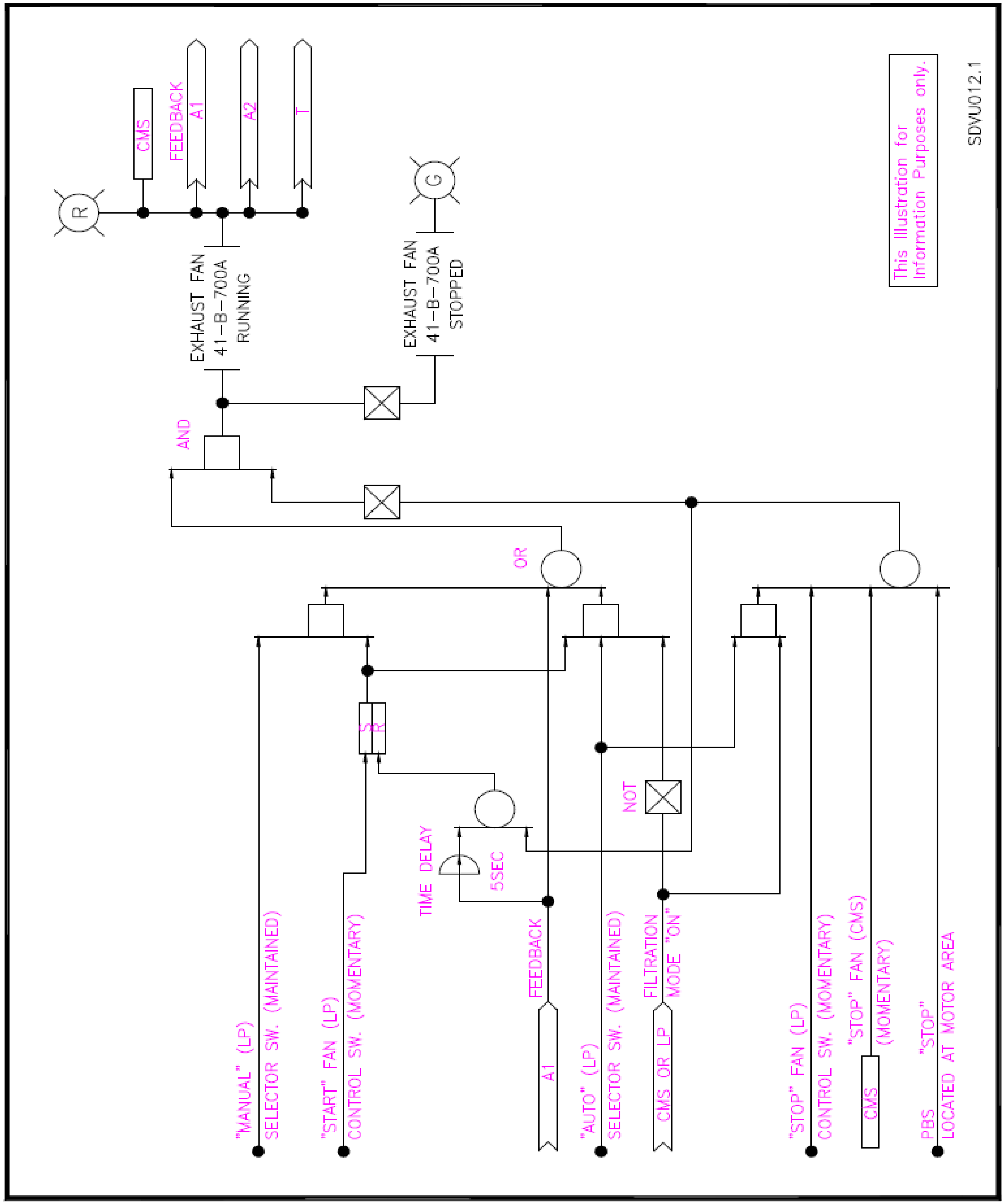

Figure VU I - 11 – Exhaust Fan 41-B-700A Logic (41-B-700B and 41-B-700C similar)

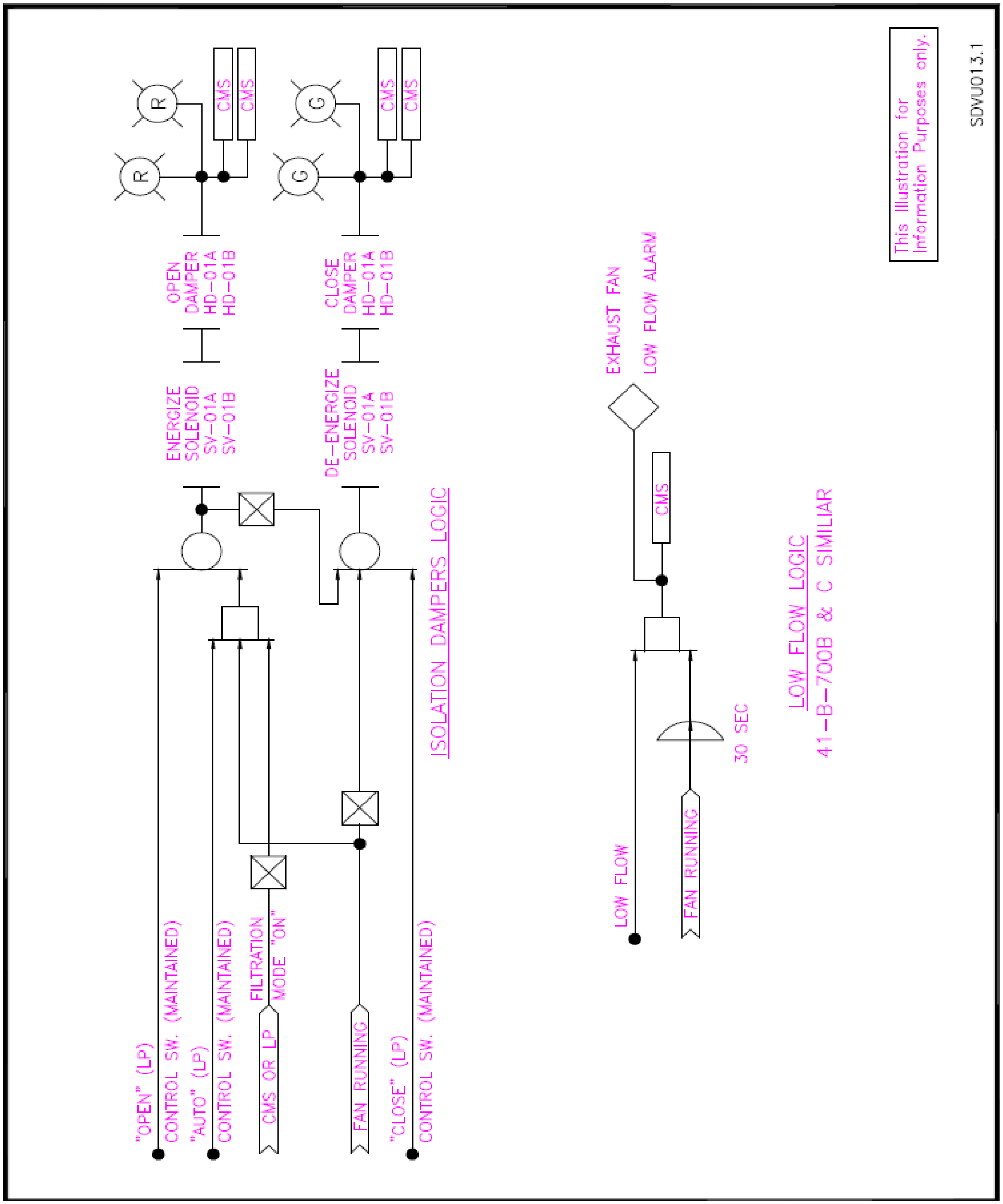

Figure VU I - 12 – Main Exhaust Fan Isolation Damper and Low Flow Logic

ANNUNCIATOR ENGRAVING FOR 413-CP-056-01

WINDOW NO.	LINE 1	LINE 2	LINE 3	LINE 4
1-1	FAL-056-010	AIR FLOW LOW	EXH. FAN 41-B-860A	
1-2	FAL-056-011	AIR FLOW LOW	EXH. FAN 41-B-860B	
1-3	FAL-056-012	AIR FLOW LOW	EXH. FAN 41-B-860C	
1-4	SPARE	AIR FLOW LOW	EXH. FAN 41-B-860C	
1-5	SPARE			
1-6	SPARE			
2-1	PDAH-056-002	MOD. EFF. FILTER	HEPA UNIT 41-B-856	CLOGGED
2-2	PDAH-056-003	HIGH EFF. FILTER	HEPA UNIT 41-B-856	CLOGGED
2-3	PDAH-056-004	1ST HEPA FILTER	HEPA UNIT 41-B-856	CLOGGED
2-4	PDAH-056-005	2ND HEPA FILTER	HEPA UNIT 41-B-856	CLOGGED
2-5	PDAH-056-006	MOD. EFF. FILTER	HEPA UNIT 41-B-857	CLOGGED
2-6	PDAH-056-007	HIGH EFF. FILTER	HEPA UNIT 41-B-857	CLOGGED
2-7	PDAH-056-008	1ST HEPA FILTER	HEPA UNIT 41-B-857	CLOGGED
2-8	PDAH-056-009	2ND HEPA FILTER	HEPA UNIT 41-B-857	CLOGGED

This Illustration for Information Purposes only.

SDVU035.1

Figure VU I - 13 – Annuciator Engraving for Fan Control Panel

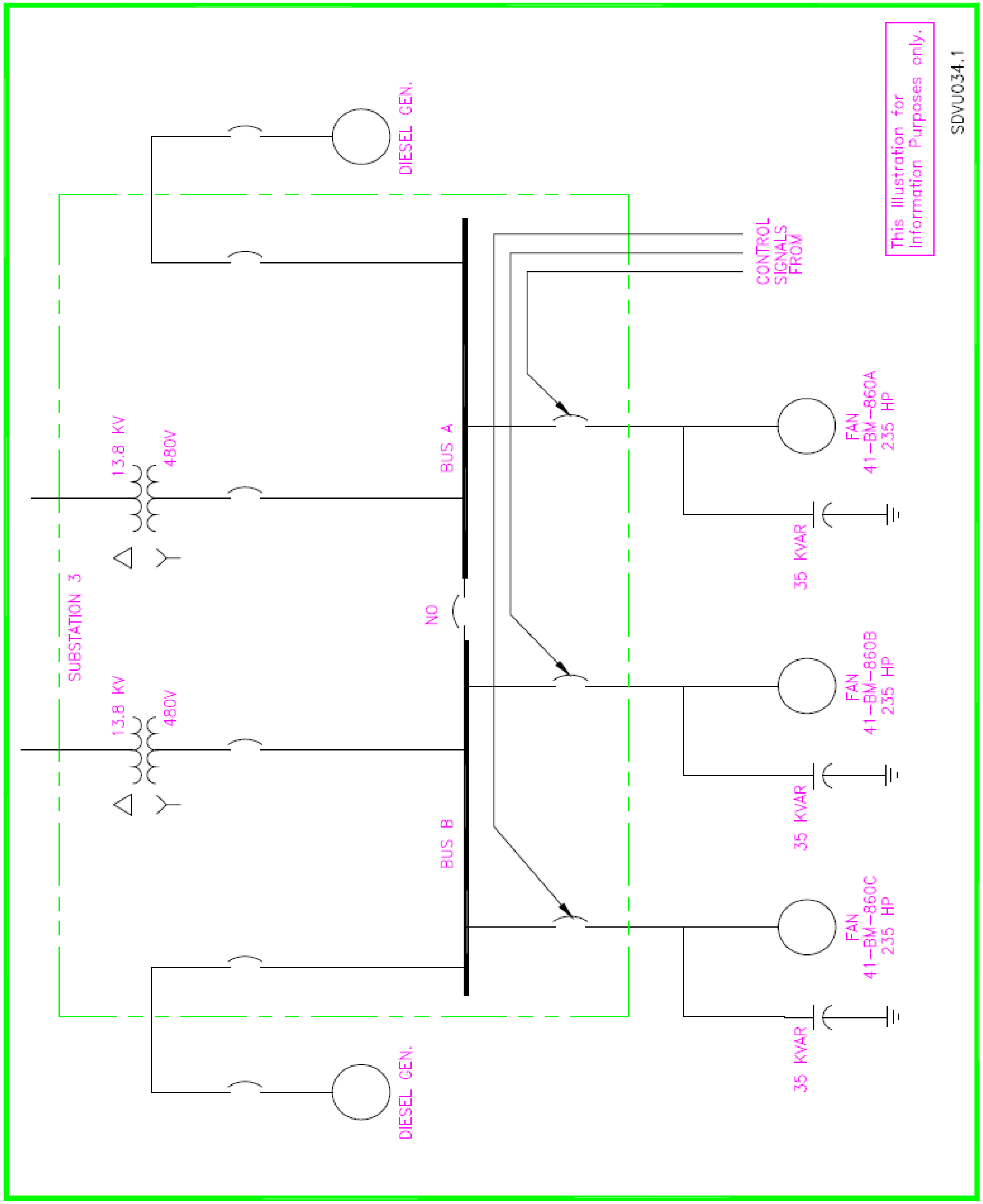

Figure VU I - 14 – Electrical Supply for Filtration Fans

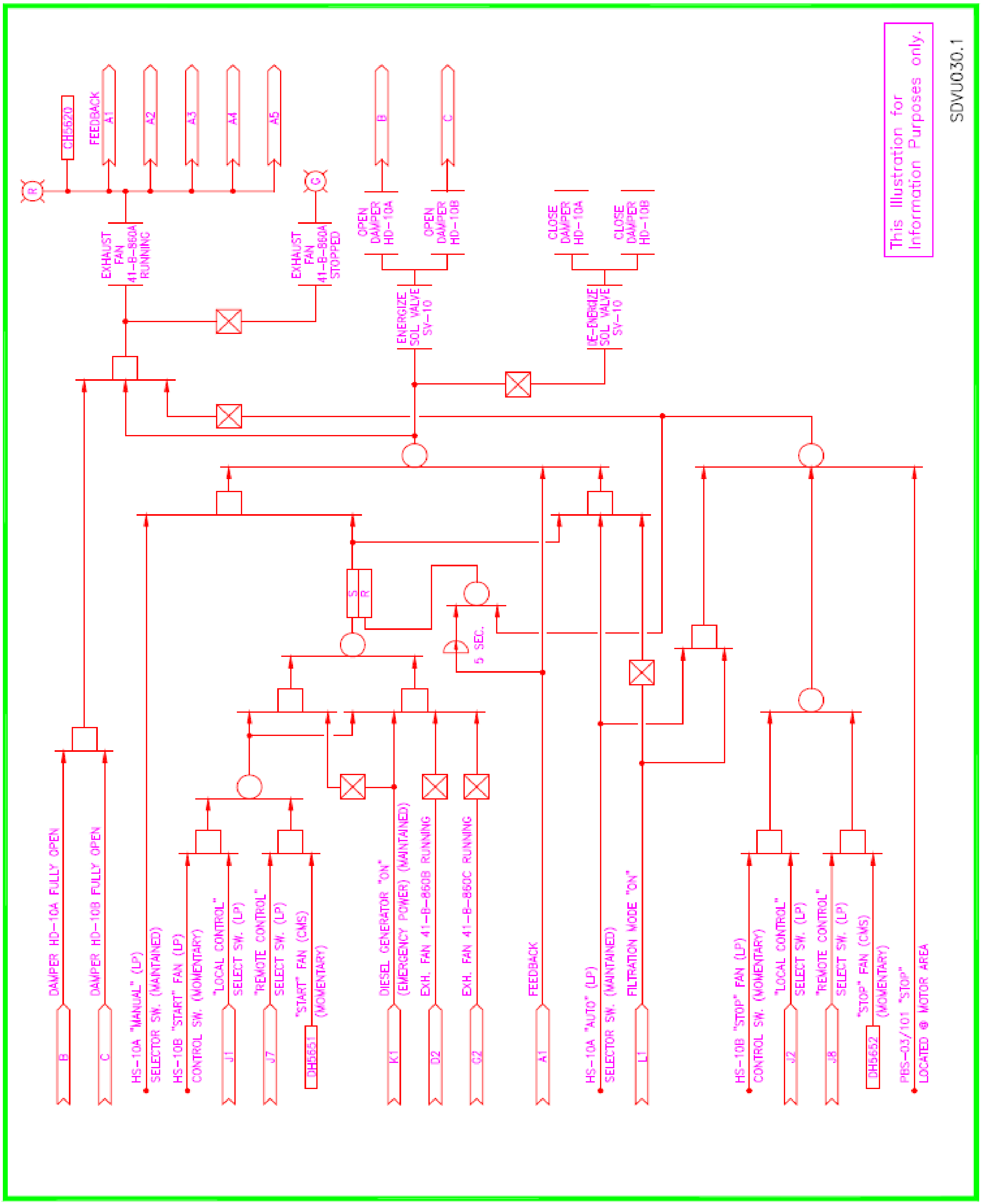

Figure VU I - 15 – Filtration Fan and Damper Control Logic

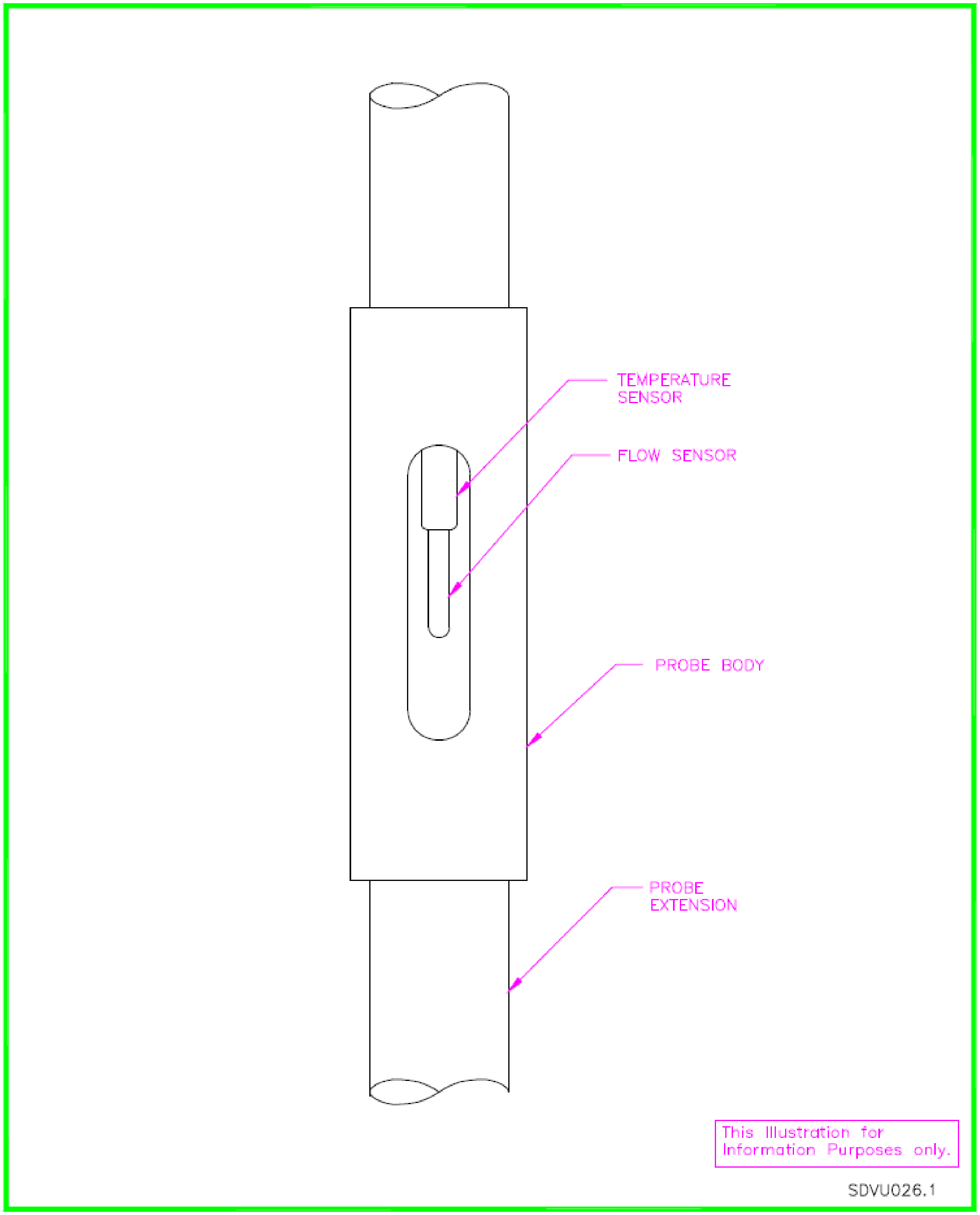

Figure VU I - 16 – KURZ Flow Sensor

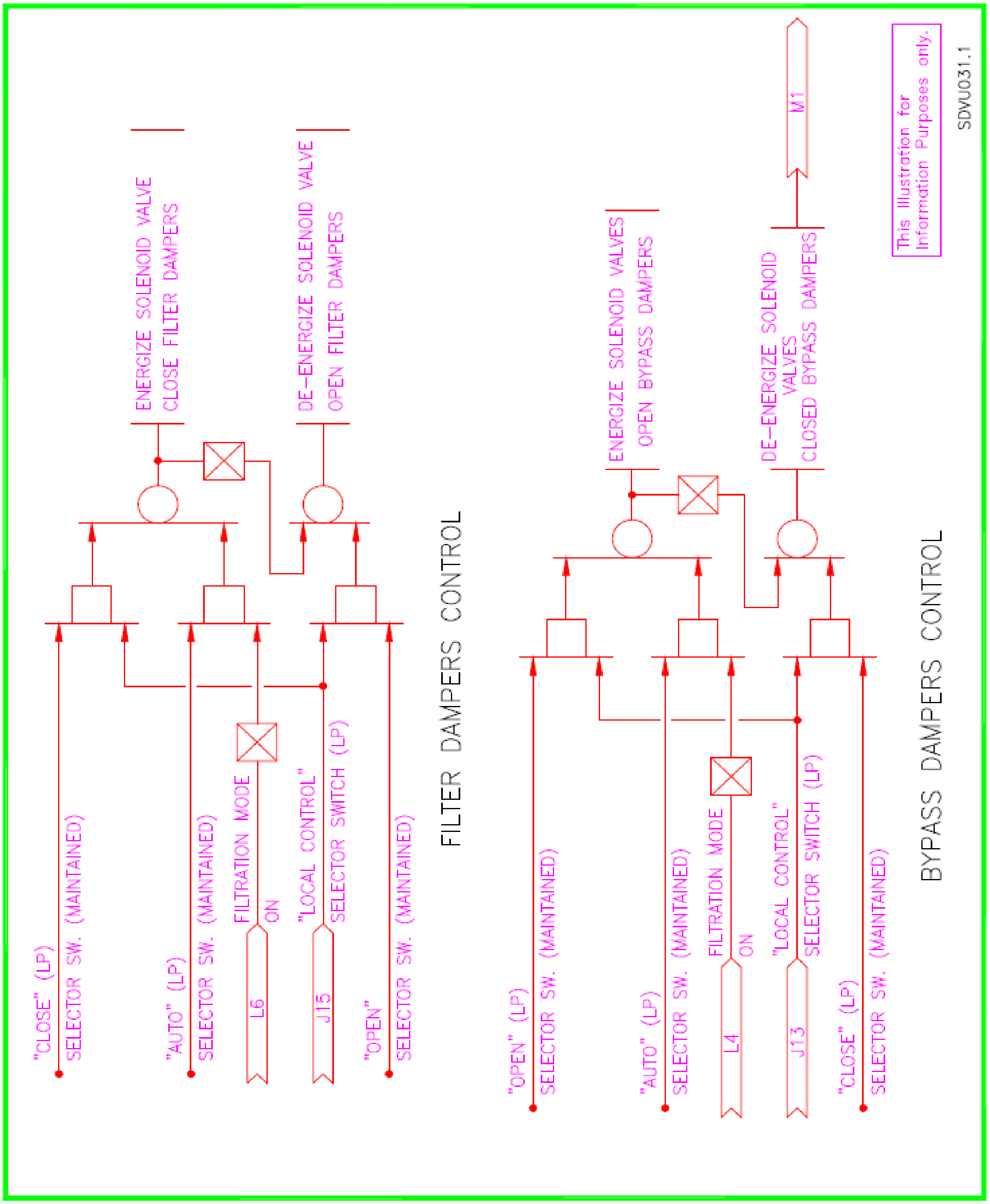

Figure VU I - 17 – Filter and Bypass Damper Logic

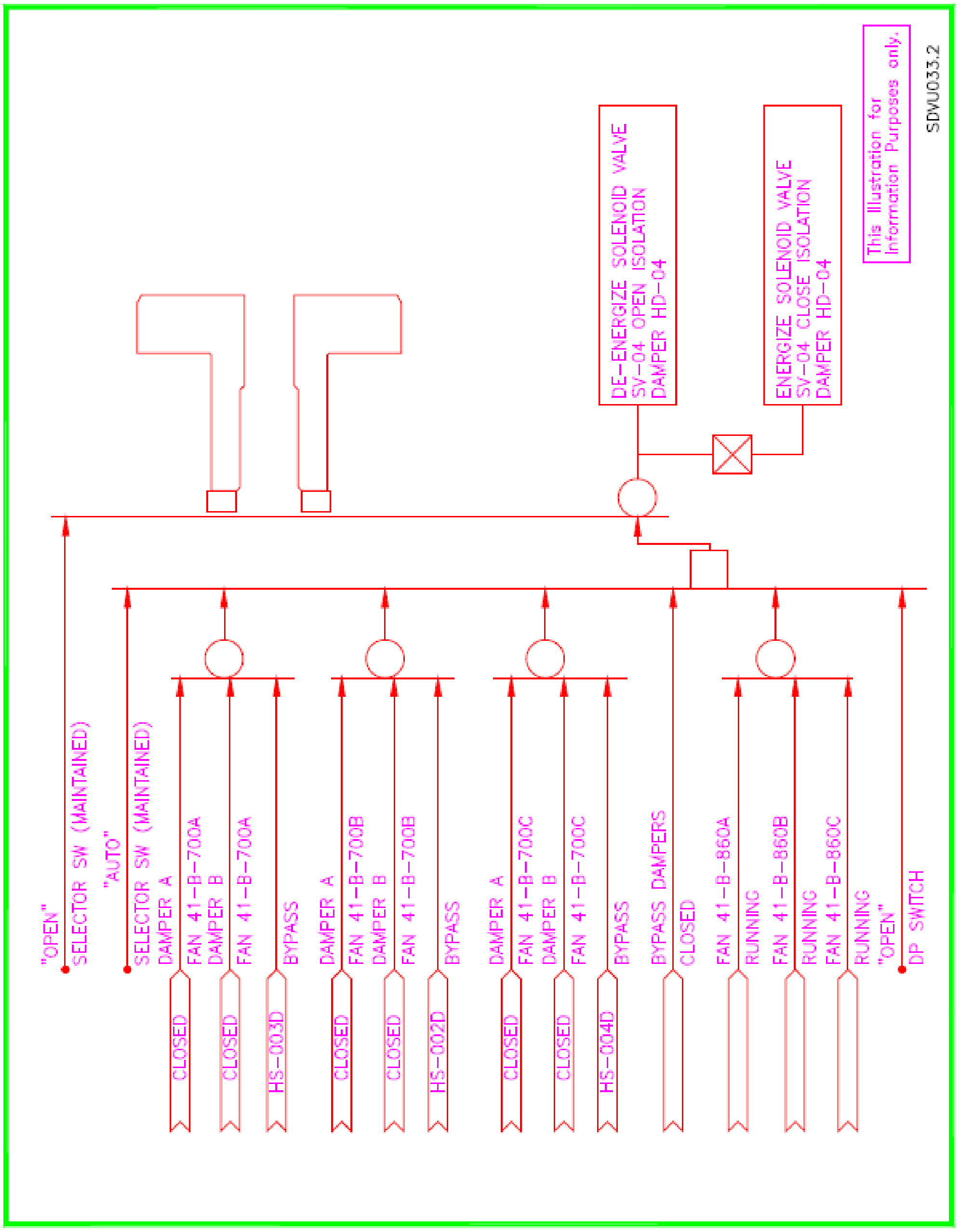

Figure VU I - 18 – Inlet Plenum Isolation Damper Control

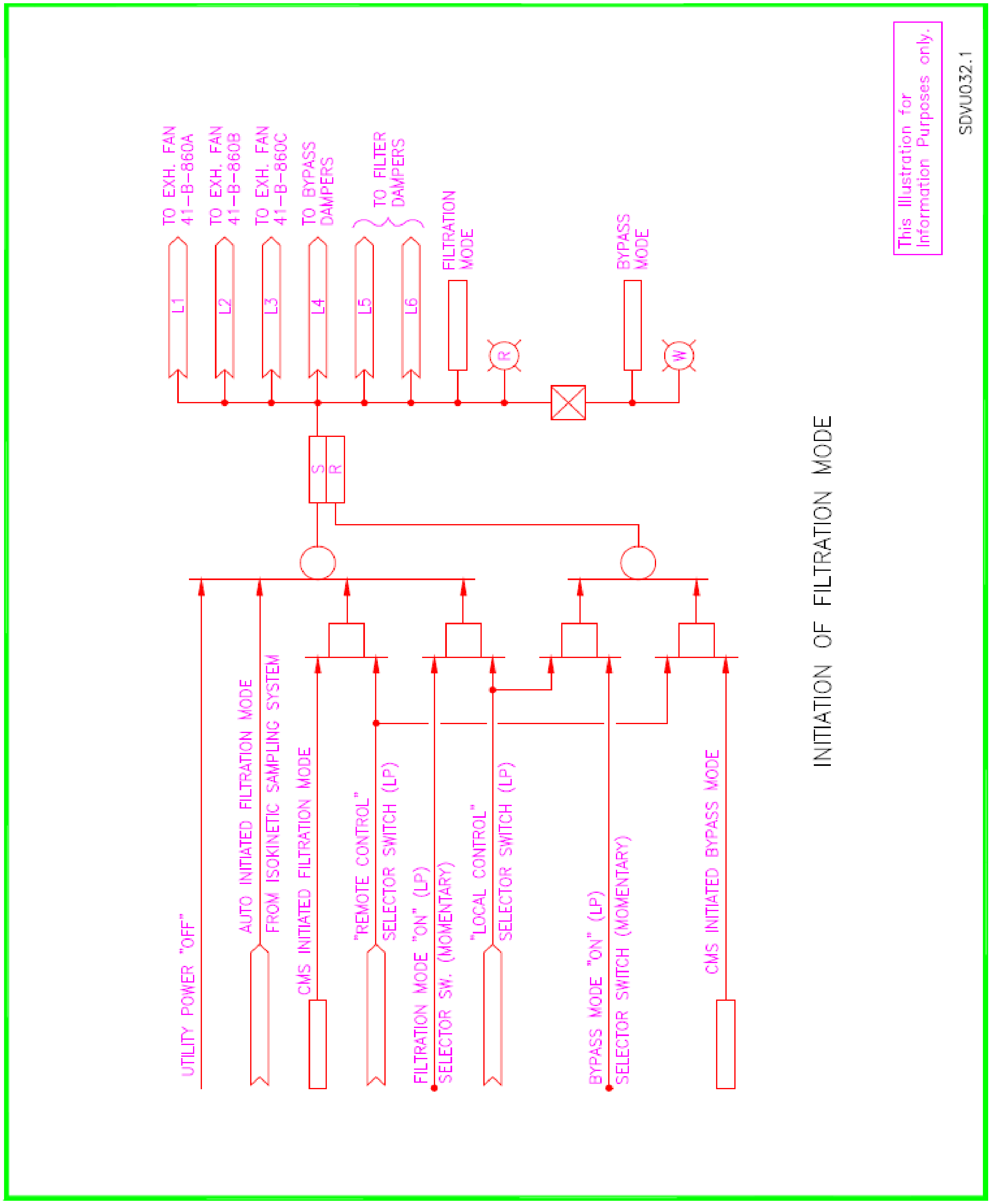

Figure VU I - 19 – Filtration Initiation Logic

Chapter II
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Subsystem VU02 - Installed Auxiliary Fans & Ducts

Chapter II

Subsystem VU02 - Installed Auxiliary Fans & Ducts

1.0 PRIMARY FUNCTIONS

The primary functions for the installed auxiliary fans, and the related auxiliary ducts are presented in section 1.0 of chapter G.

2.0 DESIGN REQUIREMENTS

2.1 General

The general design requirements for installed auxiliary fans, and the related auxiliary ducts are presented in section 2.1 of chapter G.

2.2 Subsystem Requirements

2.2.1 Dead end rooms or drifts shall have local ductwork and fans or regulators to provide the required ventilation.

2.2.2 Air used for ventilating the fuel stations shall not be recirculated but shall be directly exhausted to an exhaust drift.

2.3 - 2.12 Technical Cross Reference

Refer to section 2.3 to section 2.12 of chapter G for general requirements applicable to each of the following topics:

- 2.3 Operational Requirements
- 2.4 Structural Requirements
- 2.5 General Arrangement & Essential Requirements
- 2.6 Maintenance Requirements
- 2.7 In-Service Inspection Requirements
- 2.8 Instrumentation and Control Requirements
- 2.9 Interface System Requirements
- 2.10 Quality Assurance Requirements
- 2.11 Codes and Standards Requirements

- 2.12 Reliability Requirements

3.0 DESIGN DESCRIPTION

3.1 Summary

Refer to section 3.1 of chapter G for the Underground Ventilation System summary design description.

In order to meet the operational requirements of the facility, supplemental air circulation is provided in dead ended areas when personnel are in the spaces. Subsystem VU02 provides the ducts and the manually controlled fans which are required to provide or modify local air flow in those spaces.

3.2 Detailed System Description

In order to meet the operational requirements of the facility there are many rooms, alcoves and blocked drifts in the underground facilities which require supplemental air circulation when personnel are in the spaces. Subsystem VU02 provides those fans and ducts which are required to provide or modify local air flow in those spaces.

The remaining fans and ducts of subsystem VU02 are distributed in the underground works as necessary to satisfy the requirements for safe mining activity. This equipment has local manual controls so that it can be operated as needed when the space is occupied. The fans and ducts are described in the Component Design Description section 3.5.

3.3 - 3.4 Technical Cross Reference

Refer to section 3.3 to section 3.4 of chapter G for general requirements applicable to each of the following topics:

3.3 Performance Characteristics

3.4 System Arrangement

3.5 Component Design Description

3.5.1 Auxiliary Fans and Ducts

Throughout the UVS there are many dead end room and drifts that require auxiliary fans and ductwork to assure adequate air circulation when the area is occupied. All fans are locally controlled.

For the most current information concerning auxiliary ventilation fans (equipment numbers air flow, or Hp) refer to drawing 54-W-001-W and the WIPP Equipment Register on file in the EFR.

Likewise refer to the current Mine Ventilation Plan (DN:00CD-0001) for current as-built fan and duct configurations.

3.6 Instrumentation and Control

3.6.1 General Fan Controls

Each fan of this subsystem simply has a hand switch to turn the fan on and off. There is no instrumentation for these fans.

3.7 System Interfaces

Primary Interfaces

System Providing Service	Service to be Provided
ED00	Provide electric power to local and auxiliary fans.

Secondary Interfaces

No Secondary Interfaces to VU02.

4.0 OPERATIONS

Refer to section 4.0 of chapter G for VU00 system integrated operations information.

5.0 SYSTEM LIMITATIONS, SETPOINTS, AND PRECAUTIONS

Refer to section 5.0 of chapter G for system-subsystem performance limitations, setpoints, and precautions.

6.0 OFF NORMAL EVENTS AND RECOVERY

Refer to section 6.0 of chapter G for system-level off normal events and recovery.

7.0 MAINTENANCE

Refer to section 7.0 of chapter G for information relating to the Underground Ventilation System maintenance approach, corrective maintenance, preventative maintenance and surveillance program requirements. Presented are the VU02 minimum specific maintenance requirements and considerations that must be incorporated in VU02 maintenance procedures.

The following items are removed, replaced, or repaired on an "As Needed" basis:

- Auxiliary Fans - Small
- Auxiliary Fans - Large
- Underground Air Ducts

Chapter III
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Subsystem VU03 - Ventilation Control Bulkheads & Air Regulators

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Chapter III

Subsystem VU03 - Ventilation Control Bulkheads & Air Regulators

1.0 PRIMARY FUNCTIONS

The primary functions for the ventilation control bulkheads and air regulators are presented in section 1.0 of chapter G.

2.0 DESIGN REQUIREMENTS

2.1 General

The general design requirements for the ventilation control bulkheads and air regulators are presented in section 2.1 of chapter G.

2.2 Subsystem Requirements

2.2.1 Ventilation controls include bulkheads, ventilation doors, and air regulators. These controls shall direct or prevent airflow, govern the volume distribution of the flow, maintain required pressure differentials between the storage and construction ventilation air streams, and prevent incorrect airflow direction.

2.2.2 Bulkheads shall be placed in entries and cross-cuts to direct or prevent airflow. The bulkheads shall be equipped with personnel doors or drive-through doors where required. Air flow through bulkheads shall be controlled by air regulators. Select regulators shall be operated by motorized positioners controlled locally and monitored by the Central Monitoring System (CMS) with provision for CMS control.

2.2.3 Bulkheads shall be installed in the cross-cuts between ventilation streams. Airlocks shall be provided where necessary for underground operations.

2.2.4 Ventilation doors shall be normally opened or closed depending on the ventilation flow path desired during normal operation. In the event of a fire, selected doors, shall be capable of being closed or opened from a remote location.

2.2.5 Those bulkheads that enclose underground fuel storage station(s) shall be fire resistant.

2.2.6 A method for personnel escape (personnel and vehicle doors) through all bulkheads shall be provided, except for unpassable bulkheads. Personnel doors shall be placed at every other cross-cut as a minimum for emergency escape. In locations where high differential pressure differentials exist across the bulkheads, appropriate airlocks shall be provided.

2.2.7 The SHS station, AIS station and WS station shall be capable of being isolated from the spread of, smoke or toxic gases by control doors constructed to meet the requirements of 30 CFR Part 57. These control doors shall be capable of being operated remotely from the Central Monitoring Room (CMR). The door operations shall be designed to maintain the doors closed against the largest possible pressure differential that can develop across the doors. The doors shall be capable of being opened from either side by one person, or be provided with a manway door that can be opened from either side.

2.2.8 Any underground shop where maintenance work is done on mobile equipment shall have enclosing bulkheads and control doors which are fire resistant, or the shop air shall be directed to the exhaust stream. Whichever method is used must meet the requirements of 30 CFR Part 57.

2.2.9 All control and ventilation door openings and swing space shall be kept free of obstructions that could prevent remote operation of the door.

2.3 - 2.12 Technical Cross Reference

Refer to section 2.3 to section 2.12 of chapter G for general requirements applicable to each of the following topics:

- 2.3 Operational Requirements
- 2.4 Structural Requirements
- 2.5 General Arrangement & Essential Requirements
- 2.6 Maintenance Requirements
- 2.7 In-Service Inspection Requirements
- 2.8 Instrumentation and Control Requirements
- 2.9 Interface System Requirements
- 2.10 Quality Assurance Requirements
- 2.11 Codes and Standards Requirements
- 2.12 Reliability Requirements

3.0 DESIGN DESCRIPTION

3.1 Summary

Refer to section 3.1 of chapter G for the Underground Ventilation System summary design description.

The underground horizon plan is shown in figure VU III-1, including the planned storage panels. In order to separate, direct, and regulate the air flow in each stream, bulkheads are provided. Bulkheads are basically walls constructed to block flow of air through a drift. Bulkheads can be used to fully block air flow or to regulate air flow through them by means of adjustable air flow regulators. A bulkhead is also referred to as a stopping.

Normal and/or emergency passage is provided through all bulkheads which are located in escape paths. Refer to the current WIPP MINE Ventilation Plan which identifies the as-built conditions for bulkheads and air regulators.

3.2 Detailed System Description

The underground horizon plan is shown in figure VU III-01, including the planned storage panels. In order to separate the different air streams and to direct and regulate the air flow in each stream, barriers have to be provided.

The barriers provided are bulkheads which are walls constructed to block flow of air through a drift. Bulkheads are provided to fully block air flow or to restrict air flow by means of adjustable air flow regulators. The regulating capability is utilized to control the airflow volume and the differential pressure between waste handling and none waste handling areas.

The typical bulkhead is assembled of welded steel tubing covered by sheet metal. Sealing to the salt is accomplished by attaching rubber flashing to the bulkhead frame and to the salt. In a few areas where a higher fire resistance is required the bulkhead may be double sided with a fire resistant material (rockwool insulation) enclosed between the two sides.

Normal and/or emergency passage is provided through all bulkheads which are located in escape paths. This is accomplished by means of vehicle access doors and human scale personnel access doors or emergency hatches. Most vehicle access doors are power actuated by compressed air cylinders designed to stop and hold in place on loss of power. Some strategic vehicle doors are equipped with battery back-up power which enables the doors to be operated during the loss of primary power to these doors. Batteries and charger/inverter units are located near the power distribution panels that provide the 120 volt power to these bulkhead control panels.

The personnel doors are hung to be self closing with the prevailing air flow. Bulkhead doors are equipped with sensors for closure indication.

Airlocks are provided where doors must be kept closed to achieve normal underground air flow and differential pressure. Vehicle airlocks are created by placing two bulkheads containing vehicle doors near each other in the same drift. Critical airlock doors have interlocks to prevent simultaneous open condition on both bulkheads. Interlocks may be overridden manually if necessary under administrative control. Personnel airlocks are constructed as part of a single bulkhead.

To ensure compliance with the ventilation control measures provisions of 30 CFR, bulkheads with control doors are provided in the drifts near the shaft stations for all three of the intake shafts. In the event of fire or other off-normal occurrence, each shaft can be isolated to limit the spread of smoke or other hazard. The bulkheads are constructed in accordance with 30 CFR Part 57. Certain shops and fuel storage spaces are isolated by fire resistant bulkheads.

There is a unique pair of bulkheads in the S400 drift to ensure that air leakage from the Waste Shaft station area at the base of the WS cannot mix with the fresh air stream in drift W30. During waste handling operations in the waste shaft and/or waste shaft station area, the space between the two bulkheads is pressurized (if necessary) with air to a level which ensures that air leakage is into the waste handling station area. This mitigates the problem of the differential pressure between drift W30 and the waste handling station falling to an unacceptable value or possibly air reversal.

3.3 -- 3.4 Technical Cross Reference

Refer to section 3.3 to section 3.4 of chapter G for general requirements applicable to each of the following topics:

3.3 Performance Characteristics

3.4 System Arrangement

3.5 Component Design Description

Subsystem VU03 incorporates those features of the underground which serve to:

A. Regulate, channel and isolate the main underground air streams

B. Provide the capability to isolate each shaft

The main features are bulkheads, airlocks, the pressure chamber and the overcasts. Auxiliary features include vehicle access doors, personnel access doors, emergency personnel hatches (doors), air flow regulators, and slide gates.

3.5.1 Underground Bulkheads

A bulkhead is a wall installed to fill the cross-section of a drift to minimize air passage. Throughout the underground horizon there are numerous bulkheads. The bulkheads provide the isolation and channeling functions and are combined to form airlocks and the pressure chamber. The bulkheads combined with auxiliary features provide the airflow regulation and ventilation. Bulkheads with regulators installed in non-active disposal rooms in active panels regulate air flow through the active disposal room to provide desired air flow.

The location and function of each bulkhead is different. Consequently the design of each bulkhead is unique in its details. The location of each bulkhead is recorded on a drawing, and the construction of each bulkhead is recorded on a separate drawing.

The addition and removal of individual bulkheads will routinely be required as the operating plans, construction and storage change and as salt creep exceeds the allowances built into bulkheads. New and replacement bulkhead designs will vary from the previous designs as improved materials and techniques are developed.

3.5.1.1 Bulkhead Structure

Framing for the majority of the bulkheads is fabricated by welding of rectangular steel tubing. Tubing size and thickness and the number of framing members varies to suit the location, size, functions and loads. Sheathing is galvanized sheet steel screwed to the frame. Figure VU III-2 illustrates a typical bulkhead frame arrangement where provision has been made to mount a pair of vehicle access doors. Anchoring and sealing to the salt ribs, floor and back is discussed under Accommodation of Salt Movement. Bulkheads are constructed of noncombustible materials, except for flexible flashing used to accommodate salt movement, in accordance with 30 CFR 57, "Safety and Health Standards - Underground Metal and Nonmetal Mines" [**DSA sections 2.4.4.2.1]**.

> The bulkheads are designed of noncombustible material except for flexible flashing.

Flyash Brick bulkheads are used in several areas in the underground to create an unpassable barricade. These barricades isolate non ventilated areas from ventilated areas of the mine. See figure VU III-6.

3.5.1.2 Accommodation of Salt Movement

The salt surrounding a bulkhead in a drift will slowly move inward in response to the compressive load from the overburden. In order to accommodate the changing dimensions, the fixed bulkhead framing is fabricated shorter and narrower than the drift when installed. The allowance for salt creep is adjusted with the size of the drift, with 1.5 foot at top and 1 foot each side being typical.

To accommodate the salt creep and still anchor a framed bulkhead in place, a telescoping extension to the main framing is used. The extension is then fastened to the salt by anchored studs or bolts.

Since the function of a bulkhead is to control or block air flow, the bulkheads are sealed to the walls, floor and back (top) of the drift in which they are installed. To accommodate the salt creep while sealing off air flow, the majority of bulkheads use rubber belting as flashing which is gasketed to the frame on one side and to the salt on the other.

3.5.1.3 Provisions for Access

It is necessary to make provision for personnel and/or equipment to pass through many of the bulkheads. In order to limit air leakage, all access openings seal to the bulkhead when closed. Where access openings expose the floor of the drift, a flexible sweep is provided at the bottom to provide a seal when closed. Doors are placed to swing toward the side which normally has the higher pressure. Where space limitations or other interferences require the reverse, latches and/or pneumatic cylinders are used maintain the seal.

Personnel passage is provided by man doors. In a few cases, where the differential pressure across a bulkhead is high or the air flow through the open door is unacceptable, personnel airlocks are provided. Personnel airlocks consist of a closed chamber attached to a bulkhead with man doors at entrance and exit.

In locations where regular personnel passage is not required but an escape route is needed, emergency hatches are installed.

Passage through bulkheads by forklifts and other machinery is provided by large, drive through doors. Most of the drive through doors are operated by means of pneumatic cylinders designed to hold their position. The door control is local. As with personnel openings, where the air flow through the open door is unacceptable, airlocks are installed.

3.5.1.4 Provisions for Air Flow Control

Bulkheads may be equipped with slide gates or volume regulators to control the flow of air through a bulkhead.

A slide gate is an opening in a bulkhead, with a horizontally sliding cover. Figure VU III-3 illustrates a typical bulkhead slide gate. The slide gate provides ventilation into a local area.

3.5.1.5 Air Flow Regulators

The air flow regulators are used to balance the flow streams in the underground, assure the differential pressure requirements are met and adjust air flow in local areas.

The regulators are commercial louver type air flow controllers, some are electrically adjusted. The units are typically rectangular in shape with multiple blades mounted on a horizontal axis. Figure VU III-3 illustrates a typical bulkhead air flow regulator.

The louver blades are positioned by gear motors that lock in the current position upon power failure. The louver drive units provide position information to and can be controlled by the CMS, but have provision for local electric control and position readout. In the event of a total power failure, the louvers can be adjusted by means of a handwheel on the gear train.

Monitoring of air regulator status is accomplished with continuous shaft position sensors that report the output shaft position angle through the CMS and locally, where applicable. The regulators are located in bulkheads as shown on Mine Map drawing 54-W-001-W.

3.5.1.6 Provisions for Cable and Pipe Penetrations

It is necessary to make provision for pipe and cable to pass through many of the bulkheads. Penetrations for cable and pipe are typically provided in the bulkhead framing. The pipe and cable are sealed to the bulkhead to minimize air leakage. Many of the new and replacement penetrations utilize prefabricated gland seals which can be opened from the side to accommodate cable and pipe already in place.

3.5.2 Underground Airlocks

There are drifts in which air flow must be blocked continuously but which simultaneously require personnel or vehicle passage. Airlocks are provided to permit access through a stopping without altering the airflow. Airlocks are constructed of noncombustible materials, except for flexible flashing used to accommodate salt movement, in accordance with 30 CFR 57, "Safety and Health Standards - Underground Metal and Nonmetal Mines **[DSA sections 2.4.4.2.1]**.

Airlocks are non-combustible construction (except for flexible flashing).

3.5.2.1 Vehicle Airlocks

To provide vehicle access while blocking air flow, bulkheads with vehicle doors are installed in pairs to create an airlock. Figure VU III-4 illustrates an airlock with vehicle access doors installed in a drift. Airlock doors are normally closed and are operated locally by color coded pull cords. Operation of most of the airlock doors is locally interlocked such that only the doors in one bulkhead at a time can be open. Airlock door open/close are monitored in the CMR.

Specific doors can be opened and closed from the CMR. Personnel access doors, man doors or emergency hatches, may also be placed in these bulkheads.

3.5.2.2 Personnel Airlocks

To provide personnel access while blocking air flow, a personnel airlock is attached to a single bulkhead. A personnel airlock is simply a small room attached to the bulkhead. The airlock has two doors, which open to provide access to opposite sides of the bulkhead.

3.5.3 Pressure Chamber

Drift S400 runs from W30, through the waste handling station, to the exhaust shaft. Drift W30 is the main fresh air source for both the mining area and the disposal area. Drift S400 is blocked by bulkheads to prevent shunting flow directly from W30 to the exhaust shaft.

There is no isolation between the west end of S400 and the exhaust shaft. The entire length of S400 could potentially become contaminated. In order to ensure that air flow leakage is never from the potentially contaminated exhaust stream to the fresh air stream in W30, the differential pressure must always be toward the exhaust shaft during waste handling operations in the waste shaft and/or waste shaft station area.

There are two standard bulkheads located between the waste shaft station and the W30 drift. Each bulkhead is sealed to the floor, back, and ribs of drift S400. High pressure fans in the west bulkhead draw suction (when activated) from the W30 Drift and exhaust into the space between the bulkheads, forming a pressure chamber.

The pressure chamber was tested to withstand as much as 3 inch wg. As a secondary backup system, pressure will be supplied by an actuated valve on a plant air pressurized line.

The valve will be controlled by a Foxboro controller to regulate the flow of air into the chamber and maintain pressure differentials.

In normal operation there will always be higher pressure in W30 than S400. In off normal operation there are conditions in which the pressure in W30 could be slightly lower than that in S400. During this off-normal condition, when waste handling operations in the waste shaft and/or waste shaft station area the pressure chamber will be activated to mitigate this condition.

Figure VU III-5 provides a plan view of the pressure chamber.

3.5.4 Overcasts

An overcast is a structure used at the intersection where two air streams must cross but remain separate. Overcasts are constructed of noncombustible materials, except for flexible flashing used to accommodate salt movement, in accordance with 30 CFR 57, "Safety and Health Standards - Underground Metal and Nonmetal Mines" **[DSA sections 2.4.4.2.1].**

> Overcasts are non-combustible construction (except for flexible flashing).

Overcasts will be installed, as required, as construction in the underground facility proceeds.

Emergency access through and/or over the overcast is provided as necessary in the escape route map.

3.5.5 Chain Link and Brattice Cloth

Brattice cloth barricades are used to control air flow. The brattice cloth is a flame-resistant brattice cloth accepted by the MSHA Approval and Certification Center.

Once a disposal room is filled and is no longer needed for emplacement activities, it will be barricaded against entry and isolated from the mine ventilation system by removing the air regulator bulkhead and constructing chain link/brattice cloth barricades at each end. The chain link impeded physical entry into the closed disposal room, and the brattice cloth isolates the room from underground ventilation.

3.6 Instrumentation and Control

This subsystem incorporates all the underground bulkheads with the associated doors and regulators. The doors may be normally opened or closed to create specific air flow modes.

3.6.1 Bulkheads With No Doors Or Regulators

Those bulkheads which have no access doors or air flow regulators have no instrumentation or control. These bulkheads may have emergency escape hatches. The hatches have no instrumentation or active control.

3.6.2 Personnel Doors

The normal personnel access doors, have no active controls. Some of these doors are instrumented to detect the open/closed condition.

3.6.3 Door Operation

Typical local control of Vehicle Door controls consists of pairs of ropes attached to momentary switches which are hung from the back.

Ropes are located far enough from doors so as not to interfere with door operation.

A bell sounds or a strobe light flashes on initiation of door open/close.

Some doors can be remotely controlled by the CMRO. A bell sounds or a strobe light flashes on CMRO signal initiation.

3.6.4 Locally and CMR Operated Regulators

A signal from either the local panel or from the CMS through the local LPU will cause the regulator to move to the commanded position. Controls are provided near the regulator for local actuation.

On loss of power, the regulators fail as is.

3.6.5 Airlock Doors

Vehicle airlock doors are controlled in the same manner as other vehicle doors except that there is a interlock circuit added. The permissive circuit allows the doors to open if the doors at the other end of the airlock are closed.

3.6.6 Pressure Chamber Control

The underground ventilation system is designed to maintain pressure in the active Waste Handling and Disposal areas negative with respect to all other areas. This ensures that any airborne radiological leakage will be limited to these areas.

Two bulkheads are installed in parallel between the WS station and the W30 drift to create a chamber which can be pressurized. With the pressure chamber at a minimum of .05 inches wg above the WS station, no air flow should occur from the WS station back to the W30 drift.

The control panel for this system is located in W30. It provides control and power for the high pressure fan system that is installed at the pressure chamber. The control panel has a primary and alternate power supply that provides redundant power to the system. There are three process meters installed in the control panel to monitor the differential pressure locally and remotely via CMS.

3.6.7 Interface to CMS

The following bulkhead door, damper, air velocity, and differential pressure measurement and status signals are transmitted to the CMS from the LPUs underground:

Door Status	Open/ Closed
Damper Position	Value (0 to 100%)
Damper Command Status	Local/Remote (CMS)

3.7 System Interfaces

Primary Interfaces

System Providing Service	Service to be Provided
CA00	Provide air to the operating cylinders for bulkhead and airlock cylinders.
CM00	Provide backup signals to change the configuration of the UVS when needed by an emergency, or a change in mode of ventilation. Provide monitoring of the UVS.

Primary Interfaces

System Providing Service	Service to be Provided
ED00	Provide electric power to the underground door operators, local control panels, and door monitors.

Secondary Interfaces

CF00	Limit the differential pressure on the Waste Shaft Tower.
CM00	Provide wiring from UVS equipment to the CMS. Provide status of selected bulkhead doors. Provide air regulators, differential pressure measurements, airflow velocities and psychrometric conditions throughout the facility.
FP00	Provide emergency control of ventilation for underground fires.
GC00	Provide ventilation for underground construction operations.

4.0 OPERATIONS

Refer to section 4.0 of chapter G for VU00 system integrated operations information.

5.0 SYSTEM LIMITATIONS, SETPOINTS, AND PRECAUTIONS

Refer to section 5.0 of chapter G for system-subsystem performance limitations, setpoints, and precautions.

6.0 OFF NORMAL EVENTS AND RECOVERY

Refer to section 6.0 of chapter G for system-level off normal events and recovery.

7.0 MAINTENANCE

Refer to section 7.0 of chapter G for information relating to the Underground Ventilation System maintenance approach, corrective maintenance, preventative maintenance and inspection program requirements.

Presented is a list of VU03 equipment and related devices that shall be maintained in the WIPP Maintenance Procedures.

- Bulkheads
- Air Regulators
- Tornado Dampers

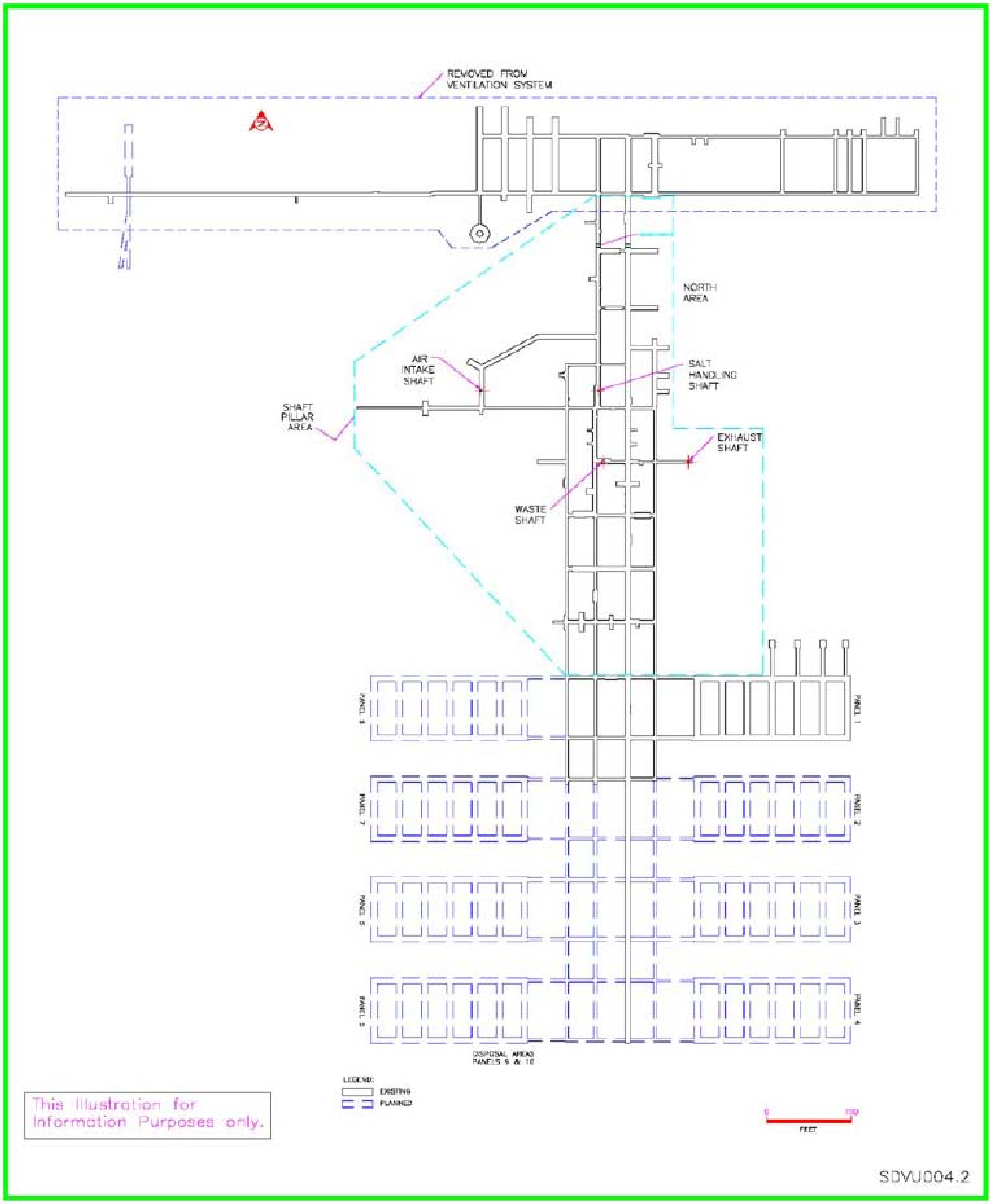

Figure VU III - 1 – Underground Horizon Plan View

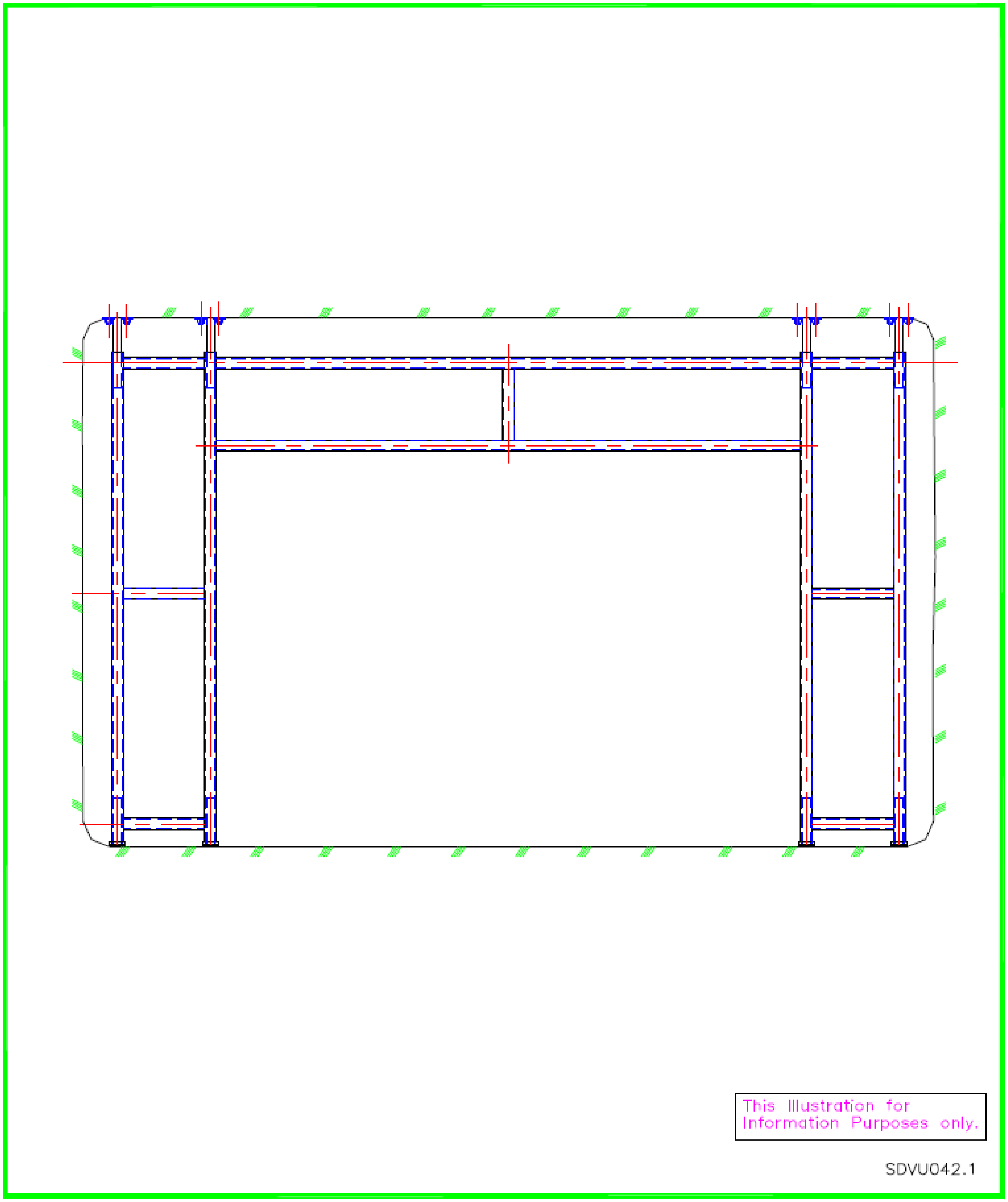

Figure VU III - 2 – Typical Bulkhead Framing

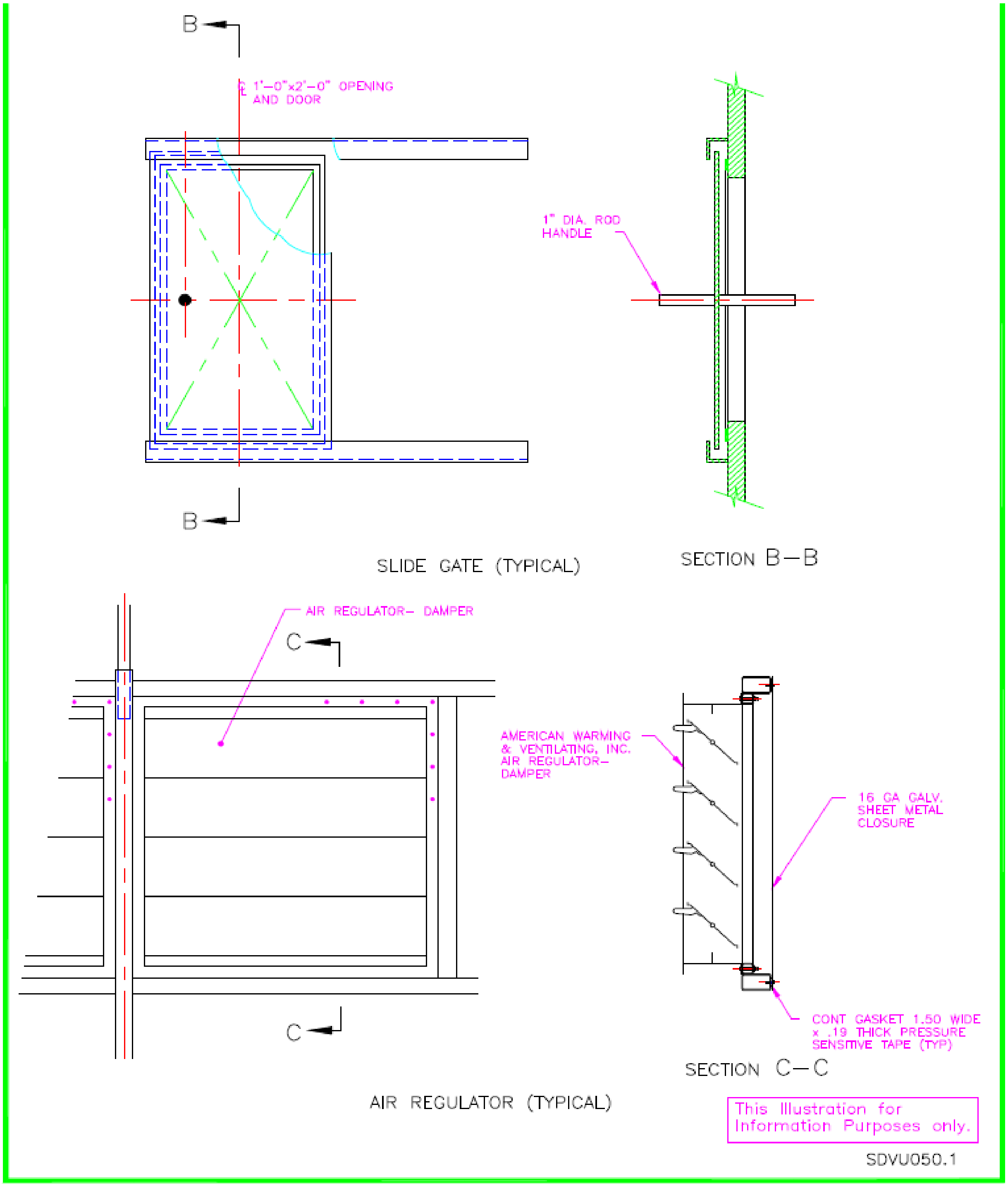

Figure VU III - 3 – Slide Gates and Air Regulators

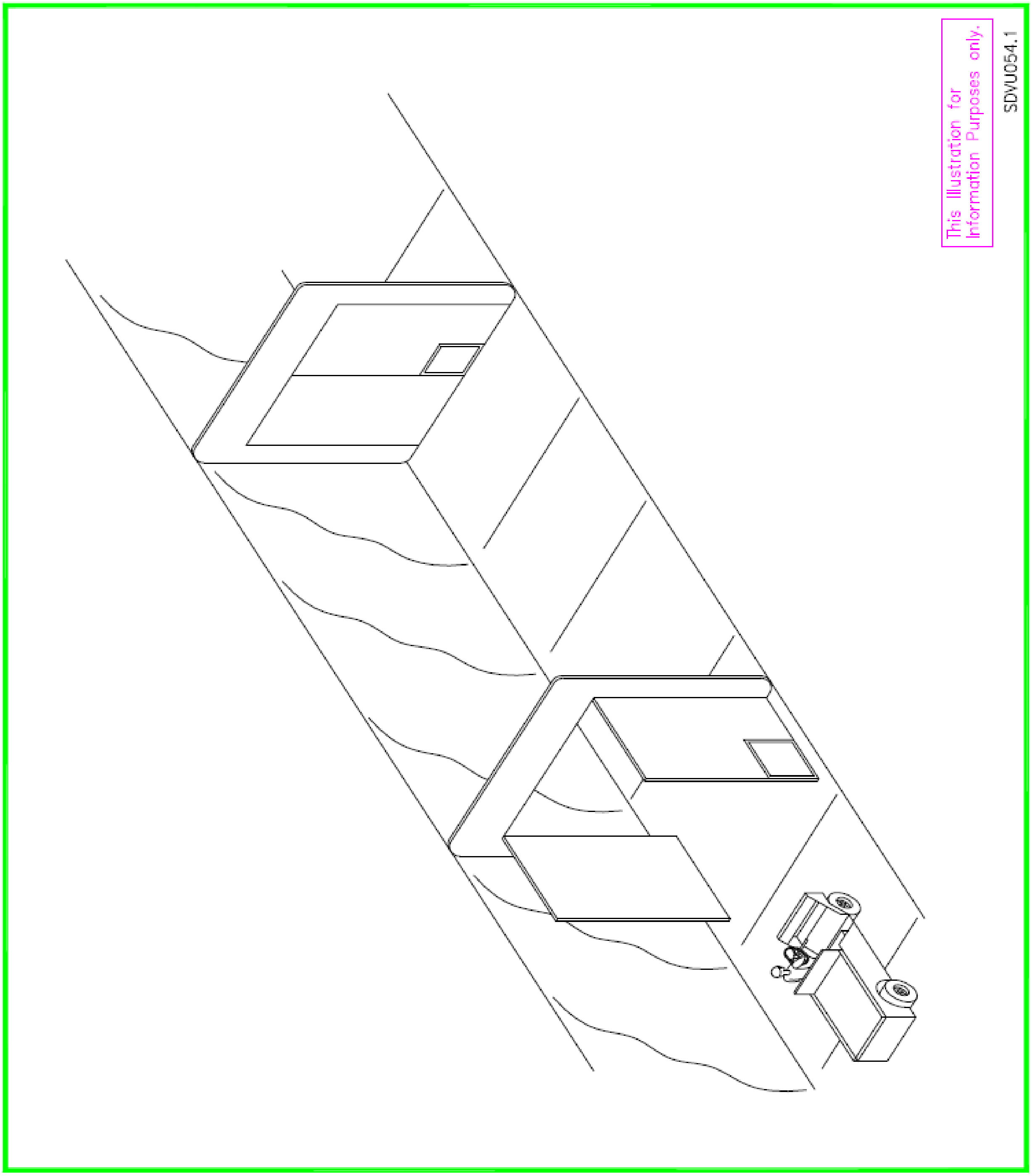

Figure VU III - 4 – Underground Vehicle Airlock

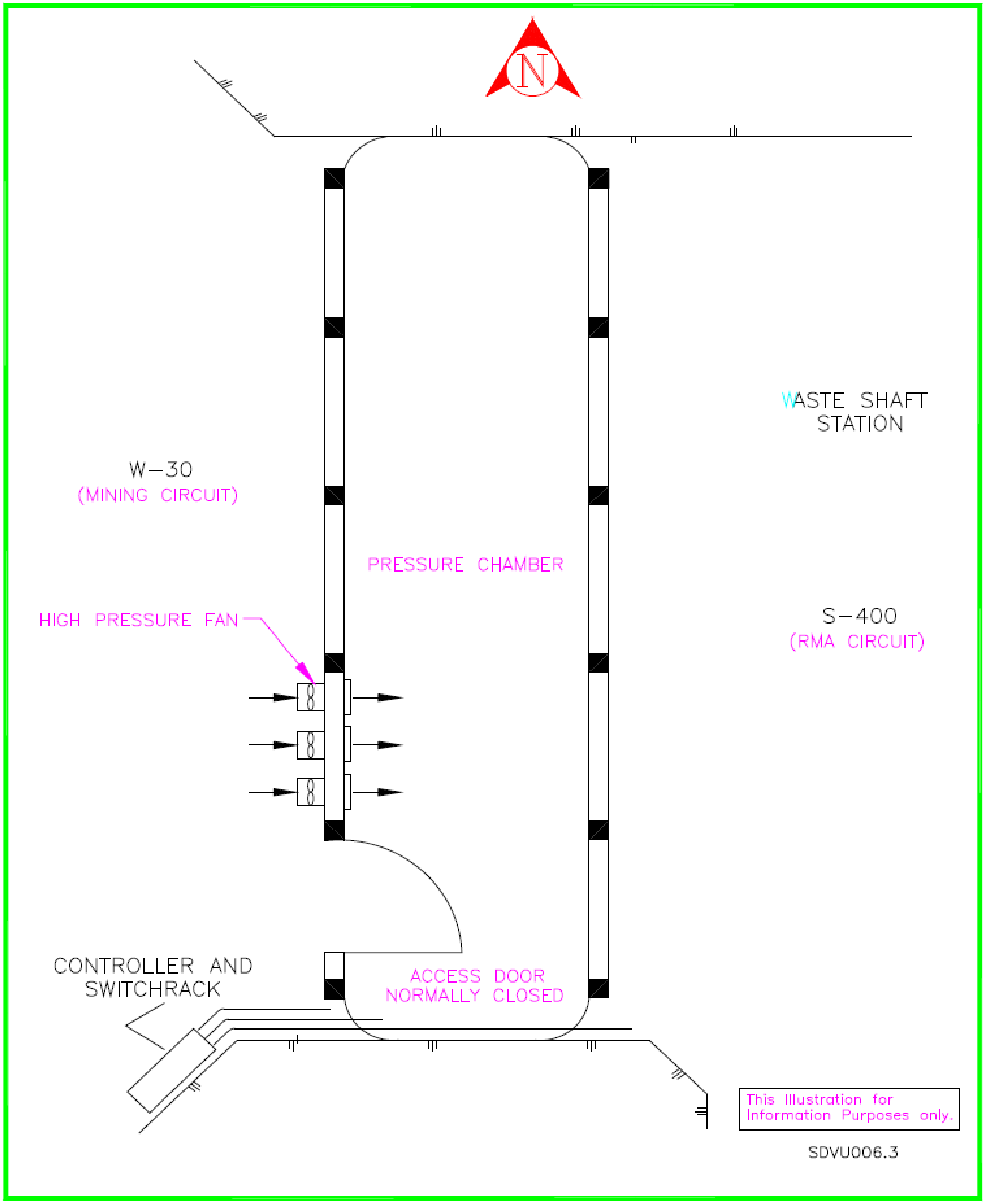

Figure VU III - 5 – Pressure Chamber

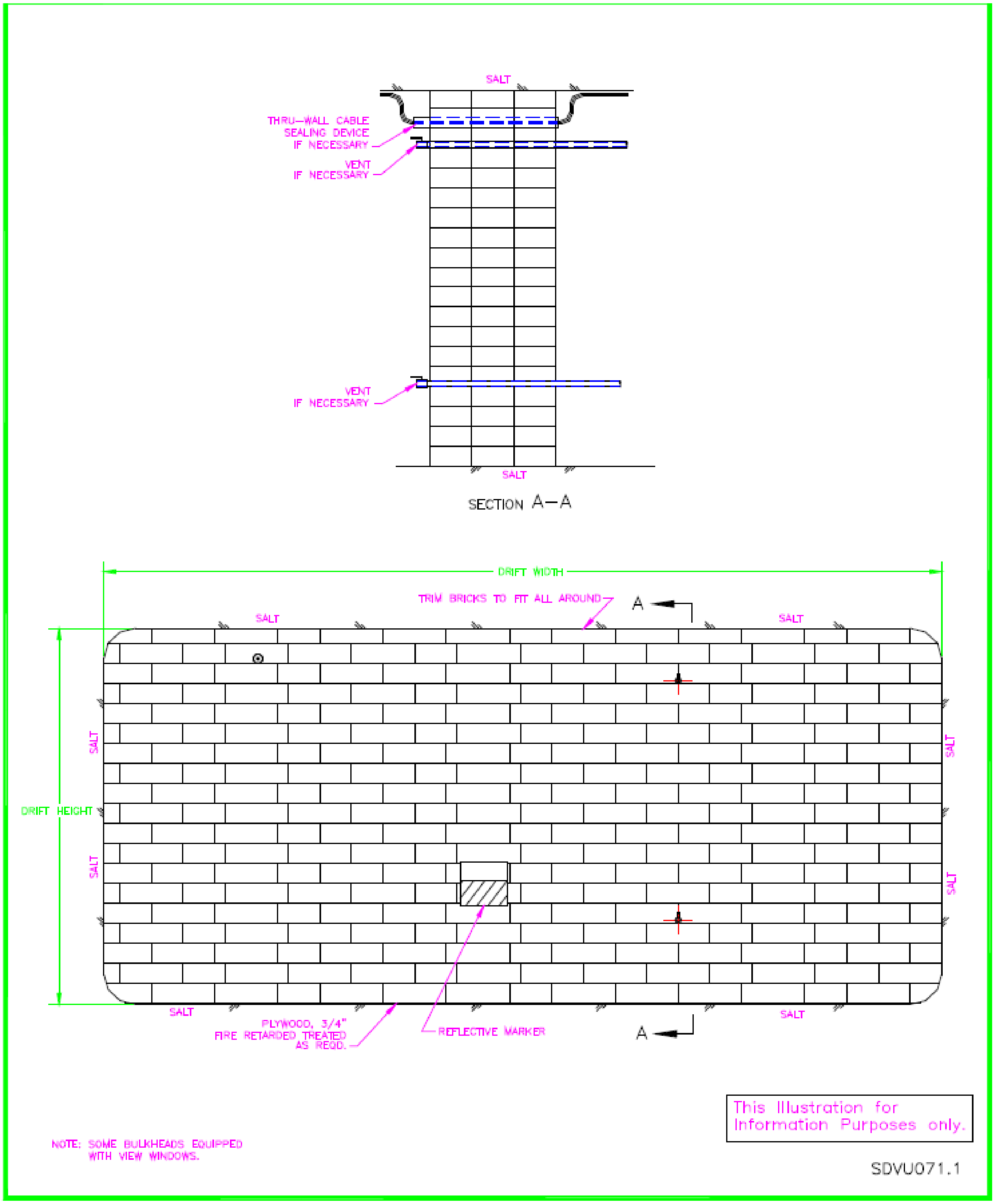

Figure VU III - 6 – Flyash Brick Bulkhead

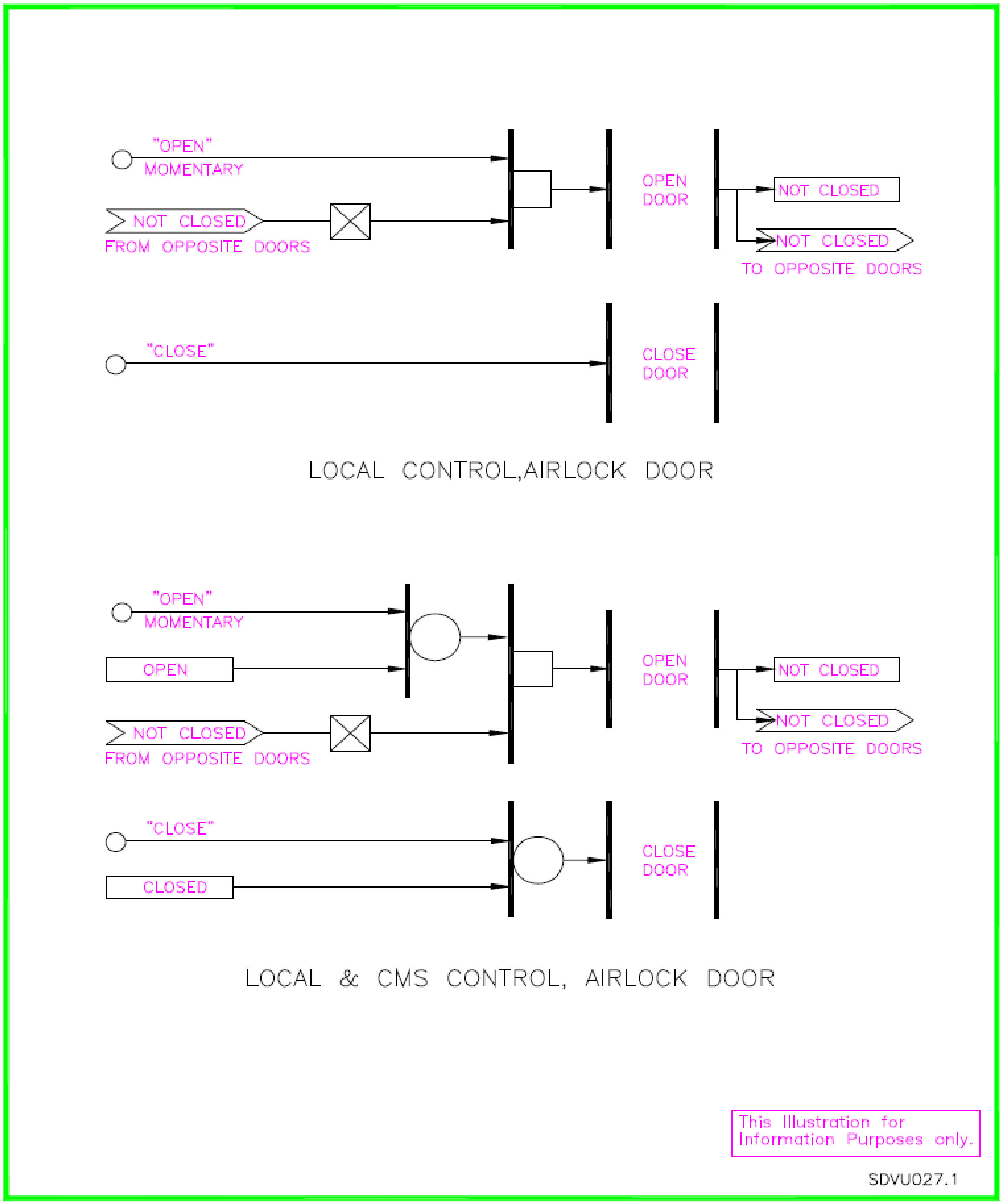

Figure VU III - 7 – Airlock Door Logic

Chapter IV
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Subsystem VU04 - Local Temporary Ventilation

Chapter IV

Subsystem VU04 - Local Temporary Ventilation

1.0 PRIMARY FUNCTIONS

The primary functions for local temporary ventilation are presented in section 1.0 of chapter G.

2.0 DESIGN REQUIREMENTS

2.1 General

The general design requirements for local temporary ventilation are presented in section 2.1 of chapter G.

2.2 Subsystem Requirements

2.2.1 Any local area which requires temporary ventilation for personnel comfort and safety shall be ventilated with auxiliary fans sized to the specific needs of the area in accordance with 30 CFR 57.

2.2.2 The face ventilation in the mining area shall be under the direction of the VU04 mining cognizant engineer or their designated representative.

2.2.3 Face ventilation shall be conducted as described in the approved WIPP Mine Ventilation Plan as required by 30 CFR 57.

2.3 - 2.12 Technical Cross Reference

Refer to section 2.3 to section 2.12 of chapter G for general requirements applicable to each of the following topics:

- 2.3 Operational Requirements
- 2.4 Structural Requirements
- 2.5 General Arrangement & Essential Requirements
- 2.6 Maintenance Requirements
- 2.7 In-Service Inspection Requirements
- 2.8 Instrumentation and Control Requirements
- 2.9 Interface System Requirements

- 2.10 Quality Assurance Requirements
- 2.11 Codes and Standards Requirements
- 2.12 Reliability Requirements

Refer to Ventilation Plan for typical pre-configuration approved plan.

3.0 DESIGN DESCRIPTION

3.1 Summary

Refer to section 3.1 of chapter G for the Underground Ventilation System summary design description.

The equipment of VU04, fans, is used to provide safe, comfortable working conditions. This equipment is moved about as needed in the underground. This system also includes the fans, ducts, and brattice work which provide air circulation at the working face.

3.2 Detailed System Description

3.3 - 3.4 Technical Cross Reference

Refer to section 3.3 to section 3.4 of chapter G for general requirements applicable to each of the following topics:

3.3 Performance Characteristics

3.4 System Arrangement

3.5 Component Design Description

The equipment in VU04 is used to provide comfortable working conditions for personnel. Fans and air-conditioners are temporarily located as needed to provide a satisfactory working environment.

The equipment utilized in the VU04 subsystem changes to accommodate current working conditions at the underground working face. Fans, ducts and brattice work for the working face are provided as required by the operation in progress.

3.6 Instrumentation and Control

The commercial portable equipment which make up this subsystem have external ON/OFF switches and proprietary controls incorporated within them.

3.7 System Interfaces

Primary Interfaces

System Providing Service	Service to be Provided
ED00	Provide electric power to local working face ventilation fans.

Secondary Interfaces

No Secondary Interfaces to VU04.

4.0 OPERATIONS

Refer to section 4.0 of chapter G for VU00 system integrated operations information.

5.0 SYSTEM LIMITATIONS, SETPOINTS, AND PRECAUTIONS

Refer to section 5.0 of chapter G for system-subsystem performance limitations, setpoints, and precautions.

6.0 OFF NORMAL EVENTS AND RECOVERY

Refer to section 6.0 of chapter G for system-level off-normal events and recovery.

7.0 MAINTENANCE

Refer to section 7.0 of chapter G for information relating to the Underground Ventilation System maintenance approach, corrective maintenance, preventative maintenance and inspection program requirements.

- Local Temporary Ventilation - VU04

The small portable fans require no preventive maintenance; use a graded repair approach as needed.

No in-service inspections should be needed for this small portable equipment unless specifically required by the manufacturer.

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Subsystem VU05 - Air Intake Flow Paths and Exhaust

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Figure Page

Chapter V

Subsystem VU05 - Air Intake Flow Paths and Exhaust

1.0 PRIMARY FUNCTIONS

The primary functions for the air intake flow paths and exhaust are presented in section 1.0 of chapter G.

2.0 DESIGN REQUIREMENTS

2.1 General

The general design requirements for the air intake flow paths and exhaust are presented in section 2.1 of chapter G.

2.2 Subsystem Requirements

2.2.1 The UVS shall receive air from the three intake shafts, and discharge the air through a single exhaust shaft.

2.2.2 The duct elbow at the top of the exhaust shaft, shall be designed to withstand the WIPP facility Design Basis Earthquake and Design Basis Tornado (DBE/DBT). Refer to the General Plant Design Basis, GPDD.

2.2.3 An Auxiliary Air Intake Tunnel (AAIT) with appropriate regulators shall be used to control the flow of air down the waste shaft. Refer to figures VU V-1 and VU V-2.

2.3 - 2.12 Technical Cross Reference

Refer to section 2.3 to section 2.12 of chapter G for general requirements applicable to each of the following topics:

- 2.3 Operational Requirements
- 2.4 Structural Requirements
- 2.5 General Arrangement & Essential Requirements
- 2.6 Maintenance Requirements
- 2.7 In-Service Inspection Requirements
- 2.8 Instrumentation and Control Requirements
- 2.9 Interface System Requirements

- 2.10 Quality Assurance Requirements
- 2.11 Codes and Standards Requirements
- 2.12 Reliability Requirements

3.0 DESIGN DESCRIPTION

3.1 Summary

Refer to section 3.1 of chapter G for the Underground Ventilation System summary design description.

The Air Intake Shaft, the Salt Handling Shaft and the Waste Shaft with its Auxiliary Air Intake Building and tunnel are used to convey fresh air to the underground. The Exhaust Shaft is utilized for bringing exhaust air from the underground to the surface level The location of the air shafts relative to other WIPP features on the surface can be seen on figure VU V-1. The location of these facilities relative to other features in the WIPP underground can be seen on figure VU III-1.

3.2 Detailed System Description

The Air Intake Shaft, the Salt Handling Shaft, the Waste Shaft, and the Auxiliary Air Intake Building and tunnel are used to convey fresh air to the underground. The design, physical features, and other uses of the air intake shafts are summarized in the Components Design Description, section 3.5, and covered in detail in SDD-UH00. The design and physical features of the Auxiliary Air Intake Building and tunnel are summarized in the Components Design Description, section 3.5, and covered in detail in SDD-CF00.

The Exhaust Shaft is utilized for bringing exhaust air from the underground to the surface level. The design and physical features of the air Exhaust Shaft are summarized in the Components Design Description, section 3.5, and covered in detail in SDD-UH00.

The driving force for the air flow through the vertical shafts is normally provided by the exhaust fans on the surface, which pull air down through the AIS, SHS and WS, through the underground, then up through the ES into the exhaust ducts and return it to the atmosphere.

3.3 - 3.4 Technical Cross Reference

Refer to section 3.3 to section 3.4 of chapter G for general requirements applicable to each of the following topics:

3.3 Performance Characteristics

3.4 System Arrangement

3.5 Component Design Description

3.5.1 Subsystem VU05 - Air Intake and Exhaust

Normal air intake is provided through three vertical shafts, the Air Intake Shaft (AIS), the Salt Handling Shaft (SHS) and the Waste Handling Shaft (WHS). Air flow into the WS is supplemented by the Auxiliary Air Intake Tunnel (AAIT). Normal air exhaust is provided through a single vertical shaft, the Exhaust Shaft (ES).

The design, physical features and other uses of the vertical air shafts are described in detail in SDD-UH00. The design and physical features of the AAIT are described in detail in SDD-CF00.

- Air Intake Shaft
- Salt Handling Shaft
- Waste Shaft
- Exhaust Shaft
- Auxiliary Air Intake Tunnel

The WS provides a secondary service to supply air for waste shaft and waste shaft areas.

3.5.2 Auxiliary Air Intake Tunnel

An AAIT is provided to supply fresh air as needed to supplement the air flow drawn down the WS from leakage into the tower area. The location of the AAIT is shown on figure VU V-1, running north and slightly east of the WS to the Auxiliary Air Intake Building (building number 465).

The Auxiliary Air Intake Building is a small block building containing air regulators/dampers on three sides. One set of dampers are for balancing and are used to adjust air flow through the AAIT in normal and alternate modes. The Tornado dampers are provided to protect the Waste Shaft Tower structure in the event of a tornado for additional pressure relief. Dampers are provided to limit the negative pressure on the waste hoist tower. These dampers are counter balanced.

Once a damper if fully open, it must be closed manually in order to restore the WS pressure to full normal and to establish normal air flow patterns.

The interface between VU-CF-UH relative to the AAIS and AAIT is as follows:

- The physical building of the AAIT is under CF00.

- The Louvers within the building (balance, pressure, relief and tornado) are under VU03.

- The tunnel which connects the building to the waste shaft (UH00) is under VU05.

3.6 Instrumentation and Control

This subsystem consists of use of the four vertical shafts plus the Auxiliary Air Intake Building and Tunnel. There is no Underground Ventilation control equipment associated with any of the shafts.

3.7 System Interfaces

Primary Interfaces

System Providing Service	Service to be Provided
UH00	Provide resistance to airflow in the Shafts.

Secondary Interfaces

UH00	Provide ventilation to the shafts and underground stations of System UH00.

4.0 OPERATIONS

Refer to section 4.0 of chapter G for VU00 system integrated operations information.

5.0 SYSTEM LIMITATIONS, SETPOINTS, AND PRECAUTIONS

Refer to section 5.0 of chapter G for system-subsystem performance limitations, setpoints, and precautions.

6.0 OFF NORMAL EVENTS AND RECOVERY

Refer to section 6.0 of chapter G for system-level off normal events and recovery.

7.0 MAINTENANCE

Preventive and corrective maintenance and in-service requirements as it relates to tornado dampers, pressure relief dampers and regulators are in accordance with WIPP Site controlled maintenance procedures.

Preventive maintenance on the vertical intake and exhaust shafts is covered in SDD-UH00, Underground Hoisting System.

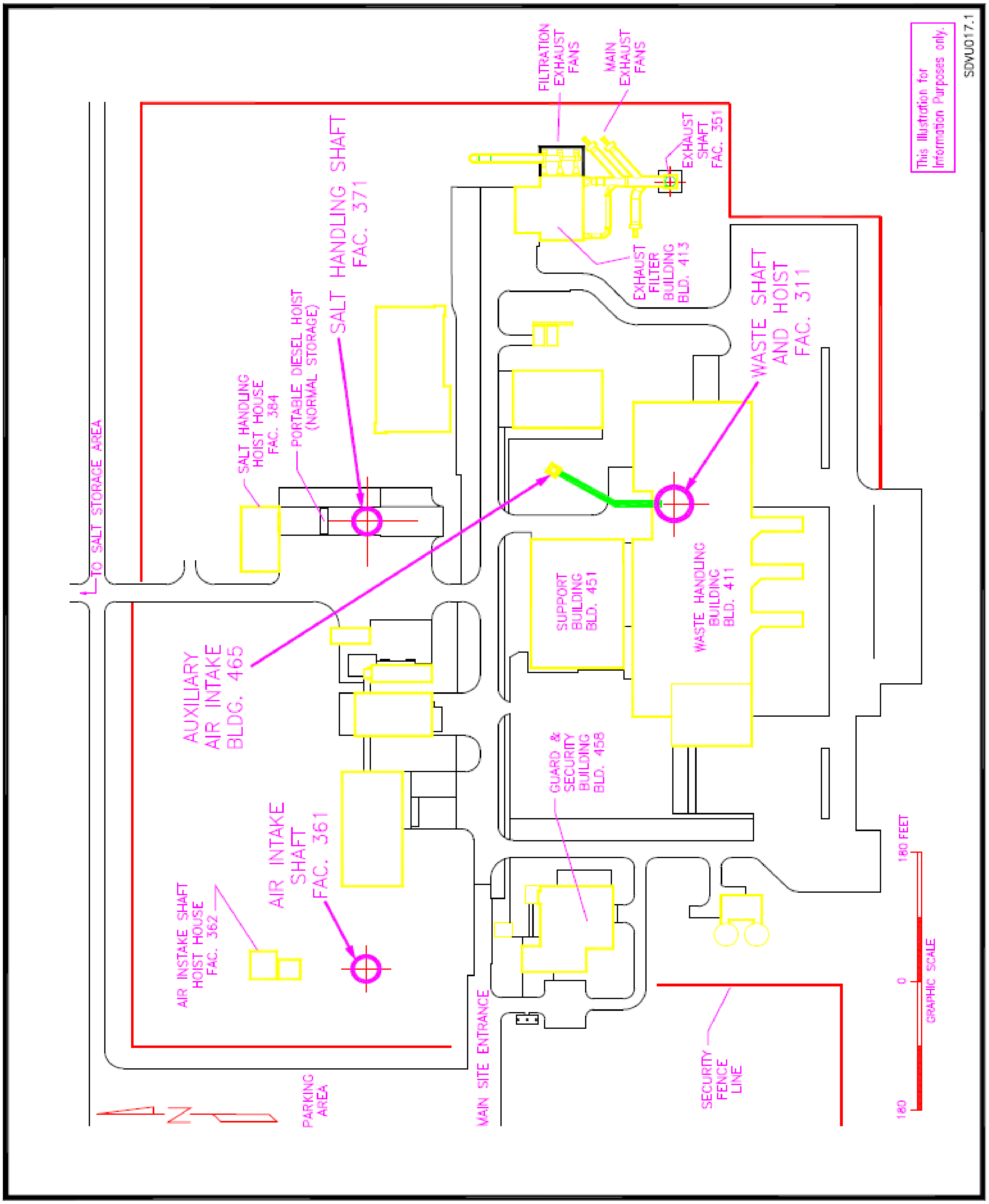

Figure VU V - 1 – WIPP Surface Plot Plan – VU00 Surface Facilities

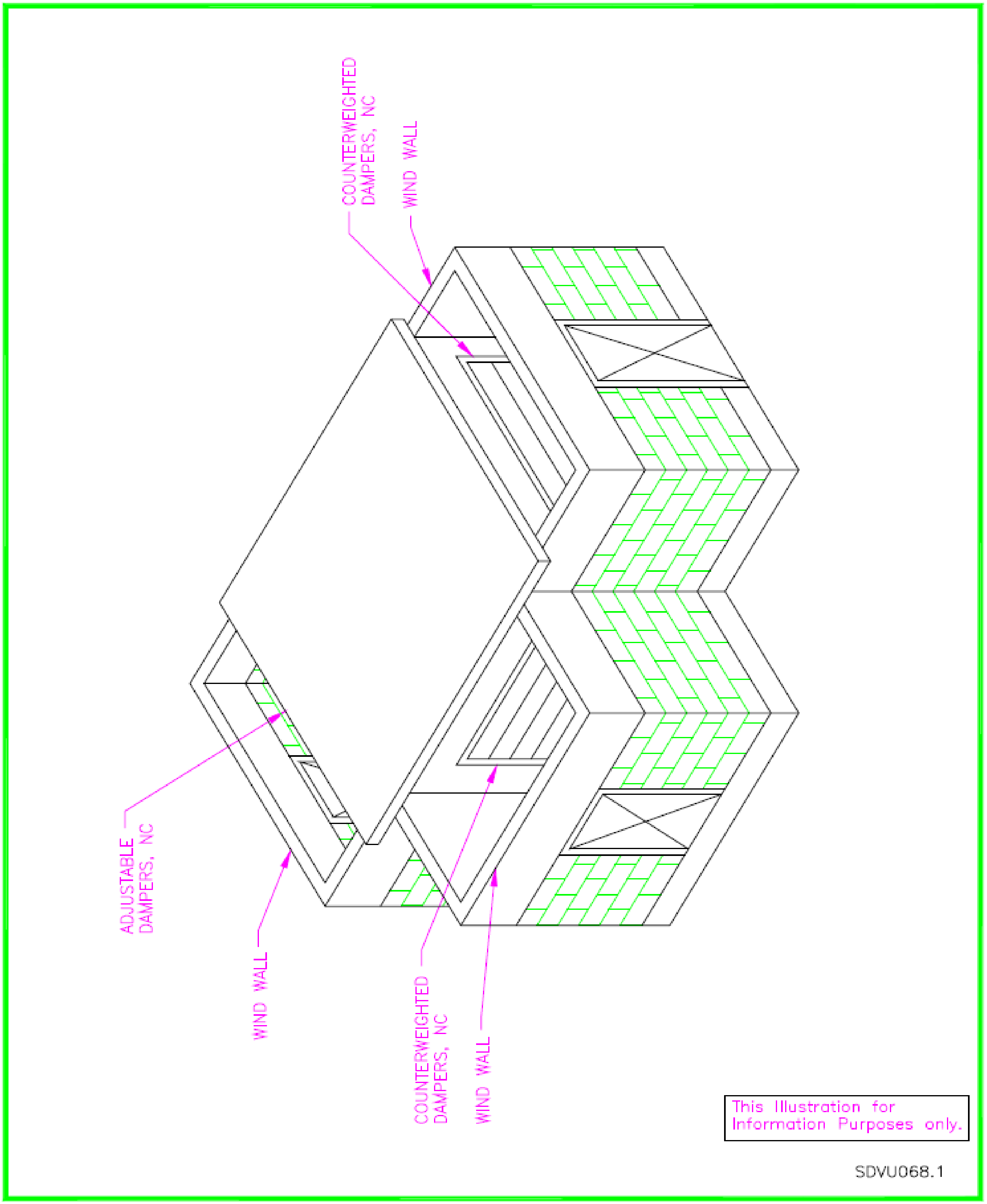

Figure VU V - 2 – Auxiliary Air Intake Building

Chapter VI
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Subsystem VU06 - Remote Monitoring and Control

Chapter VI

Subsystem VU06 - Air Flow Monitor and Control

1.0 PRIMARY FUNCTIONS

The primary functions for the air flow monitor and control features are presented in section 1.0 of chapter G.

2.0 DESIGN REQUIREMENTS

2.1 General

The general design requirements for the air flow monitor and control features are presented in section 2.1 of chapter G.

2.2 Subsystem Requirements

2.2.1 The underground ventilation shall be monitored at strategic locations to obtain adequate data. Differential air pressure is monitored across select bulkheads and air locks. Air velocity (fpm)and/or air quantity (cfm) is measured in key drifts. These measurements shall be monitored through the Central Monitoring Station (CMS) and indicated locally at each station.

2.2.2 Preservation of the monitor stations' data stream during power outages and/or fan failures is desired; therefore, the monitor stations' control power source shall be protected by uninterruptible power capable of operation for 30 minutes after primary power outage.

2.2.3 Psychrometric air conditions shall be monitored at selected stations (termed mine weather stations). Barometric pressure, dry-bulb temperature and relative humidity values shall be measured for air in-taking and exhausting each shaft. These measurements shall be monitored through the CMS. Data from the stations shall be used to evaluate the natural ventilation pressures in the facility.

2.3 - 2.12 Technical Cross-Reference

Refer to section 2.3 to section 2.12 of chapter G for general requirements applicable to each of the following topics:

- 2.3 Operational Requirements
- 2.4 Structural Requirements

- 2.5 General Arrangement & Essential Requirements
- 2.6 Maintenance Requirements
- 2.7 In-Service Inspection Requirements
- 2.8 Instrumentation and Control Requirements
- 2.9 Interface System Requirements
- 2.10 Quality Assurance Requirements
- 2.11 Codes and Standards Requirements
- 2.12 Reliability Requirements

3.0 DESIGN DESCRIPTION

3.1 Summary

Refer to section 3.1 of chapter G for the Underground Ventilation System summary design description.

In order to access current underground ventilation conditions, the CMS monitors the differential air pressure across certain bulkheads and air locks, the position of ventilation regulator dampers in critical bulkheads, and the velocity and/or quantity of the air stream at several key places in the drifts. Each monitor station has a local data display for on-site verification, for maintenance and calibration, and for underground control as necessary. The power sources for the monitor stations are served by uninterruptible power.

The ventilation regulator dampers can be positioned by electric drive motors commanded through the CMS. Each drive also has a local control panel for on-site operation. The drive motors are not connected to backup power sources, but are provided with manual hand wheels for operation during power loss.

The psychrometric conditions of the air entering and exiting the facility are continuously monitored through local mine weather stations. The data are used for base line psychrometic conditions and to calculate the natural ventilation pressure (NVP) of the facility .

3.2 Detailed System Description

The air flow in the underground can be made to vary significantly in various drifts. This airflow is monitored by sensors. In addition, the differential air pressure is monitored across selected air locks, bulkheads and regulators to monitor the performance of the ventilation system. The psychrometric conditions of the air are monitored at selected locations, both on the surface and in the underground.

The flow is regulated by operating various combinations of fans above ground and by varying the position of the louvers in the regulator bulkheads.

FloSonic Ultrasonic Airflow Sensors are used to measure air mass flow.

The placement of the air velocity probes along the drift is important because obstructions between the probes could invalidate the readings. During installation and periodic re-calibrations the air velocity is surveyed across the entire section in the plane between the probes.

Several parameters are entered into the FloSonic's memory. These parameters can be adjusted until the FloSonic is calibrated within ± 5% of the local anemometer readings.

The differential pressure station consists of an electronic sensor, a local electronic readout, a mechanical gauge, a pair of static ports shielded from dust and dynamic air flow, and associated air tubing and valves. The sensor, display, and the passive gauge are mounted in a small equipment cabinet mounted on or in the vicinity of the bulkhead.

The air regulator assemblies in certain bulkheads are driven by reversible gear motors which can be controlled through the CMS and with a local electrical override. The gear motor local control panel accepts a standard analog signal and converts it to a drive command which allows remote control and fine positioning of the regulators to any position from fully closed to fully open.

Only the gear motor drive unit and its shaft position sensors are mounted on the air regulator. The control circuitry, local operating pushbuttons, a local/remote selector switch, and the local electronic display readout of the shaft position for each drive unit are installed in a small electrical cabinet mounted either on the bulkhead or nearby.

The mine weather stations, measuring the psychrometric conditions of the air, consist of a temperature and relative humidity probe, barometric pressure sensor, data logger, analog output module and rechargeable backup battery pack.

3.3 -- 3.4 Technical Cross Reference

Refer to section 3.3 and section 3.4 of chapter G for general requirements applicable to each of the following topics:

3.3 Performance Characteristics

3.4 System Arrangement

3.5 Component Design Description

Subsystem VU06 incorporates those elements necessary to monitor the air flow conditions underground and report those conditions to the CMS. These consist of differential static pressure sensing stations, air mass flow velocity sensing stations, mine weather stations, and both control and monitor capability for air flow regulators located in bulkheads throughout the underground.

These components are referenced in the WIPP Controlled Operating Procedures documents:

- Air Flow Velocity Stations
- Differential Pressures Measurements
- Psychrometric Air Measurements

3.6 Instrumentation and Control

This subsystem consists of CMS analog and discrete output channels monitoring air flow conditions signals controlling the position of air regulators underground. These break down as follows:

- Air Velocity monitors
- Differential pressure monitors
- Mine weather stations
- Damper Position sensors
- Damper Drive commands

3.7 System Interfaces

Primary Interfaces

System Providing Service	Service to be Provided
CM00	Provide monitoring of the UVS.
ED00	Provide electric power to 120-volt ac, 60 Hz, 1 phase and UPS power to air flow monitor and control stations.

Secondary Interfaces

CM00	Provide air regulators, differential pressure measurements, airflow velocities and psychrometric conditions throughout the facility. Provide wiring from UVS equipment to the CMS.
EM00	Provide air flow to the underground VOC monitors.

4.0 OPERATIONS

Refer to section 4.0 of chapter G for VU00 system integrated operations information.

5.0 SYSTEM LIMITATIONS, SETPOINTS, AND PRECAUTIONS

Refer to section 5.0 of chapter G for system-subsystem performance limitations, setpoints, and precautions.

6.0 OFF NORMAL EVENTS AND RECOVERY

Refer to section 6.0 of chapter G for system-level off normal events and recovery.

7.0 MAINTENANCE

Refer to section 7.0 of chapter G for information relating to the Underground Ventilation System maintenance approach, corrective maintenance, and preventative maintenance program requirements.

The following instrumentation should be checked annually as to calibration, and (if applicable) serviceability of the CMS interface.

- Mine Weather
- Differential Pressure
- Select Air Flow Monitors

APPENDICES

Statement of Intent

--- NOTICE ---

The appendices that follow are for information only and thereby are not part of the Controlled Document. Some of the information provided is controlled in various component indices and no attempt to duplicate these is intended here.

Appendices

Table of Contents

Appendix A – References

The references used in writing this document included the codes and standards of section 2.11, the drawings listed in appendix D, and the following references.

1. Title 30 CFR Part 57 - "Safety and Health Standards - Underground Metal and Non-Metal Mines"

2. DOE Order 420.1B, *Facility Safety*

3. DOE Order 430.1B, *Real Property Asset Management*

4. DOE Order 433.1, *Maintenance Management Program for DOE Nuclear Facilities*

5. DOE Order 5480.4, *Environmental Protection, Safety, and Health Protection Standards*

6. ANSI-510, *Standard for Testing Nuclear Air Cleaning System*

7. DN-0440-12, *Final Report of the Phase I and II WIPP Ventilation System Studies*, May 1990.

8. New Mexico Mine Safety Code for All Mines.

9. Most recent version of the Test and Balance of the Underground Ventilation Report.

10. Current versions of the WIPP Mine Ventilation Plan which is developed and issued yearly in accord (or as required) whichever occurs first, with MSHA requirements.

Appendix B – Definitions and Acronyms

The more common definitions, acronyms and abbreviations are included in the overall design description, GPDD. Only definitions, acronyms and abbreviations specific to the Underground Ventilation System are included in this appendix.

Appendix B2 – Acronyms

AAIT	Auxiliary Air Intake Tunnel
ACFM	Actual Cubic Feet per minute
AIS	Air Intake Shaft
ANSI	American National Standards Institute
AUTO	Automatic
CFM	Cubic feet per minute
CFR	Code of Federal Regulations
CMR	Central Monitoring Room
CMS	Central Monitoring System
EFB	Exhaust Filter Building
ES	Exhaust Shaft
ft	Foot or feet
GPDD	General Plant Design Description
HEPA	High efficiency particulate air
Hg	Mercury
hp	Horsepower
in or in.	Inch(es)
IWG	Inches water gauge
KCFM	Thousand cubic feet per minute
LPU	Local Processing Unit
M	Month(s)
mA	milliamperes
MAN	Manual
MSHA	Mine Safety and Health Administration
NVP	Natural ventilation pressure
PSIG or psig	Pounds per square inch gauge
RMA	Radioactive Materials Area
rpm	Revolutions per minute
SHS	Salt Handling Shaft
SKCFM	Standard Thousand Cubic Feet per minute

Appendix B2 – Acronyms

V	Volts
WG or W.G.	Water
WHS or WS	Waste Handling Shaft
Y	Year(s)
°C	Degrees Celsius
°F	Degrees Fahrenheit

Appendix C – Equipment Register

For a list of equipment for this system (VU00, VU01, VU02, VU03, VU04, VU05, and VU06), see the Equipment Register, which is routinely updated with the latest information and controlled by the Engineering File Room.

Appendix D – Drawing Register

For a list of drawings for this system (VU00, VU01, VU02, VU03, VU04, VU05, and VU06), see the Drawing Register, which is routinely updated with the latest information and controlled by the Engineering File Room.

Appendix E – Interfaces

Appendix F-1	Interfaces imposed upon other systems by System VU00
Appendix F-2	Interfaces imposed upon System VU00 by other systems

Interfaces relocated to section 3.7 of their respective subsystem chapters.

Appendix F – Underground Diesel Equipment Ventilation Requirements

For a list of the diesel equipment in operation in the underground and their ventilation requirements refer to the current version of the WIPP ventilation plan available with the Cognizant Engineer of system VU00.

Appendix G – Central Monitoring System Point List

For a list of CMS points representing system status and alarm signals for this system (VU00, VU01, VU02, VU03, VU04, VU05, and VU06), see the WIPP CMR Point List, which is routinely updated with the latest information and controlled by Engineering.

Appendix H – Instrument Register

For a list of instruments for this system (VU00, VU01, VU02, VU03, VU04, VU05, and VU06), see the Instrument Register, which is routinely updated with the latest information and controlled by the Engineering File Room.

Appendix I – Valve Register

For a list of valves for this system (VU00, VU01, VU02, VU03, VU04, VU05, and VU06), see the Valve Register, which is routinely updated with the latest information and controlled by the Engineering File Room.

Appendix J – Pipe Line Index

For a list of pipe lines for this system (VU00, VU01, VU02, VU03, VU04, VU05, and VU06), see the Pipe Line Register, which is routinely updated with the latest information and controlled by the Engineering File Room.

Appendix K – U/G Ventilation System Bulkhead Features

For the most complete data on bulkhead design, refer to drawing 54-W-012-W, and to the WIPP drawing file No. 00CD-0008, Bulkhead Drawing Book series (located in the EFR).

Appendix L – Instrument Requirements

Instrument	Range	Accuracy	Setpoint
Exhaust Fan Flow Controller (1 fan running)	0 - 500 KSCFM	±5%	260 KSCFM
Exhaust Fan Flow Controller (2 fans running)	0 - 500 KSCFM	±5%	212 KSCFM
Filtration Fan Flow Controller	0 - 100 KSCFM	±5%	60 KSCFM
Exhaust Fan A suction (Ind. & Record.)	0 - 20 IWG	(I)	NA
Exhaust Fan B suction (Ind. & Record.)	0 - 20 IWG	(I)	NA
HEPA 856 MOD Filter ΔP	0 - 2 IWG	±10%	NA
HEPA 856 HIGH Filter ΔP	0 - 2 IWG	±10%	NA
HEPA 856 FIRST Filter ΔP	0 - 5 IWG	±10%	NA
HEPA 856 SECOND Filter ΔP	0 - 5 IWG	±10%	NA
HEPA 857 MOD Filter ΔP	0 - 2 IWG	±10%	NA
HEPA 857 HIGH Filter ΔP	0 - 2 IWG	±10%	NA
HEPA 857 FIRST Filter ΔP	0 - 5 IWG	±10%	NA
HEPA 857 SECOND Filter ΔP	0 - 5 IWG	±10%	NA
Pressure Chamber Controller	0.2 to 2.5	.1	NA
Differential Pressure Gauges	±-5" WG	±2%	NA
Differential Pressure Transducers	±-5" WG	±1%	NA
Air Mass Flow Velocity Probes (at S400 near the exhaust shaft)	0-2000 fpm 0-4000 fpm	±5% ±5%	NA NA
Barometric Pressure Sensors Temperature/Relative Humidity Probes Air Regulator Shaft Position	800-1060 mb -33 to 120°F 0 to 100 %RH 0-100%	±0.4 mb ±0.2° F ±1 %RH ±5%	N/A N/A N/A NA
Waste Hoist Tower ΔP Instrument	±5 IWG	±5%	Varied
Main and Exhaust Fan Vibration Instrument	0 - 1 IPS	(I)	NA

Notes : (I) = Indicator only
IWG = Inches water gage
IPS = Inches per second
KSCFM = Thousand standard cubic feet per minute
NA = Not Applicable

Appendix M – WIPP Damper Register

For a list of the dampers for this system (VU00, VU01, VU02, VU03, VU04, VU05, and VU06), see the WIPP Damper Register which is routinely updated with the latest in information and controlled by in the Engineering File Room.

Appendix N – Conceptual Future Ventilation Configurations

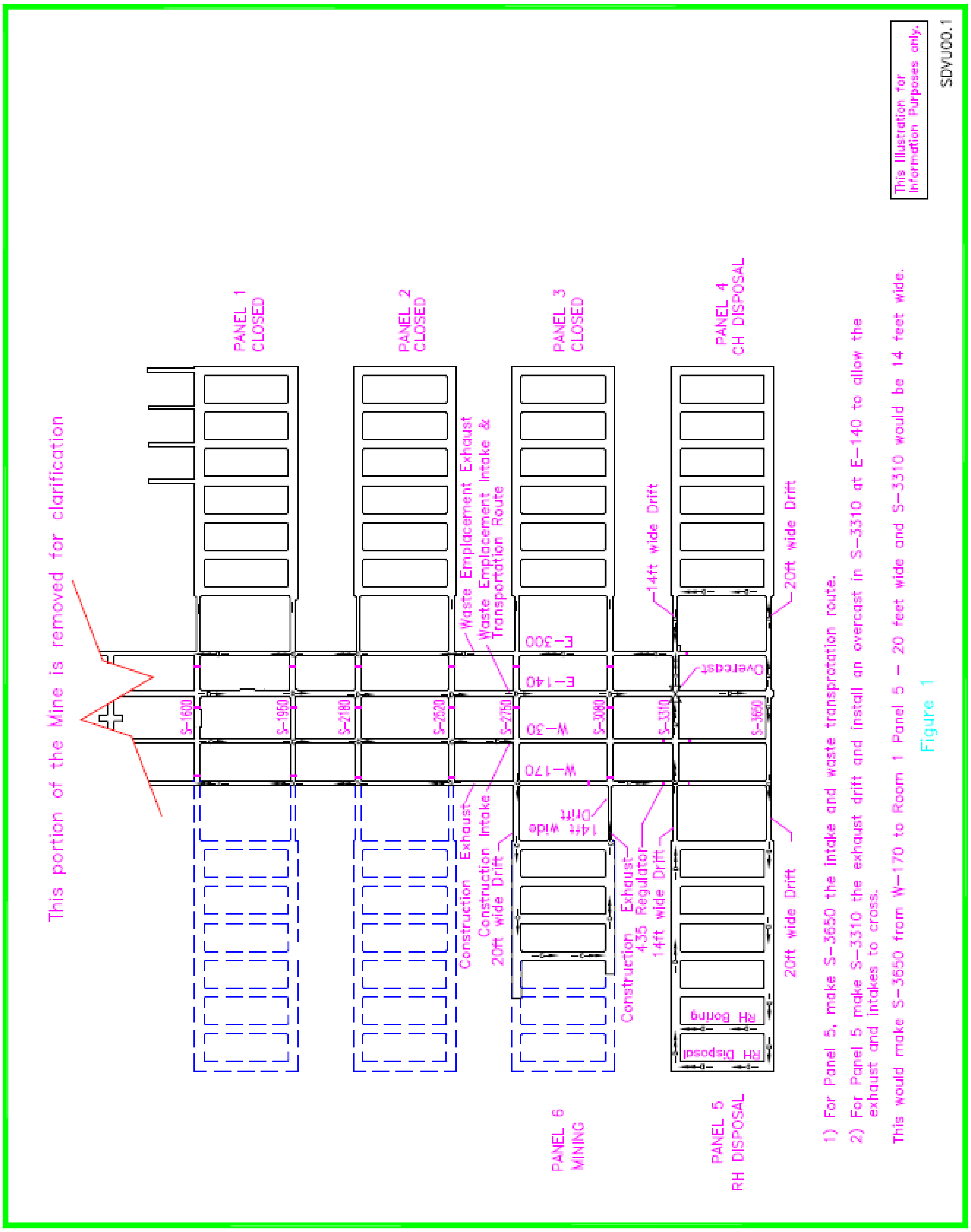

FIGURE 1 App – 16 Conceptual Configuration

Appendix N – Conceptual Future Ventilation Configurations

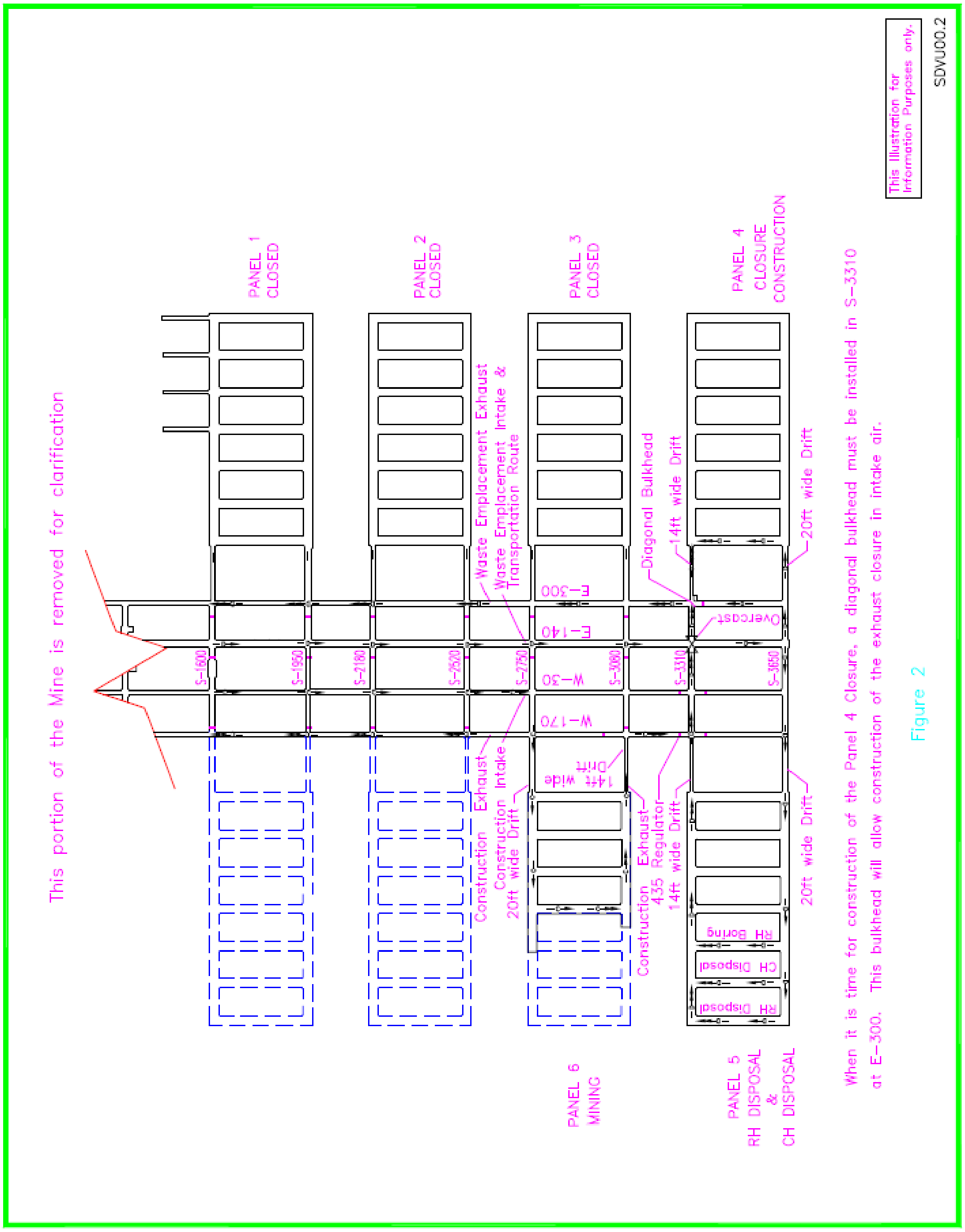

FIGURE 2 App – 16 (cont.) Conceptual Configuration

Appendix N – Conceptual Future Ventilation Configurations

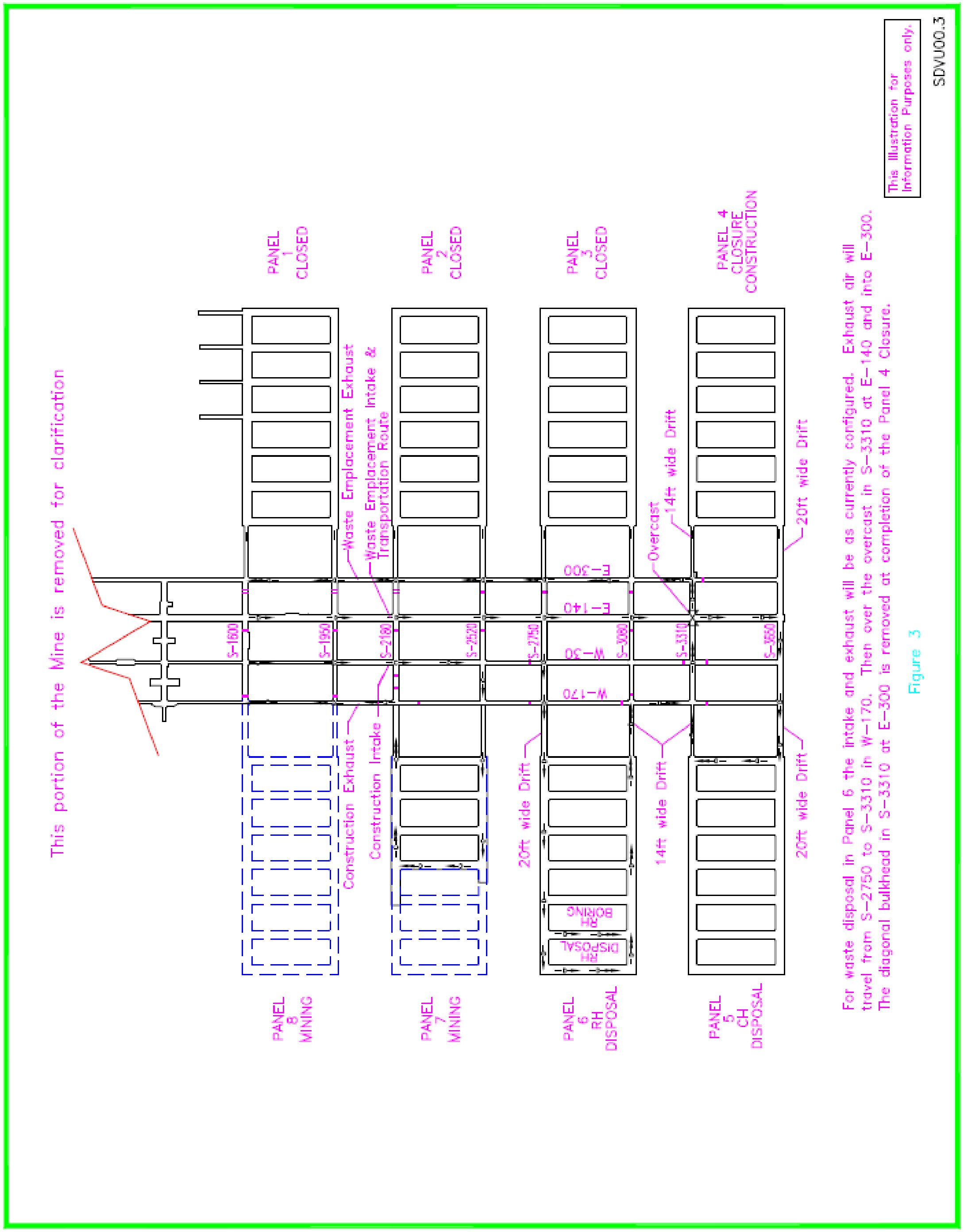

FIGURE 3 App — 16 Conceptual Configuration

Appendix N – Conceptual Future Ventilation Configurations

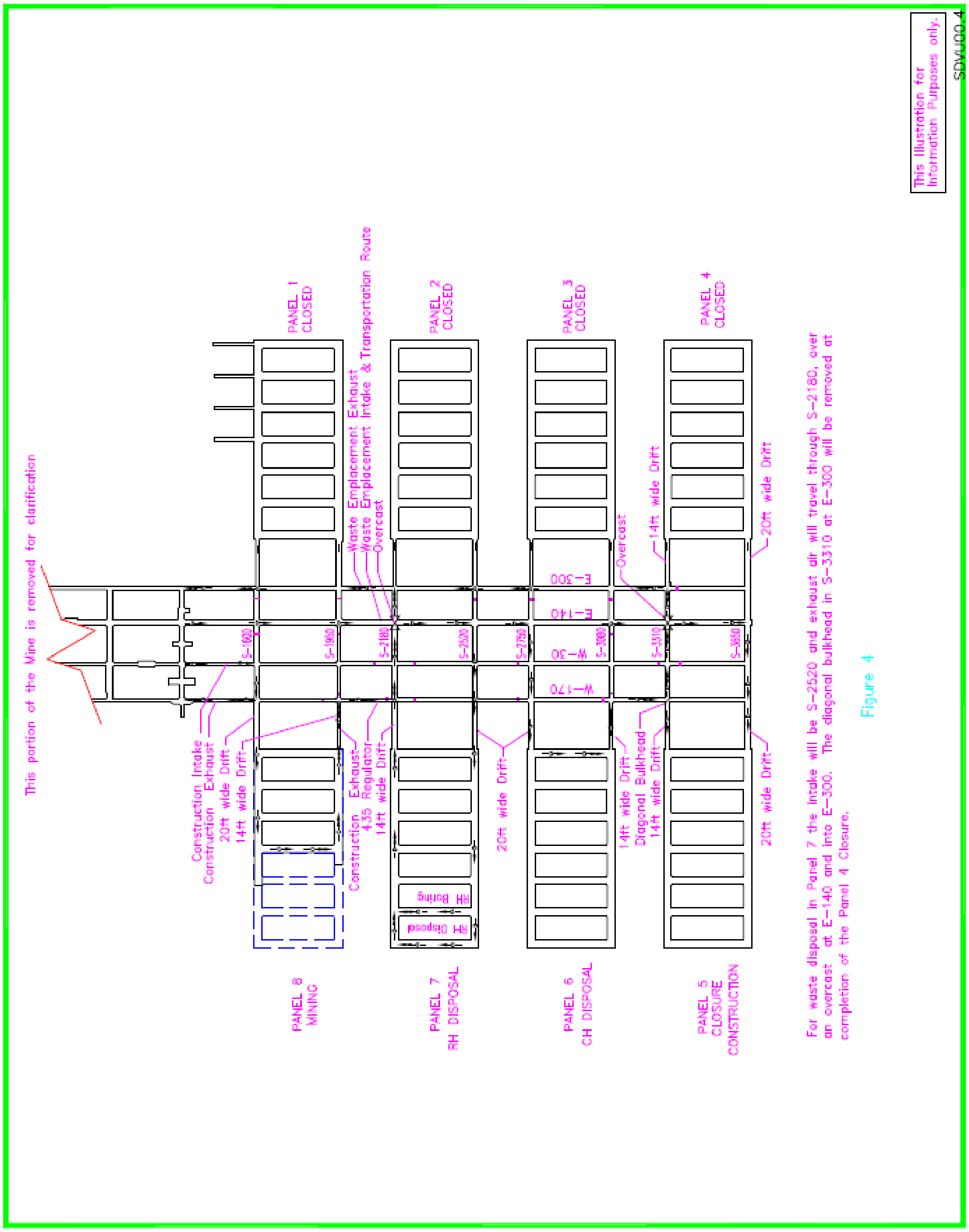

FIGURE 4 App – 16 (cont.) Conceptual Configuration

Appendix N – Conceptual Future Ventilation Configurations

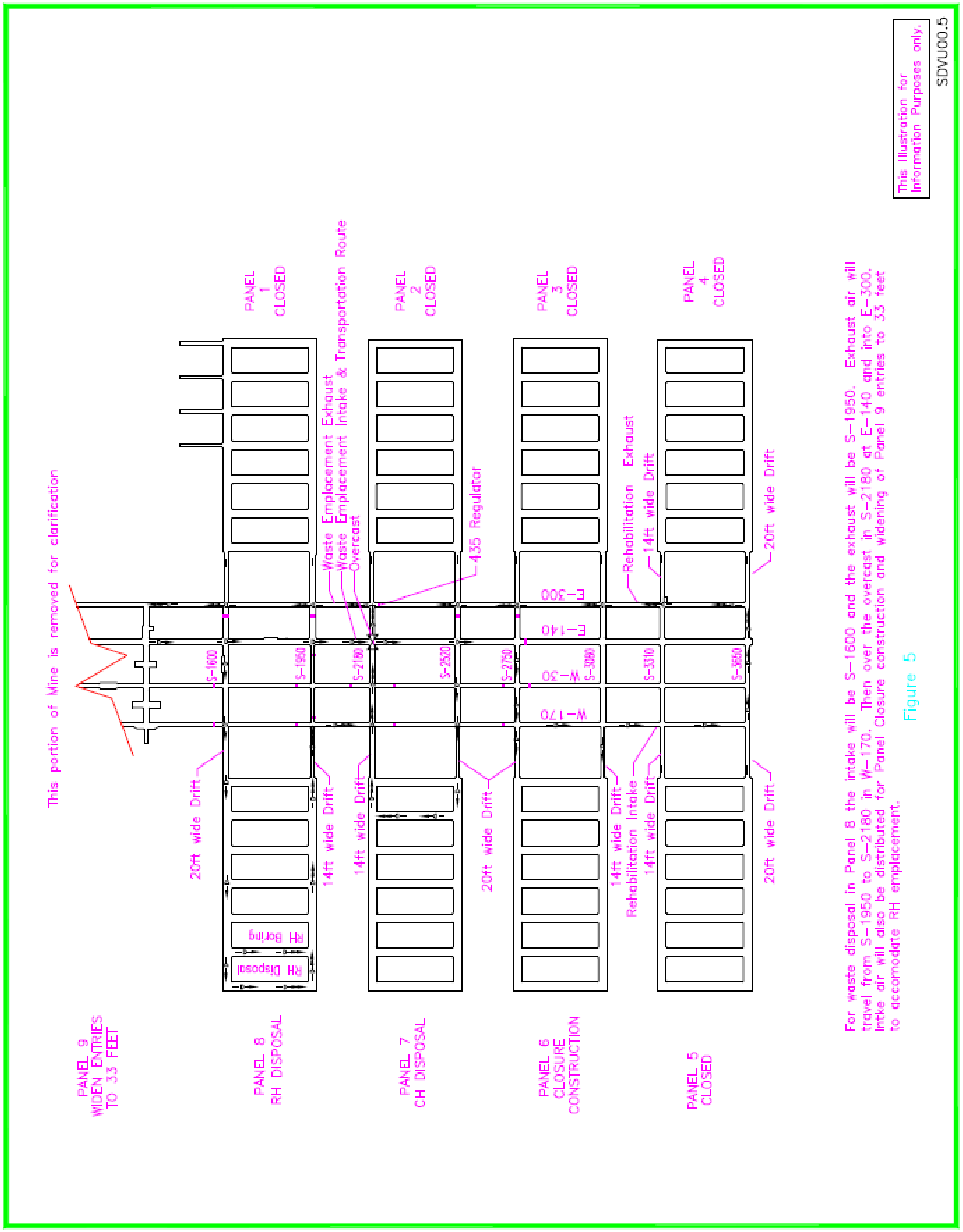

FIGURE 5 App – 16 (cont.) Conceptual Configuration