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WASTE ISOLATION PILOT PLANT

HEATING, VENTILATION AND AIR CONDITIONING SYSTEM

SYSTEM DESIGN DESCRIPTION (SDD)

SDD-HV00

Prepared by
Washington TRU Solutions LLC
Carlsbad, New Mexico

For

U.S. Department of Energy

Cognizant Individual	Roy Byrd	04/21/09
	Printed Name	Date
Cognizant Individual	Curtis Chester	04/22/09
	Printed Name	Date

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1	9/93	Revised Sect.1.0, 2.0, 3.3, and App Added Sect. 3.0, 4.0, 5.0, 6.0, 7.0	ECP 1-HV91-29 ECO No. 6849
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2	9/97	Page Section 3-7 3.2.1.1.3 3-111, 3-112 3.5.5.2 6-7 6.6.1, 6.6.3	ECP 1-WH97-019 ECO No. 8587 ECP 2-HV94-021 ECO No. 8622
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8	1/06	Section 2.0 Section 2.11 and 2.12.1	ECO No. 11320 ECO No. 11384
9	4/07	Chapter G, 3.5.5.3 and 7.3.1	ECO No. 11751
10 11	8/07 06/09	Add Section 2.4 in Chapter G Changes for new DSA to: Section G Chapter I Chapter II	ECO No. 11839 ECO No. 12218

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 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 4.4.5]**

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 4.4.6]**

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 units 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 4.2.1.2]** 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)

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 420.1, Facility Safety, and 430.1B, Life-Cycle 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

<u>American National Standards Institute (ANSI)</u>

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

<u>Air Moving and Control Association (AMCA)</u>

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

<u>Air-Conditioning and Refrigeration Institute (ARI)</u>

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

<u>National Fire Protection Association Standards (NFPA)</u>

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

<u>Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA)</u>

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 microfibre 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, PM041147, Flanders E5 Series Filter Replacement, is performed.

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 north wall of the CH Bay was reviewed and determined to not provide a two-hour fire rating (refer to documentation in ECO 10510). All fire dampers associated with the identified wall no longer provide a fire barrier function and are therefore exempt from NFPA 90A recommended inspections. Refer to Section 3.5.1 for additional information.

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 north wall of the CH Bay was reviewed and determined to not provide a two-hour fire rating (refer to documentation in ECO 10510). All fire dampers associated with the identified wall no longer provide a fire barrier function and are therefore exempt from NFPA 90A recommended inspections. Refer to Section 7.3.1 for additional information.

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.

3.7.2 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 vendors 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

NOTE

Fire dampers associated with the north wall of the CH Bay (WHB ROOM 103) will only be subjected to a visual inspection to verify the fire damper's fusible link is continuing to perform the function of retaining the fire damper curtain (not restricting air flow). The associated fire dampers are no longer serving the function of providing a fire barrier. There are no catastrophic system failures associated with the failure of a fusible link. A periodic inspection to verify the referenced dampers are not restricting air flow has been justified. Explanation and documentation can be referenced through ECO 10510 and WIPP Form 06-107.

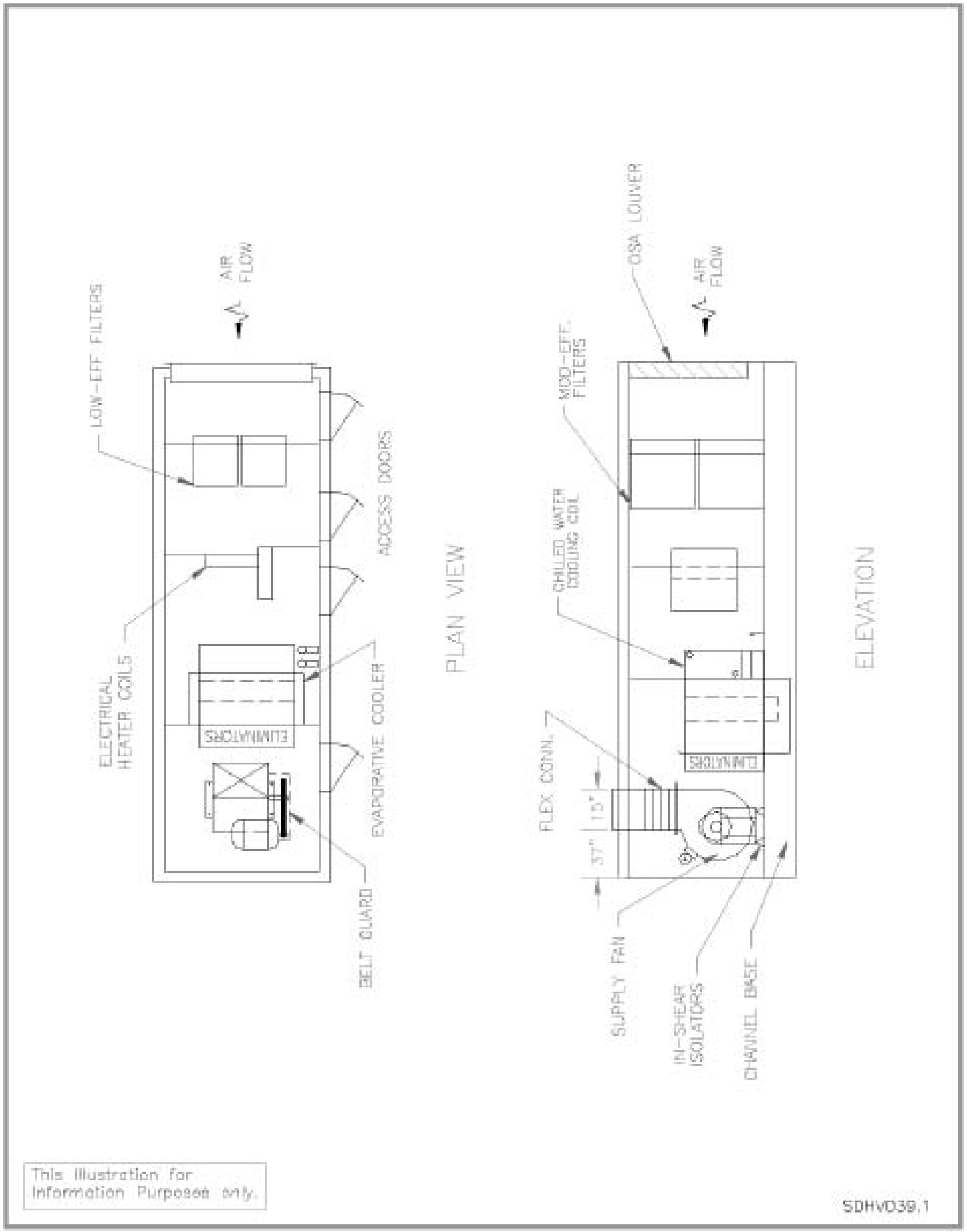


FIGURE HV G-1: Air Handling Units Plan and Elevation

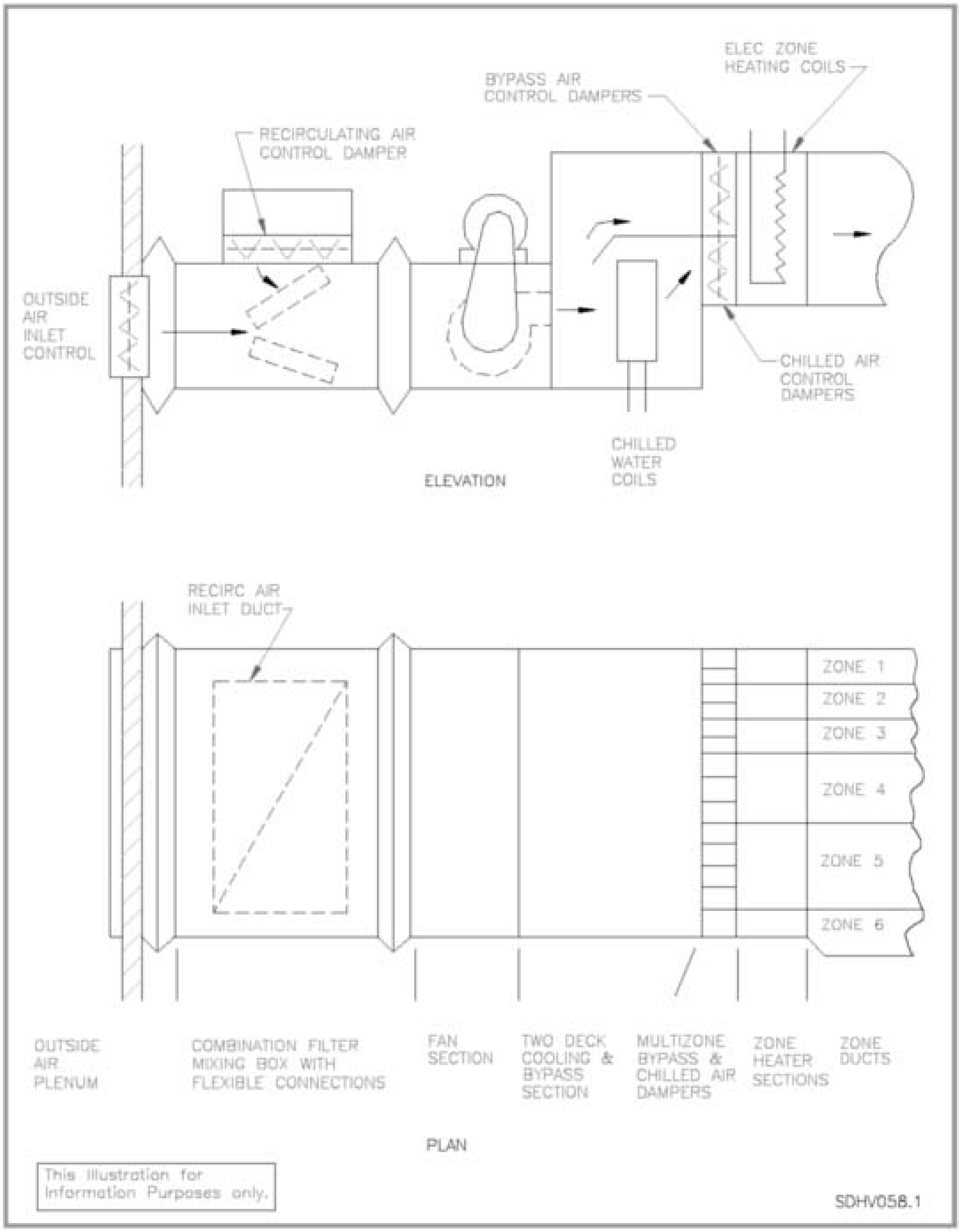


FIGURE HV G-2: Air Handling Unit Plan and Elevation

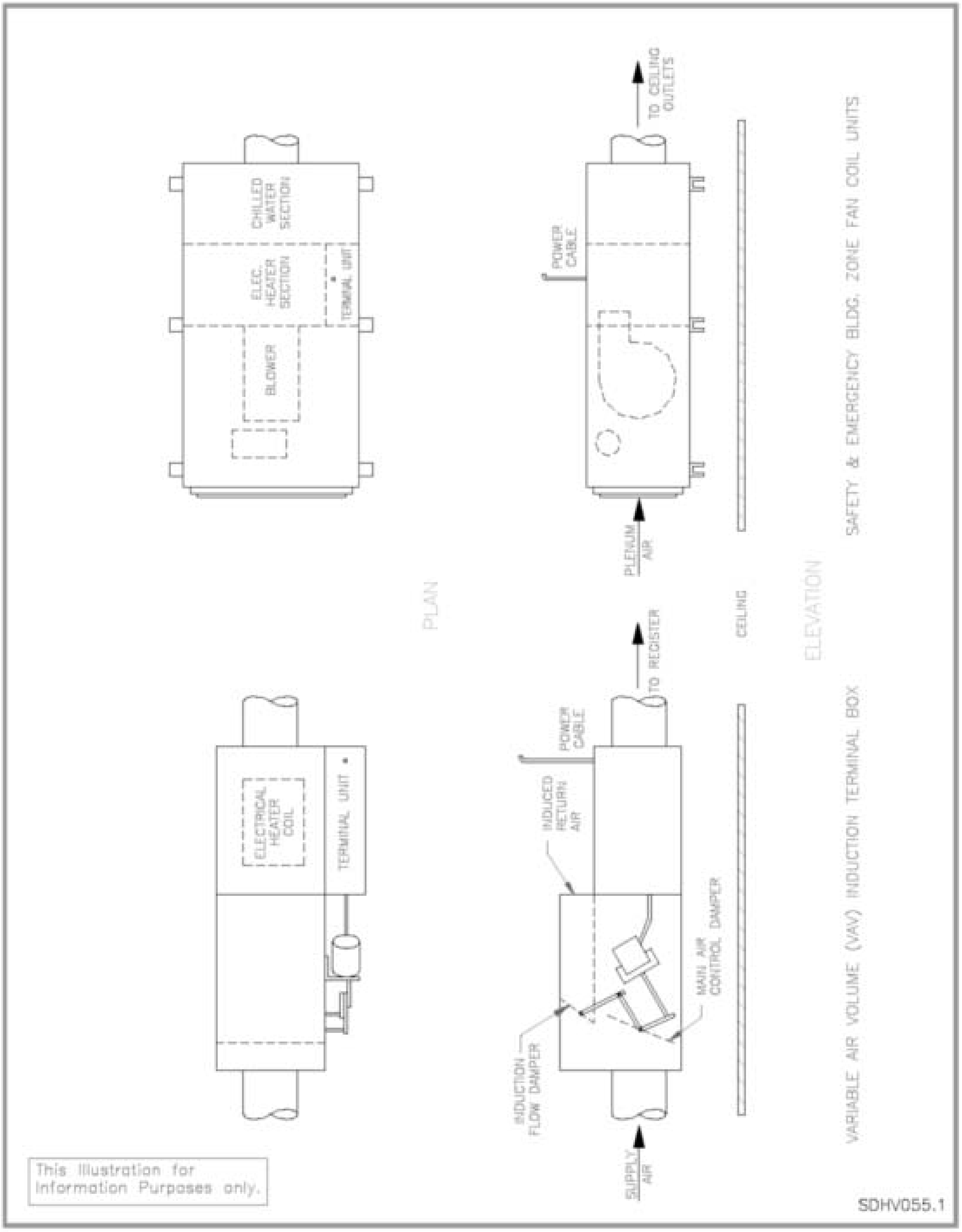


FIGURE HV G-3: HV04 & HV05 Ceiling Air Handling & Terminal Units

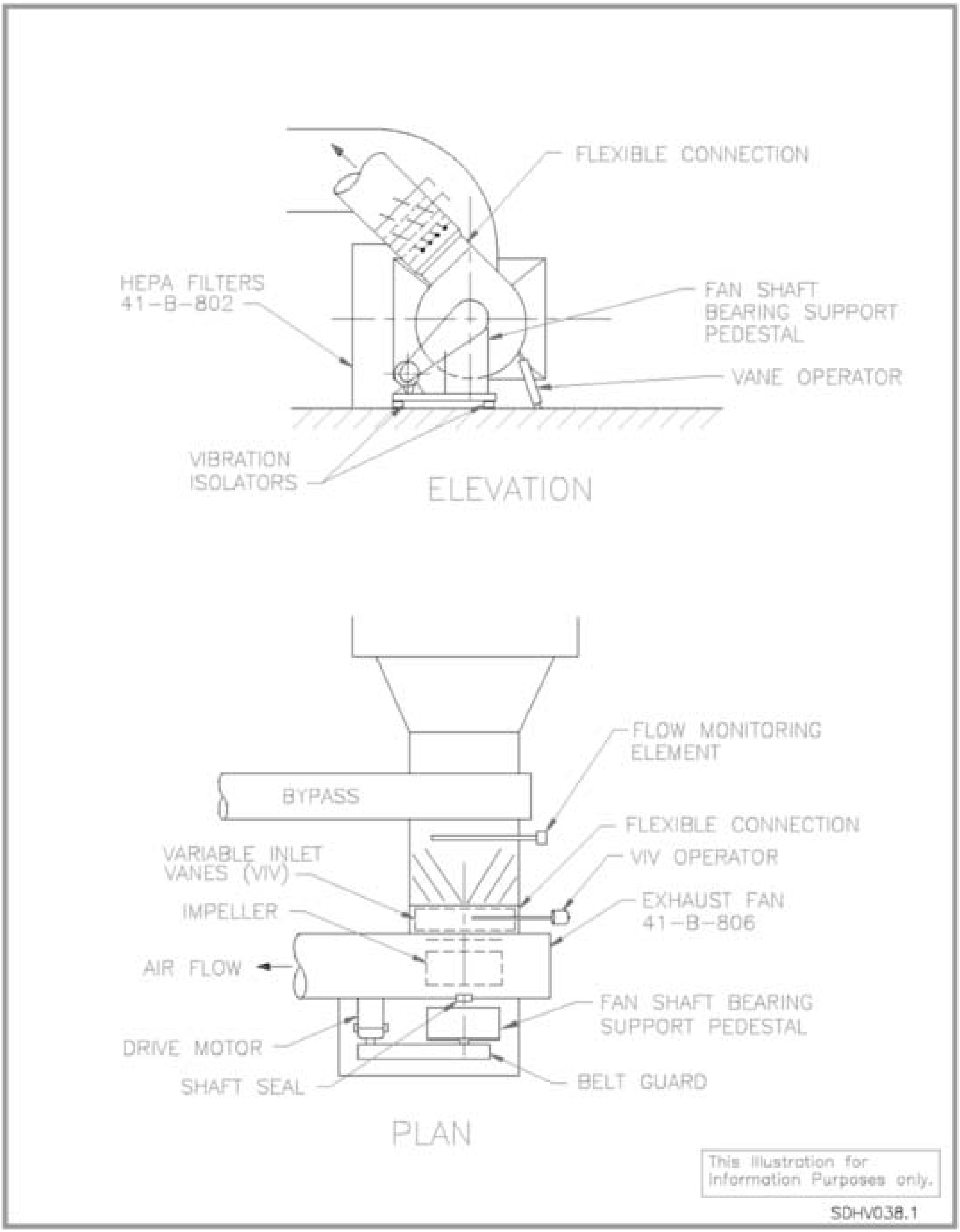
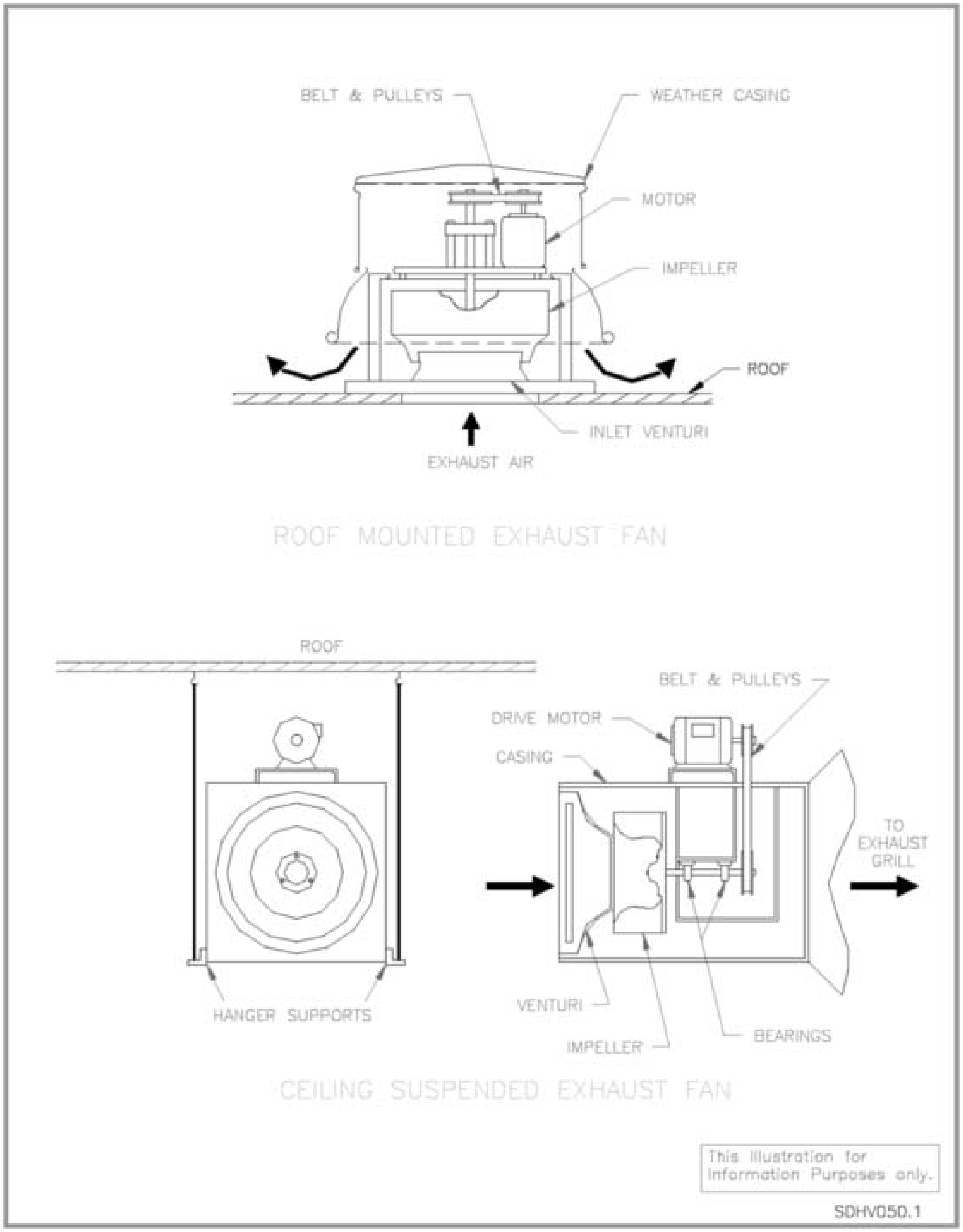


FIGURE HV G-4: Layout of Exhaust Fan



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

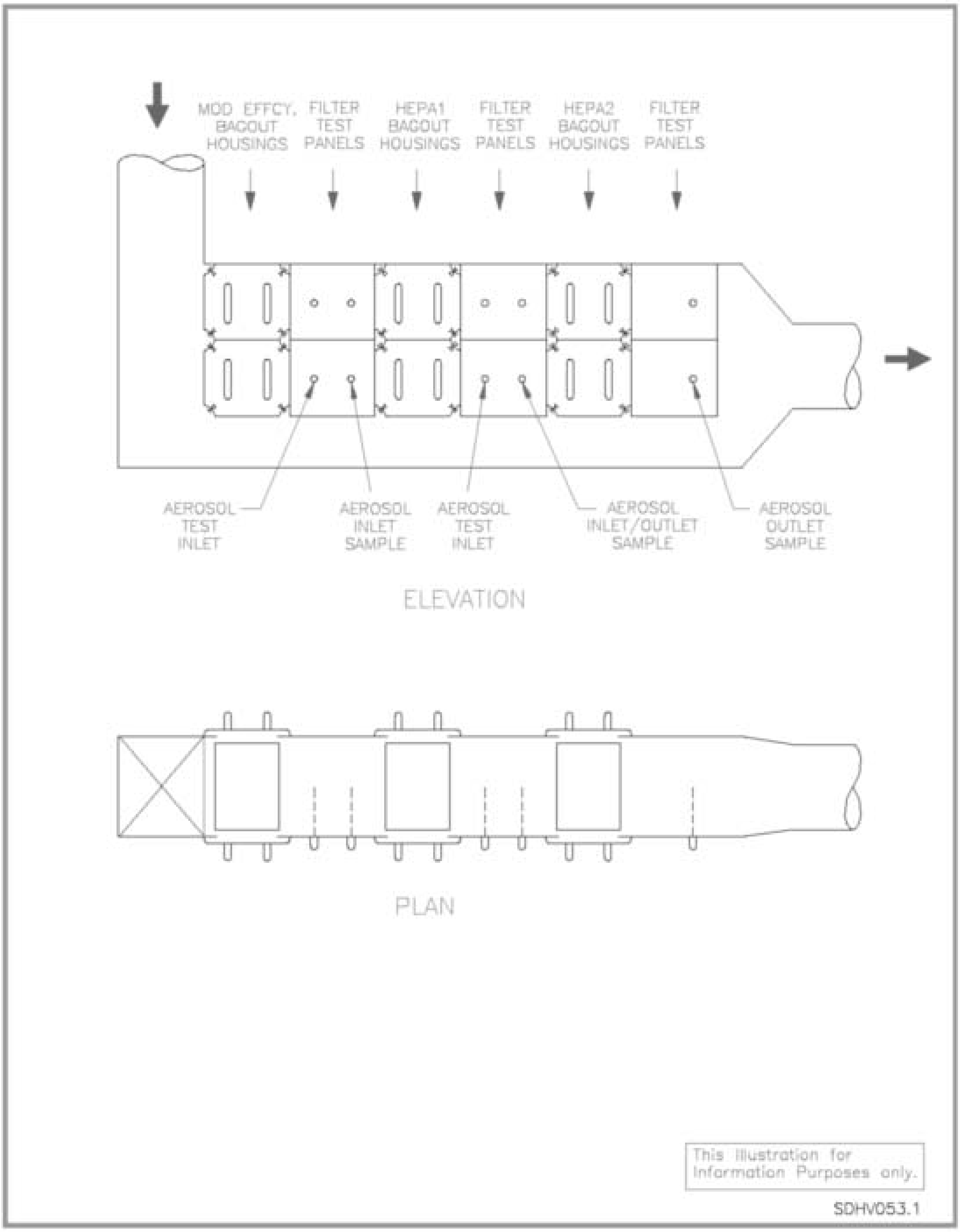


FIGURE HV G-6: Filter Assemblies Layout

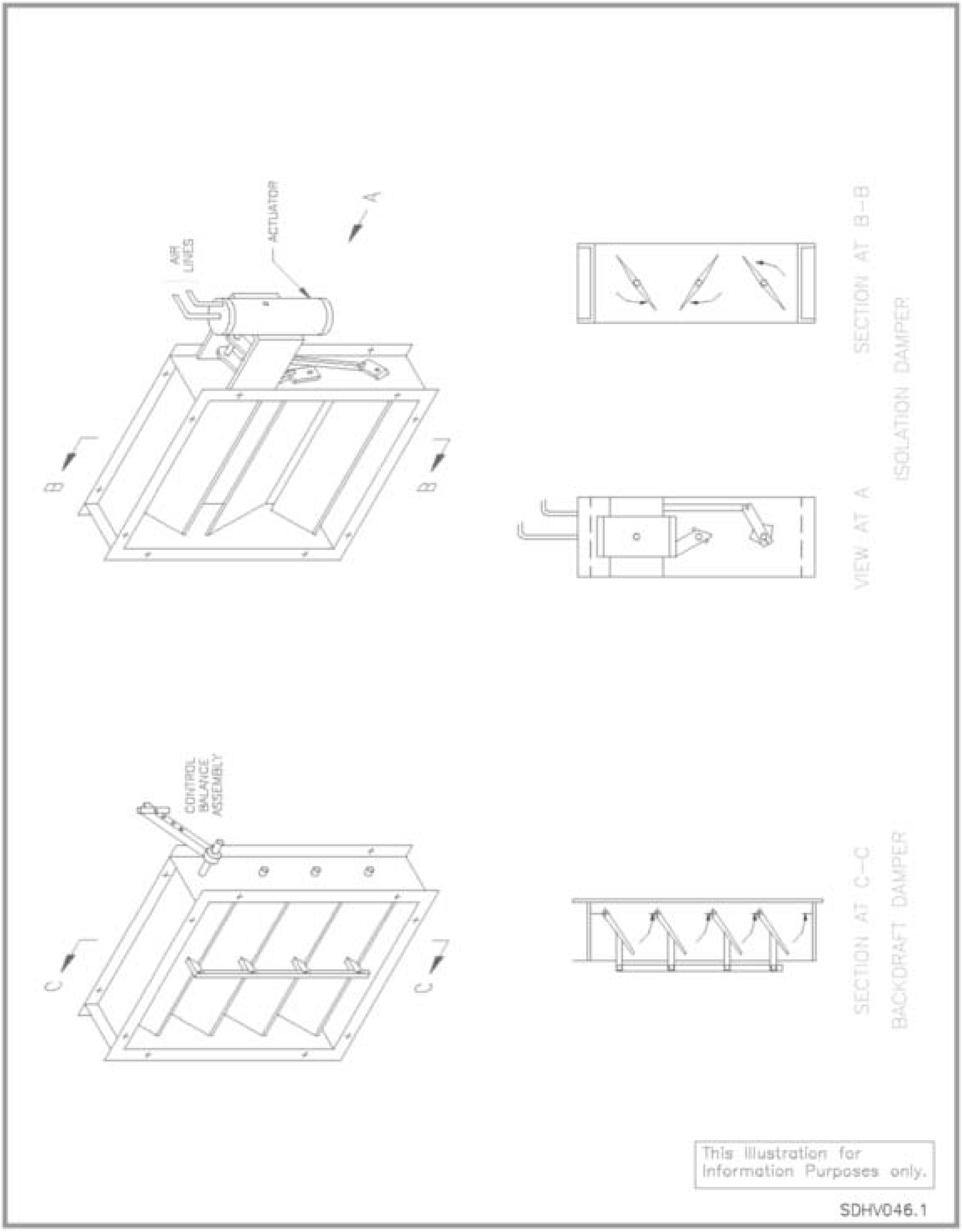


FIGURE HV G-7: HVAC Duct Dampers for Back Draft & Isolation Operation

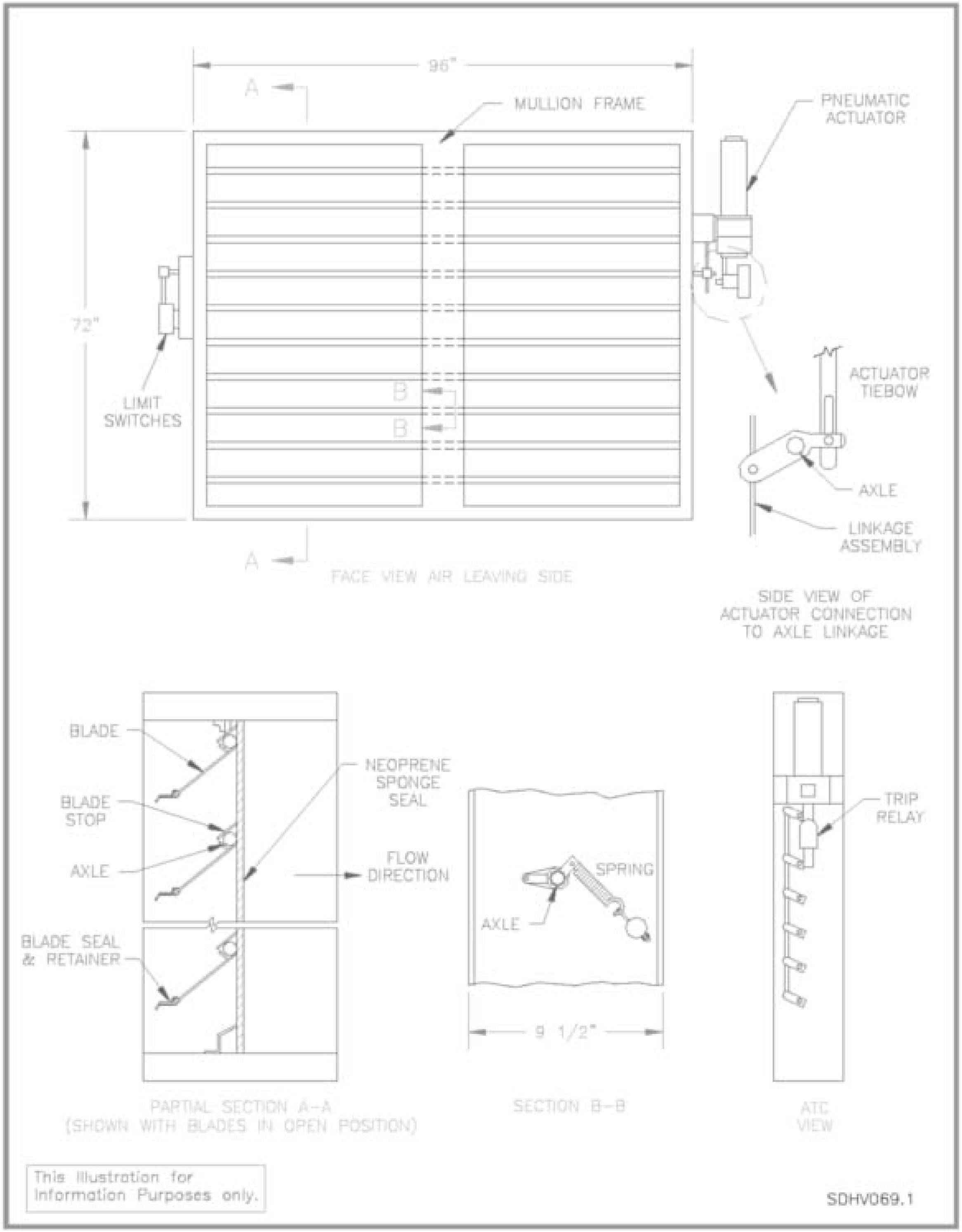


FIGURE HV G-8: WHB Exhaust Duct Tornado Damper Layout and Detail

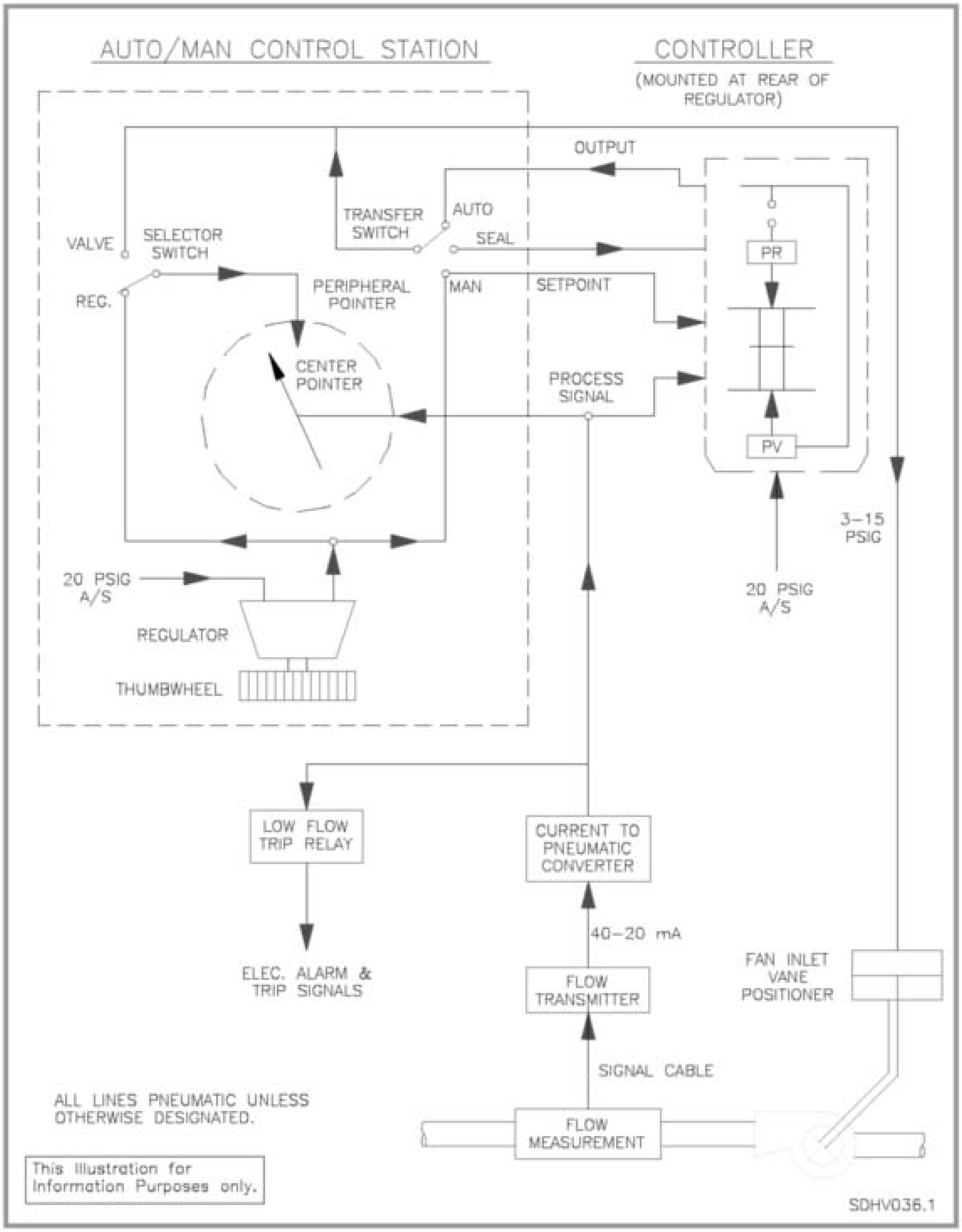


FIGURE HV G-9: Pneumatic HVAC Flow Control Block Diagram

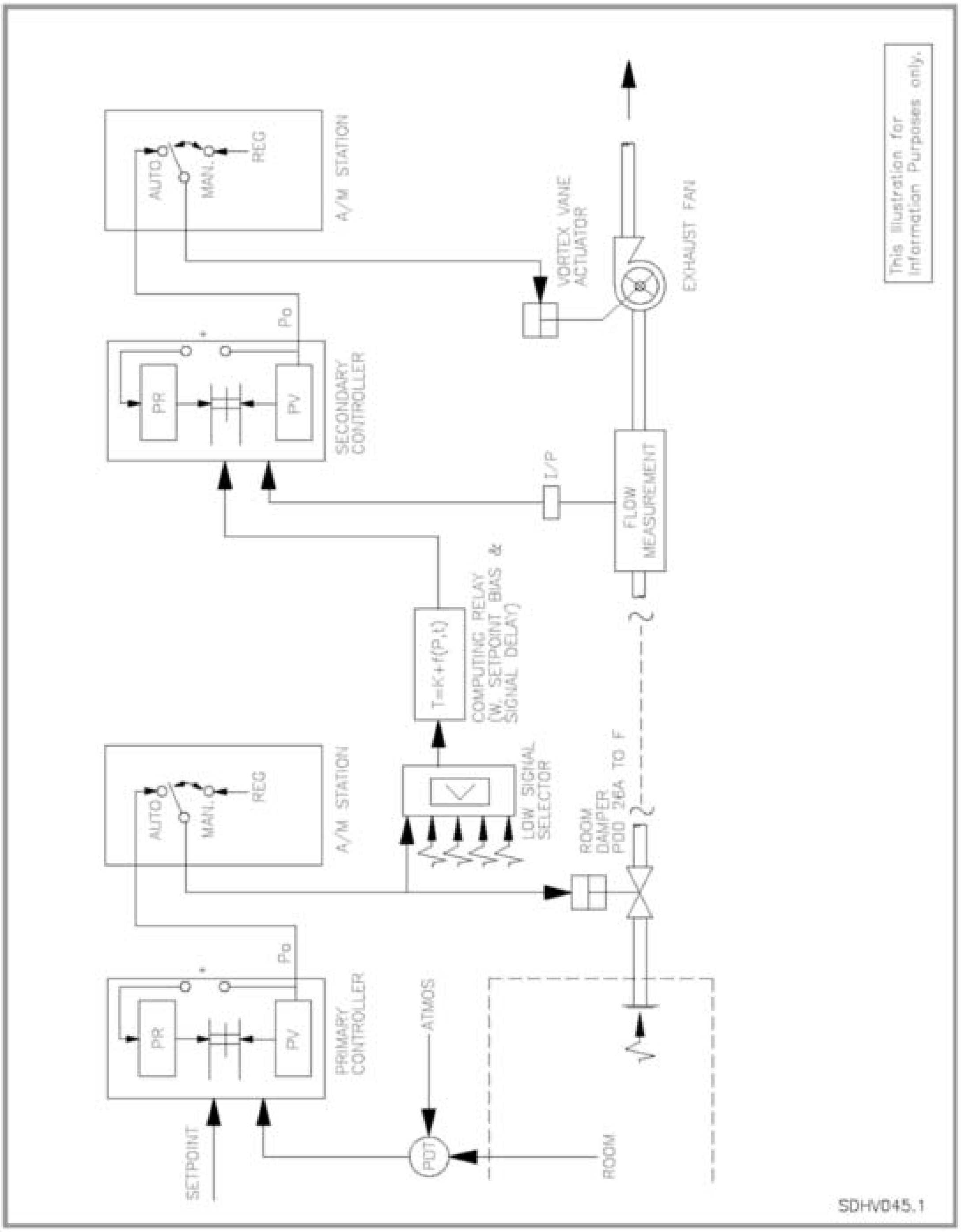


FIGURE HV G-10: Pneumatic HVAC Exhaust Fan Flow Control Block Diagram

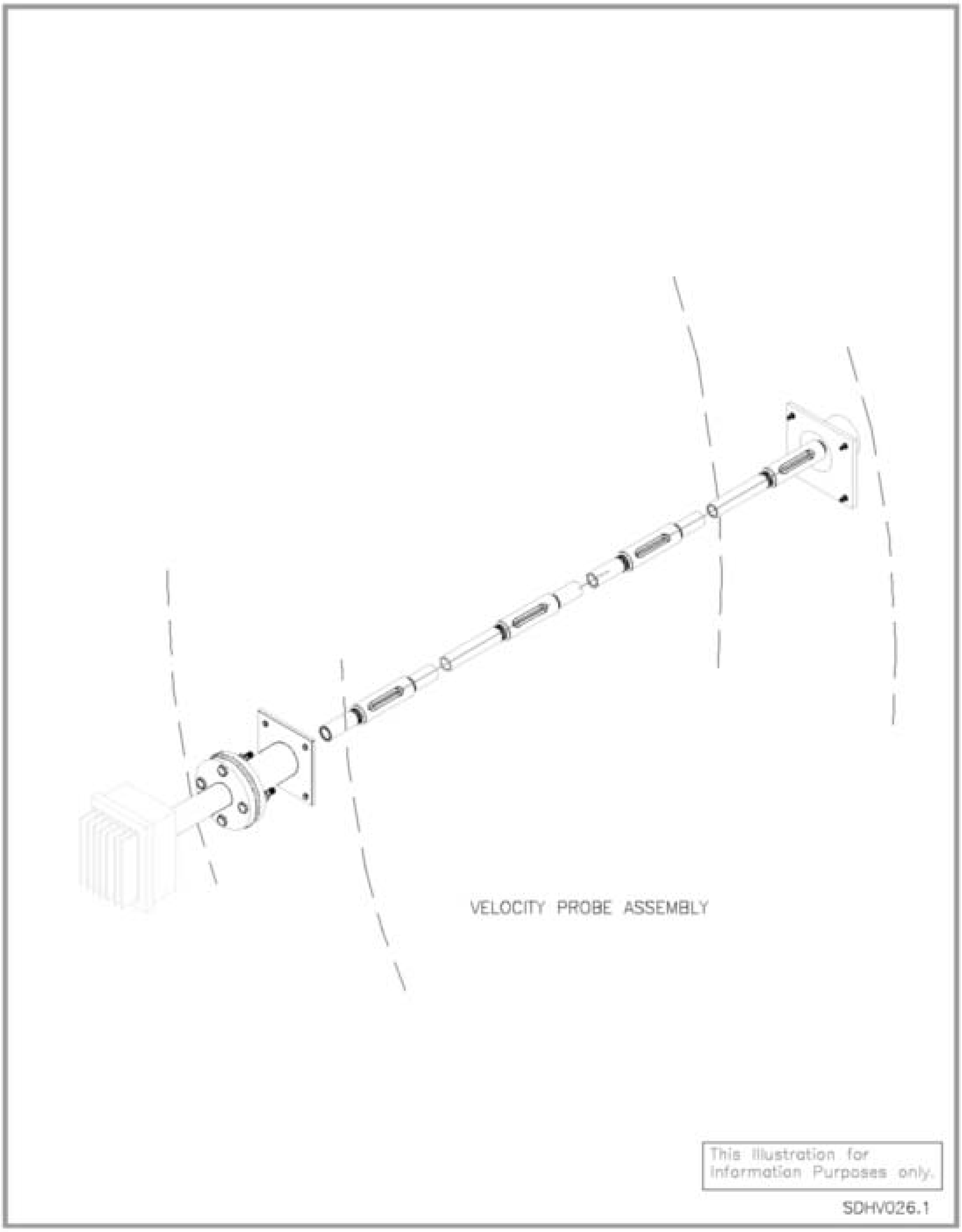


FIGURE HV G-11: Velocity Probe Assembly

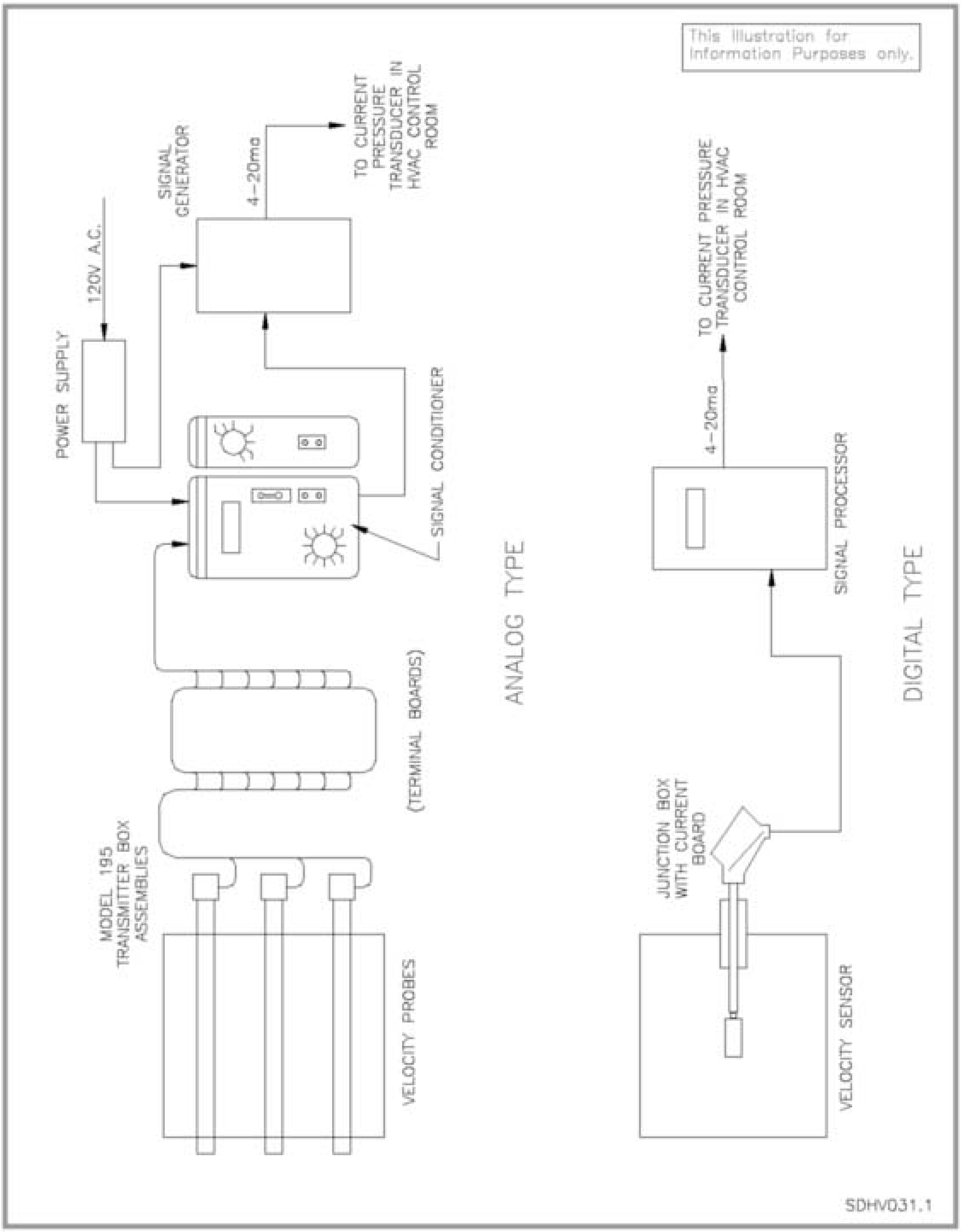


FIGURE HV G-12: HVAC Duct Flow Monitoring System Block Diagrams

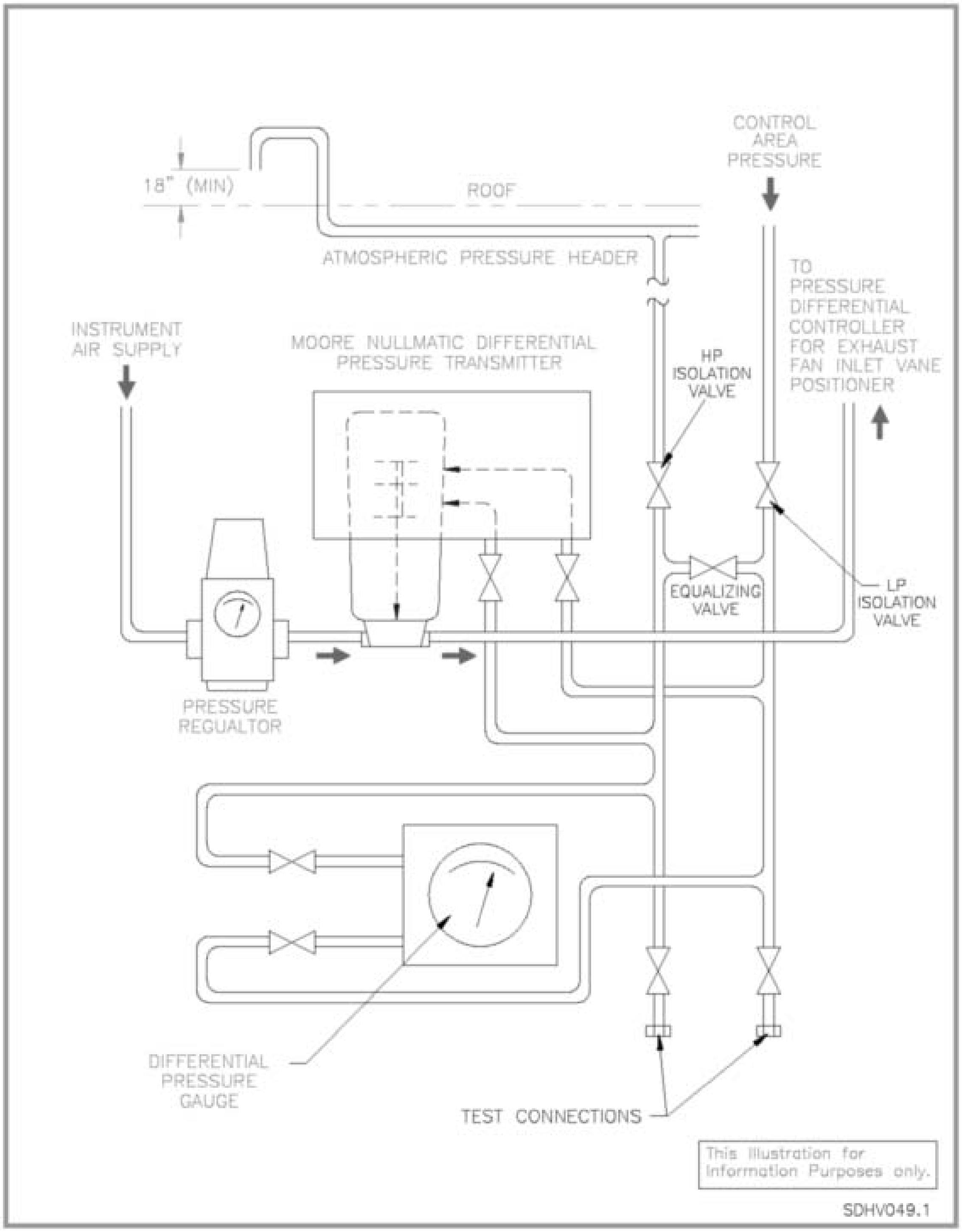


FIGURE HV G-13: Area Differential Pressure Monitor and Transmitter Unit

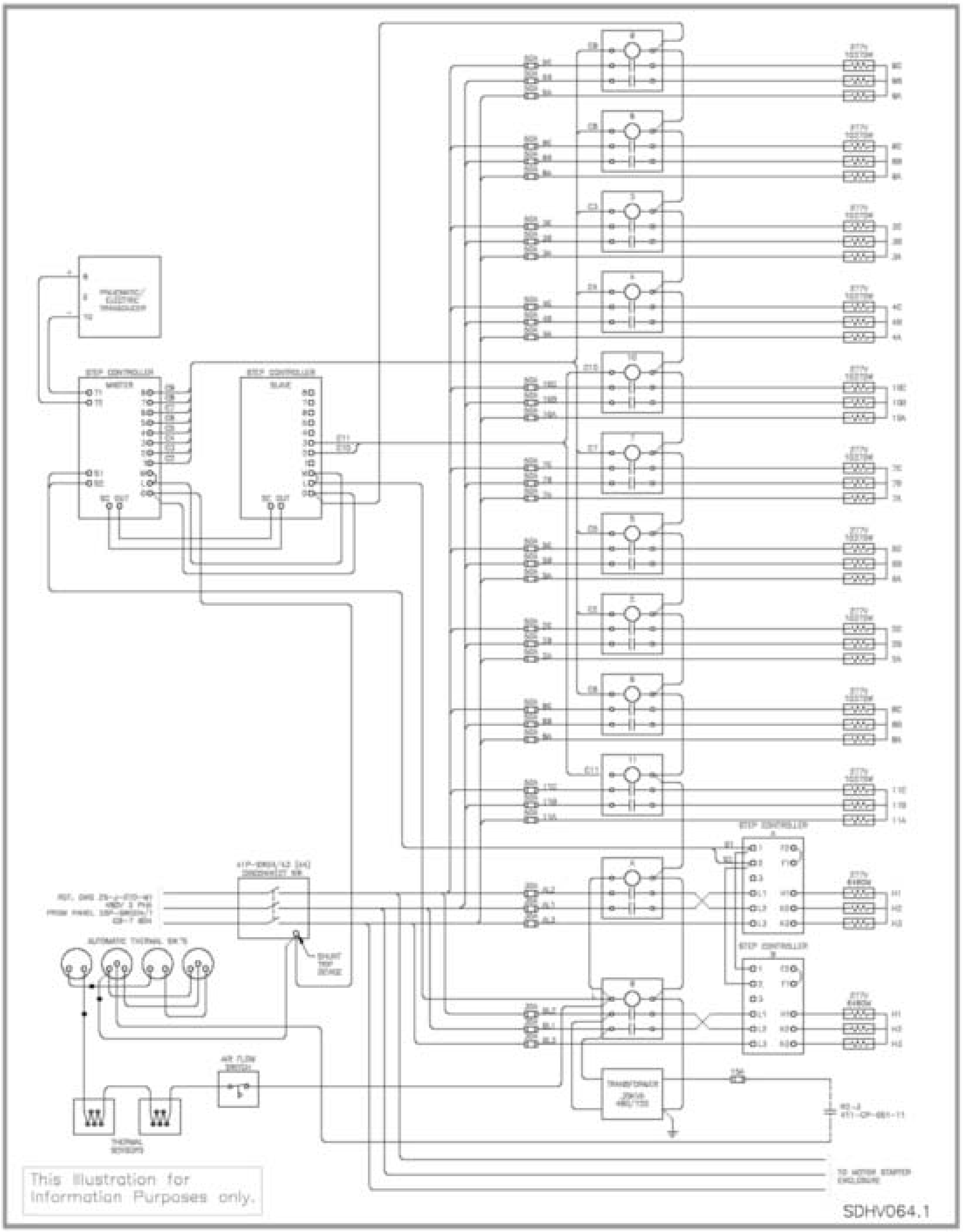


FIGURE HV G-14: AHU Electrical Heater Coil Control Circuits

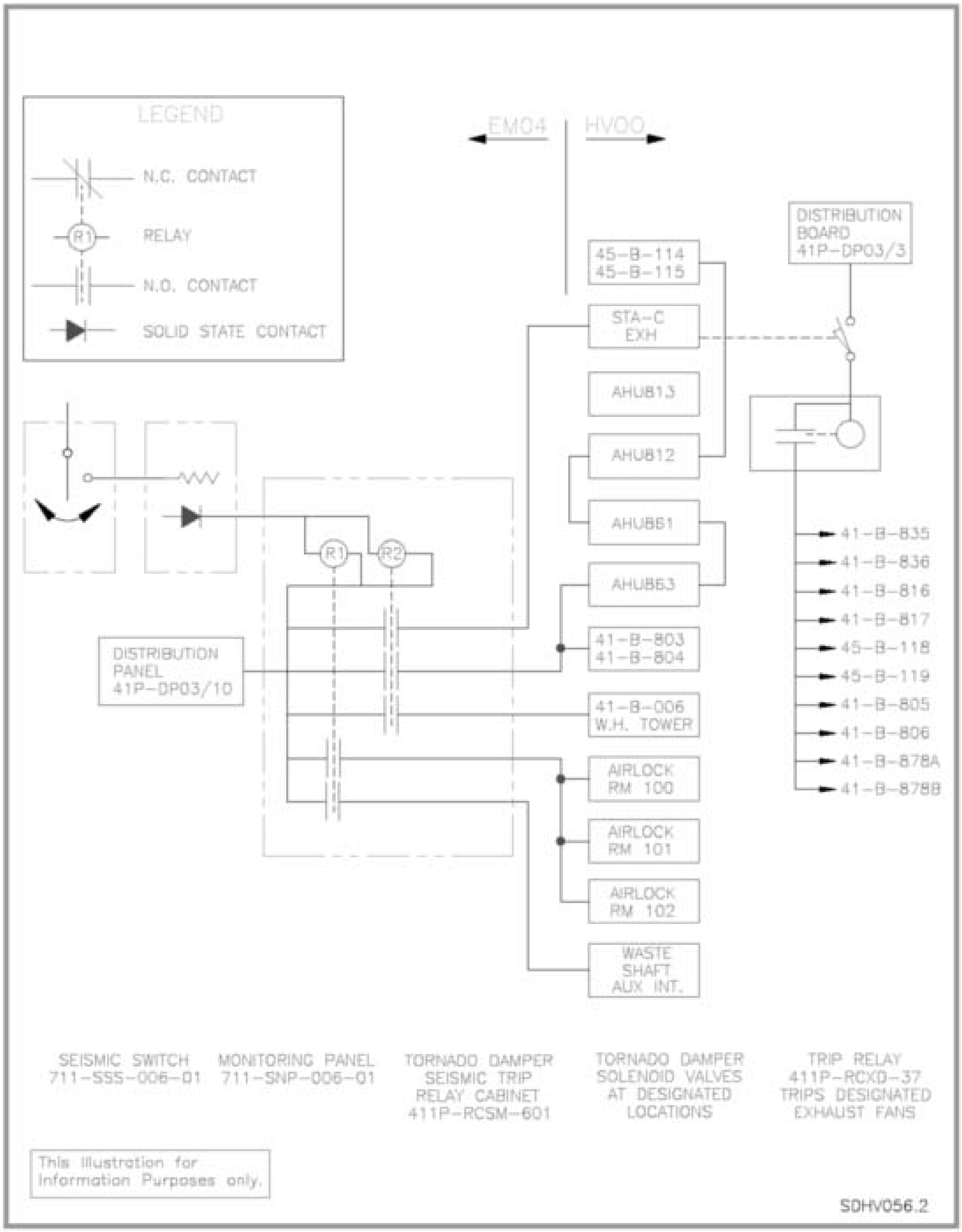


FIGURE HV G-15: Tornado Damper Seismic Trip System Block Diagram

Chapter I
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Subsystem HV01, Waste Handling Building CH Area HVAC

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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, PM041147, Flanders E5 Series Filter Replacement, is performed.

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)
    - Overpack and repair 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 inlet from the electronic flow sensors in the supply duct.

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.

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).

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
Overpack and Repair Room	-0.04

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. Overhead steel ducts carry the processed air to distribution ducting in the WHB.

- Two sets of normally closed 6' X 8' double doors, which connect room 208 to room 200, are used to remove or replace large components.

- 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

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 Control Panel (411-CP-059-20) contains the DDC module and I/O point expander which controls the static pressure in the individual rooms in the CH area, exhaust fan control manager logic, and HEPA filter bank exchange logic.

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, two-position hand switches for controlling the pump of evaporative cooler and 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	-0.1" wg	-0.02" wg	-0.01" wg
Overpack & Repair Room	-0.2" wg	-0.04" wg	-0.02" 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	-0.10" wg
Site Generated Waste Room	-0.15" wg
Small Equipment Decon Room	-0.20" wg
Overpack and Repair Room	-0.20" 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, which activates the evaporative cooler.

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.

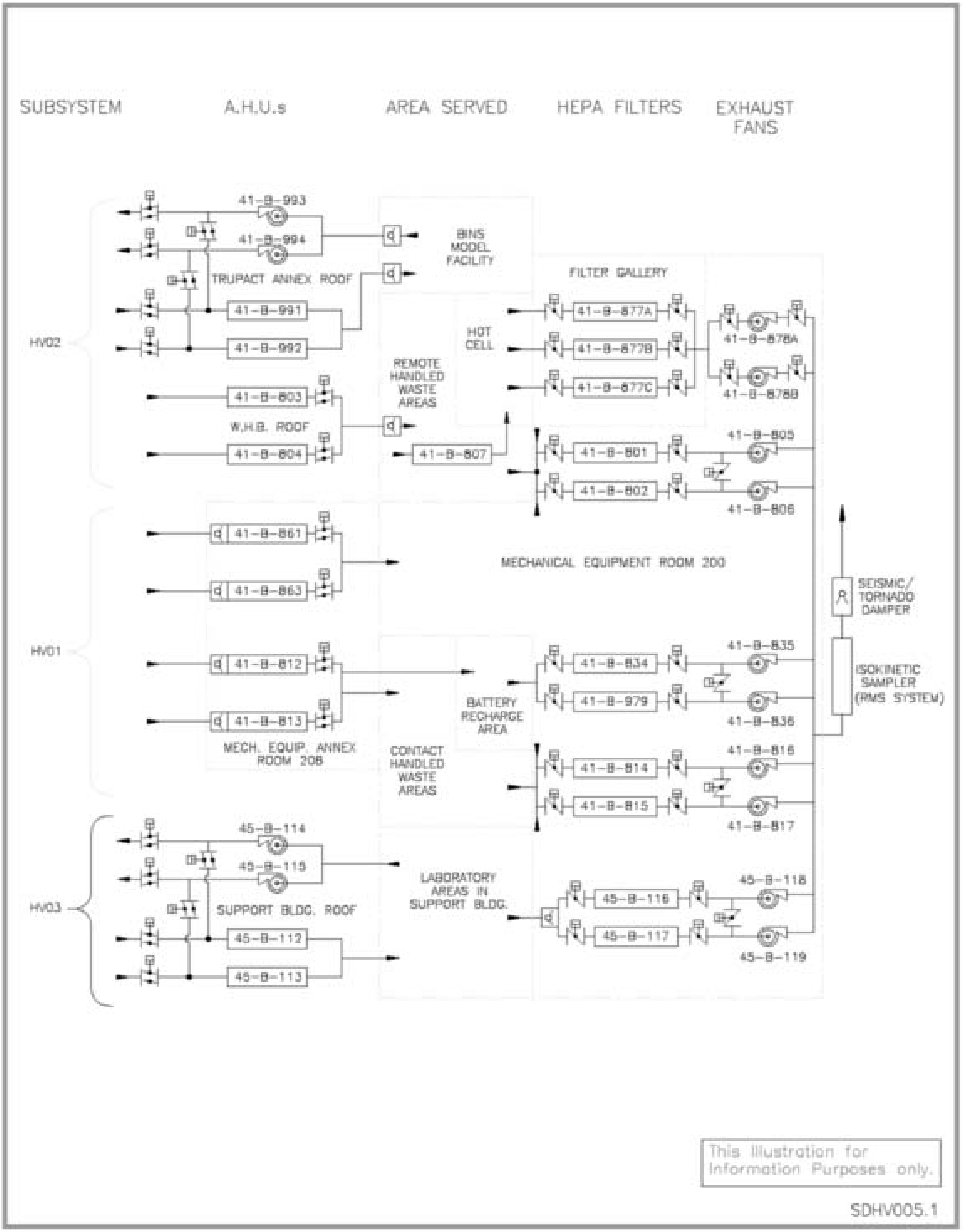

FIGURE HV I-1: HVAC Equipment Configuration in Surface Waste Handling Facility

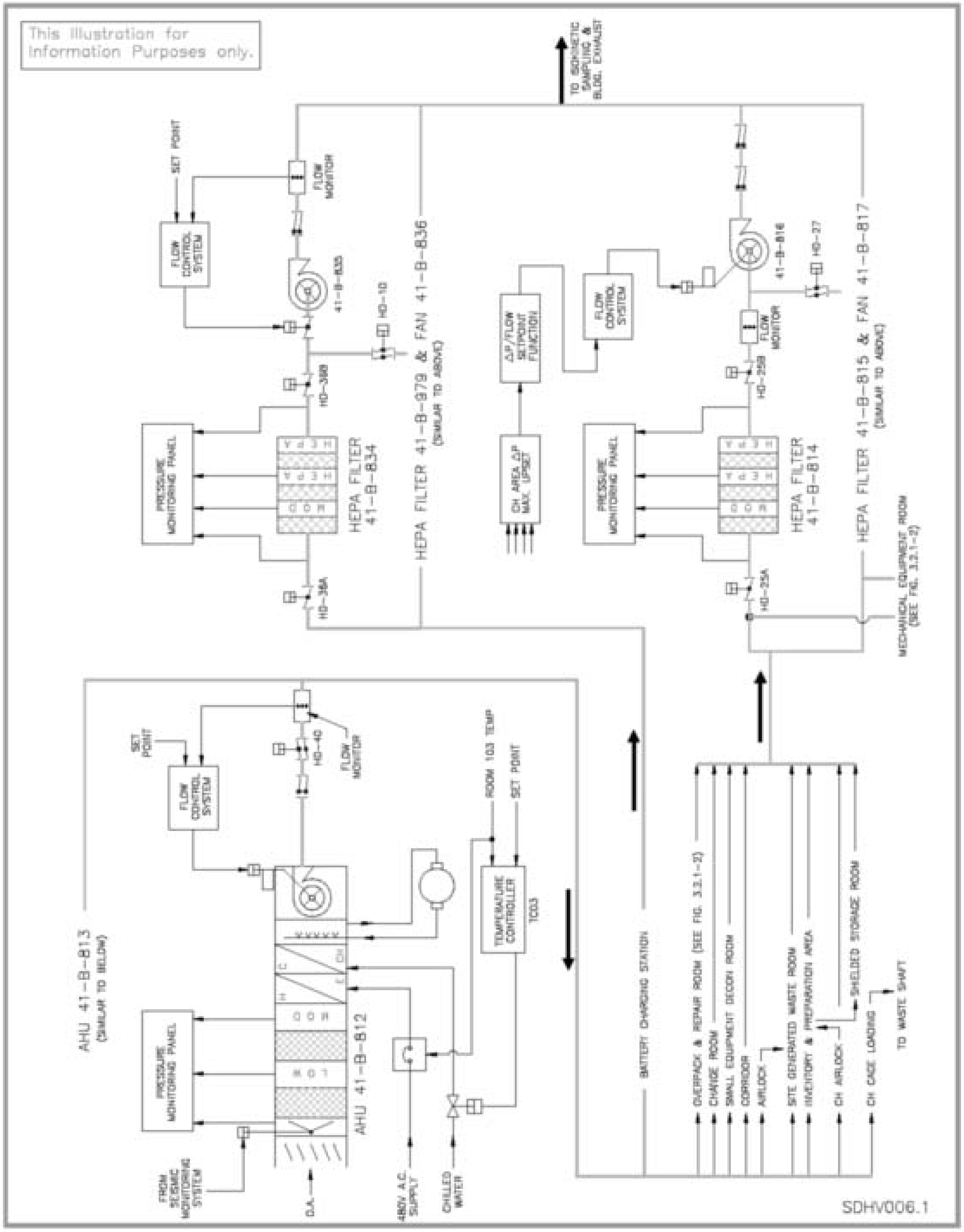

FIGURE HV I-2: Subsystem HV01 CH Area HVAC Block Diagram

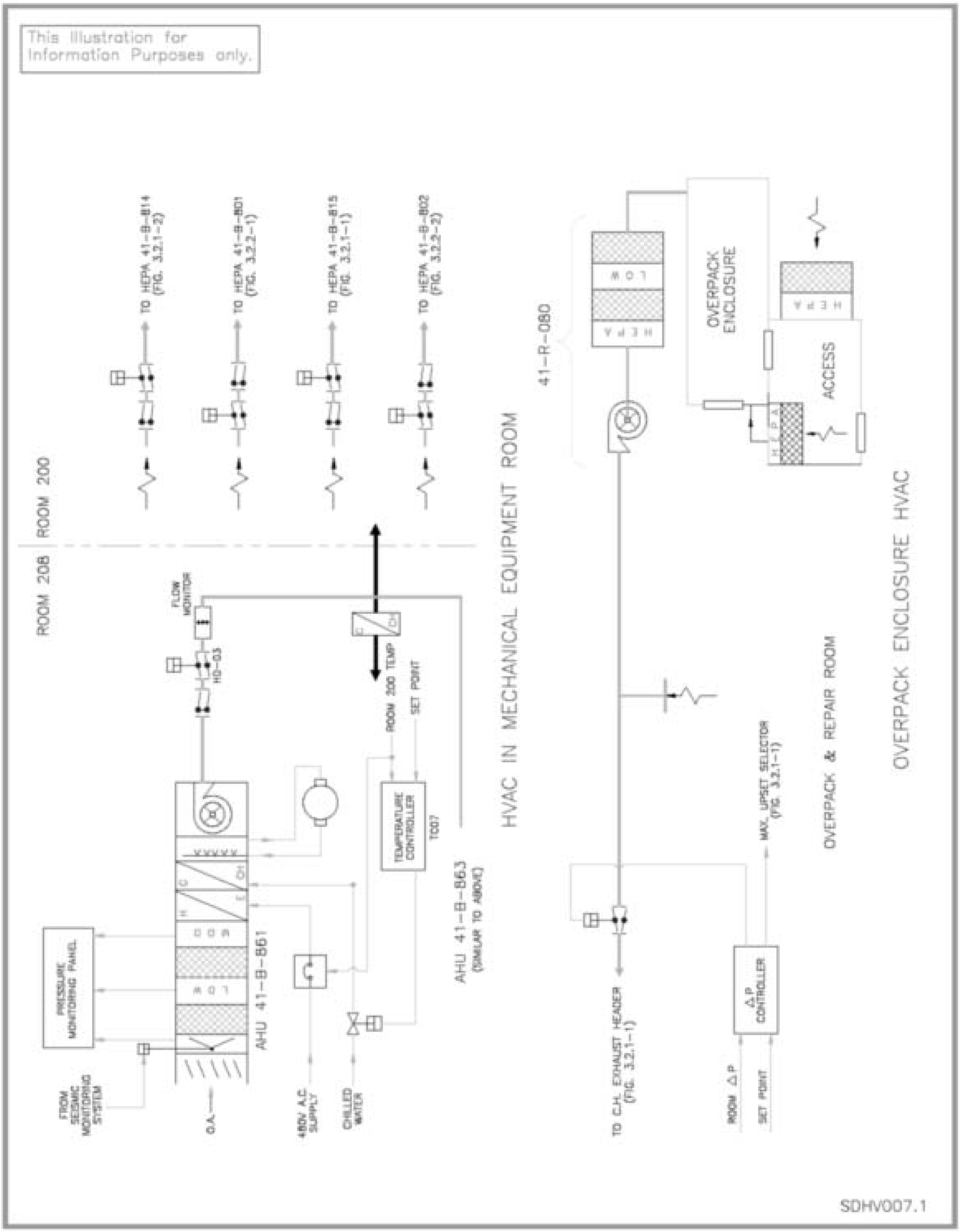

FIGURE HV I-3: HVAC in Mechanical Equipment Room & Overpack Enclosure

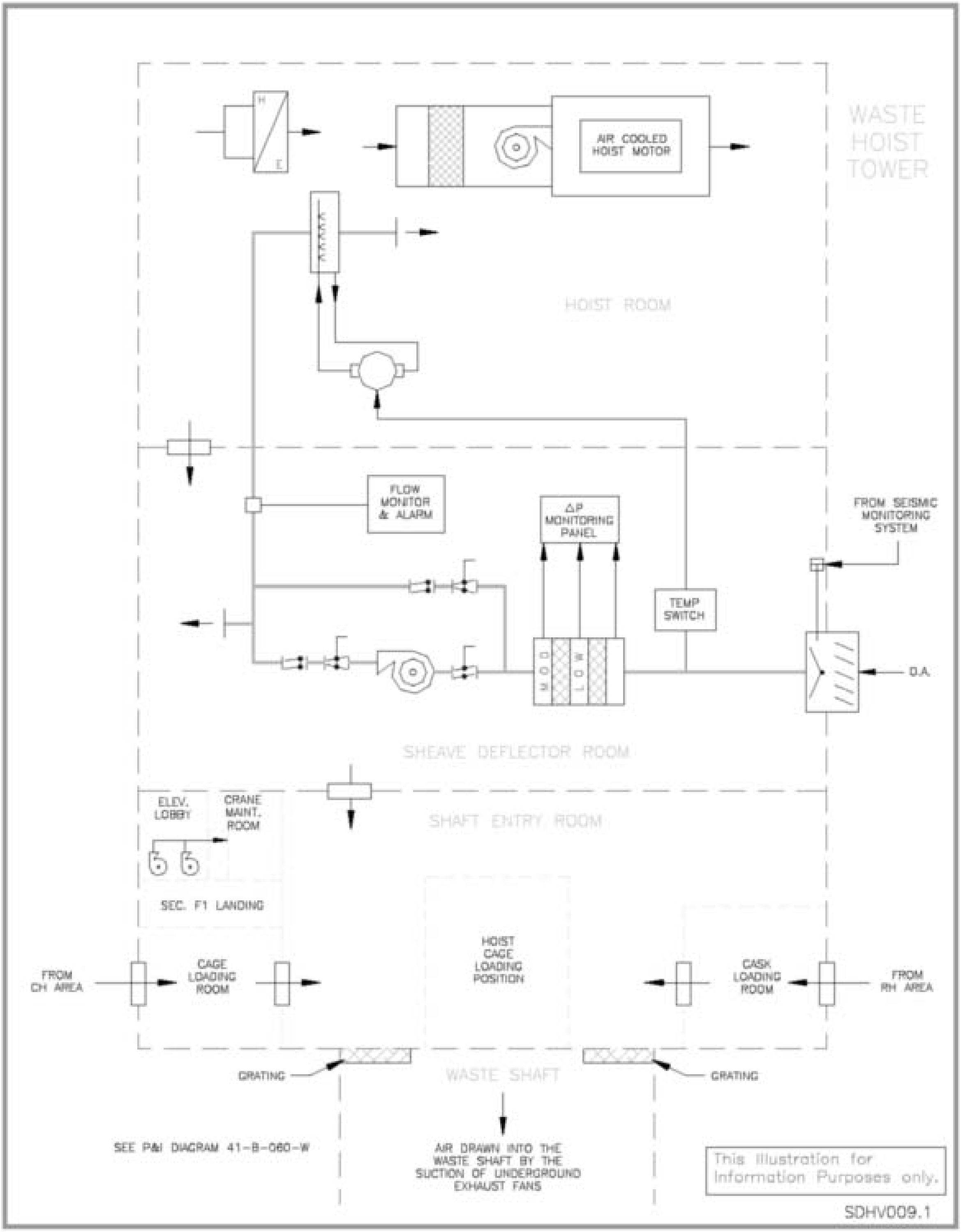

FIGURE HV I-4: Subsystem HV01 Waste Hoist Tower HVAC Block Diagram

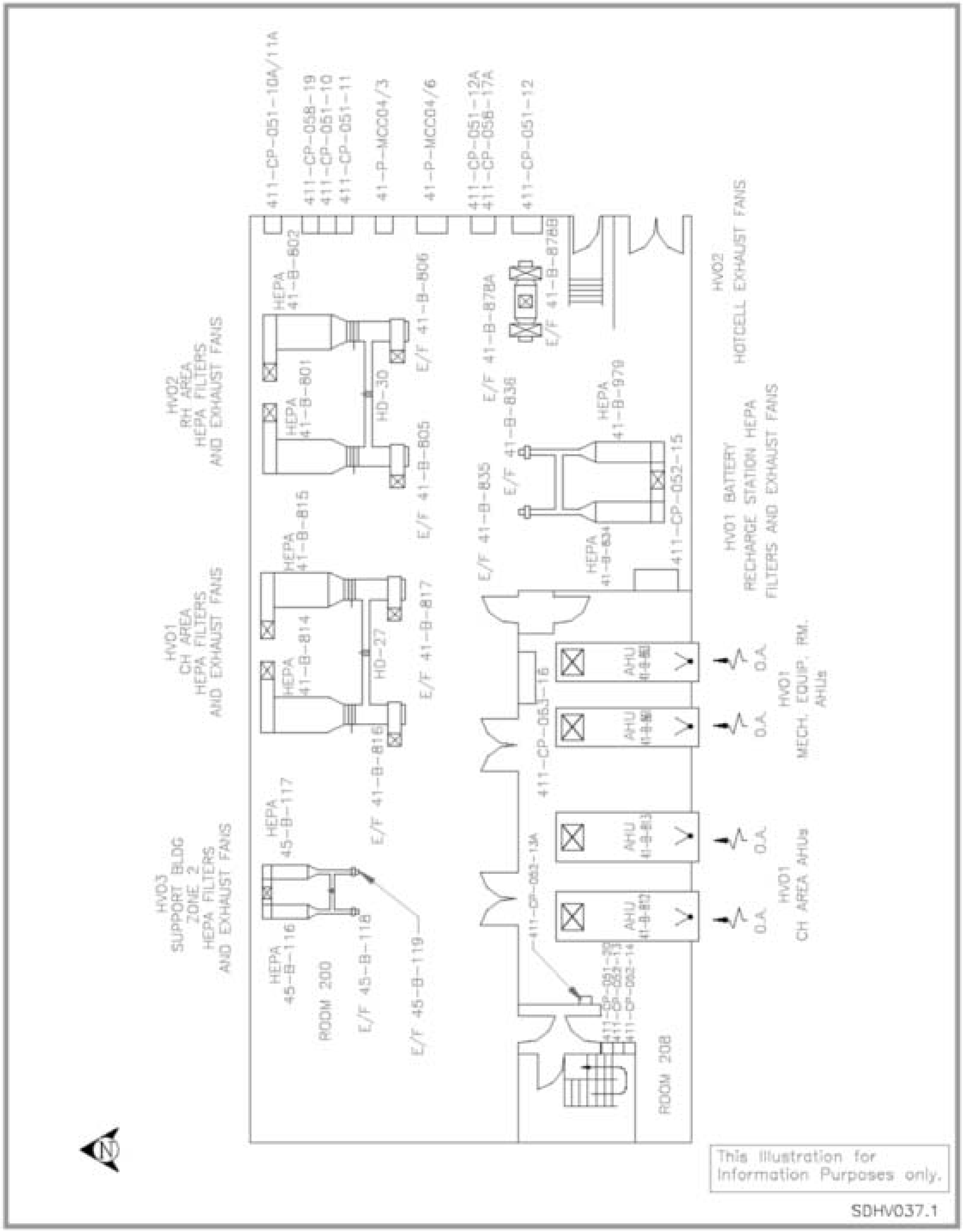

FIGURE HV I-5: Layout of HV01, HV02 & HV03 Components in the Mechanical Equipment Room

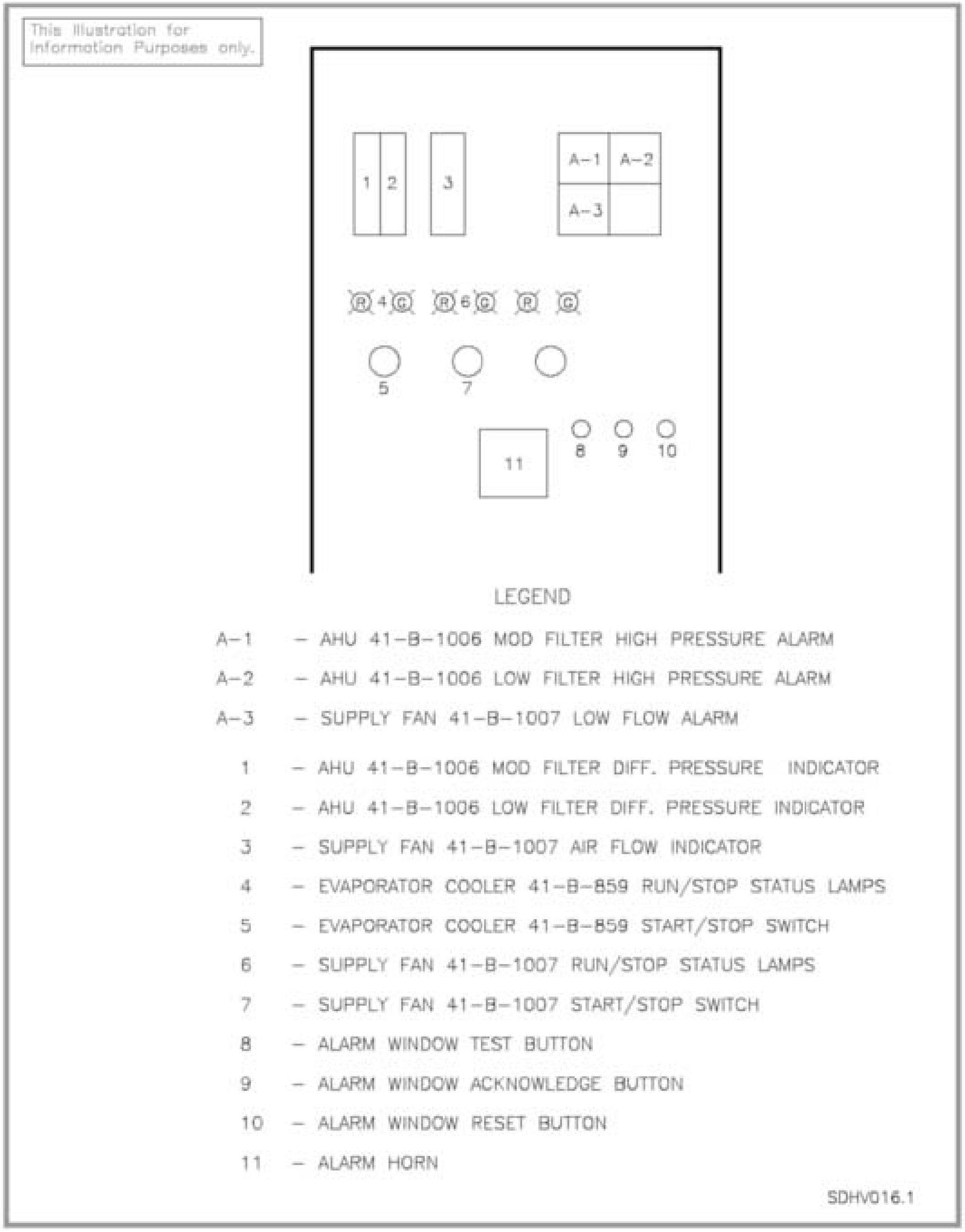

FIGURE HV I-6: Hoist Room HVAC Control Panel 411-CP-060-18 Layout

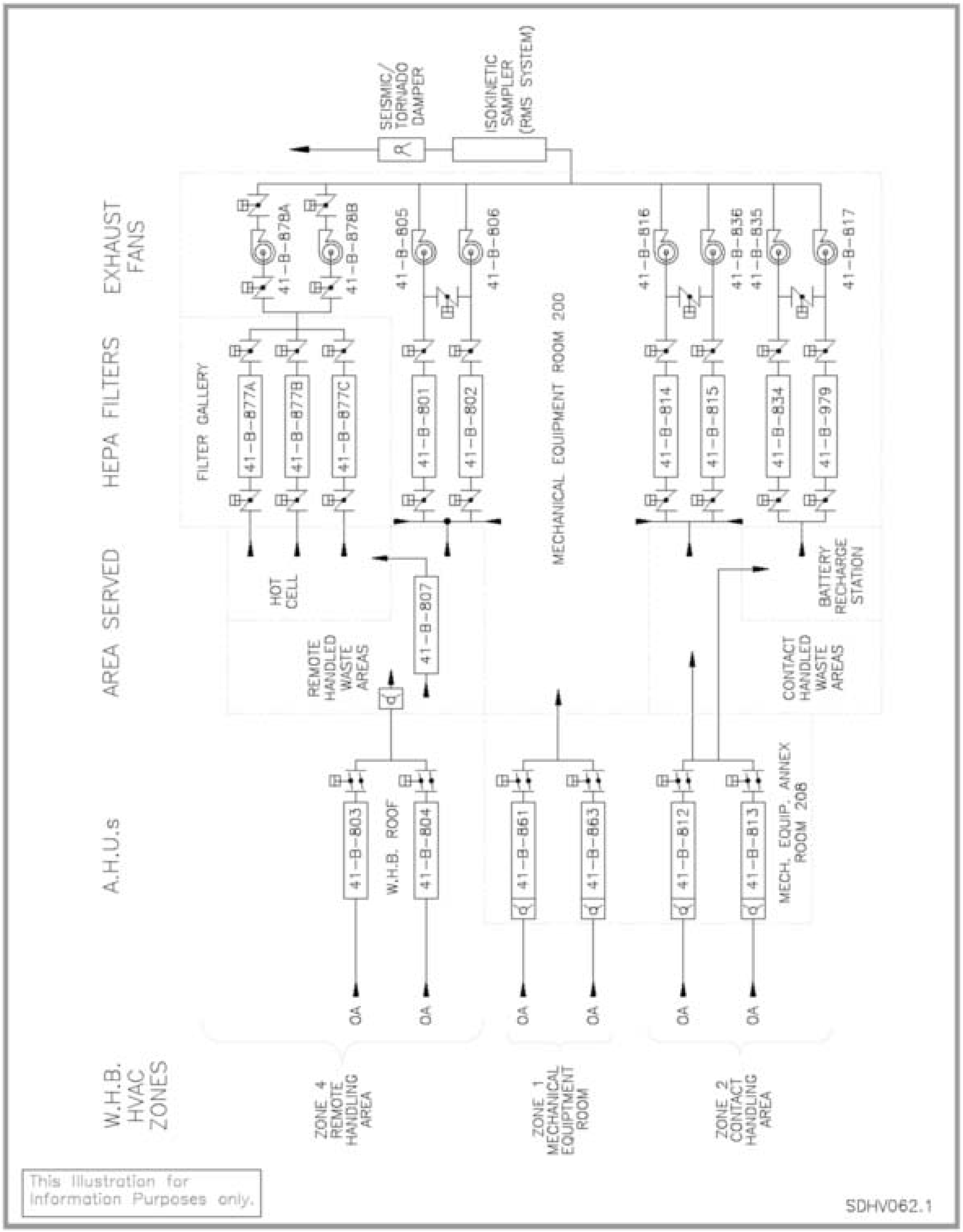

FIGURE HV I-7: Operating Zones in WHB HVAC Systems

Chapter II

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Subsystem HV02 Waste Handling Building RH Area HVAC

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Chapter II

Subsystem HV02, Waste Handling Building RH 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 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, PM041147, Flanders E5 Series Filter Replacement is performed.

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, 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.

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 exhaust fans are controlled as described in the previous section. The air is discharged from the exhaust fans 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).

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. 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.
- An AHU supply fan can only be started if a corresponding exhaust fan is operating.
- 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 will start the AHU and supply conditioned air to the hot cell.
- If the hot cell AHU is de-energized, a bypass damper automatically opens allowing air from the cask receiving area to be drawn directly into the hot cell.
- 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 consists of the fume hood (part of WH03 system), 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	Probes	Elements	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.

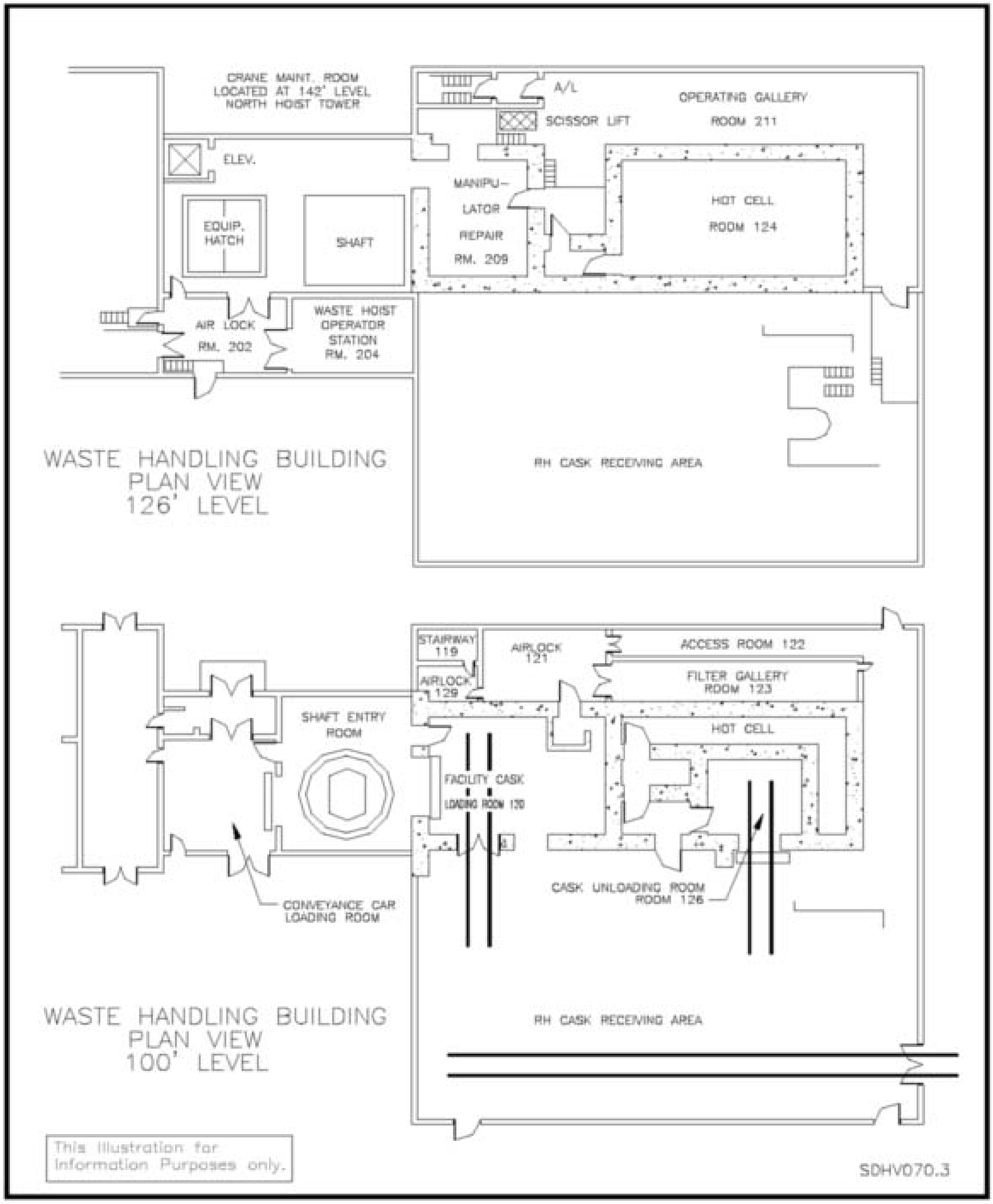

FIGURE HV II-1: Location of RH Areas Served by HV02 HVAC

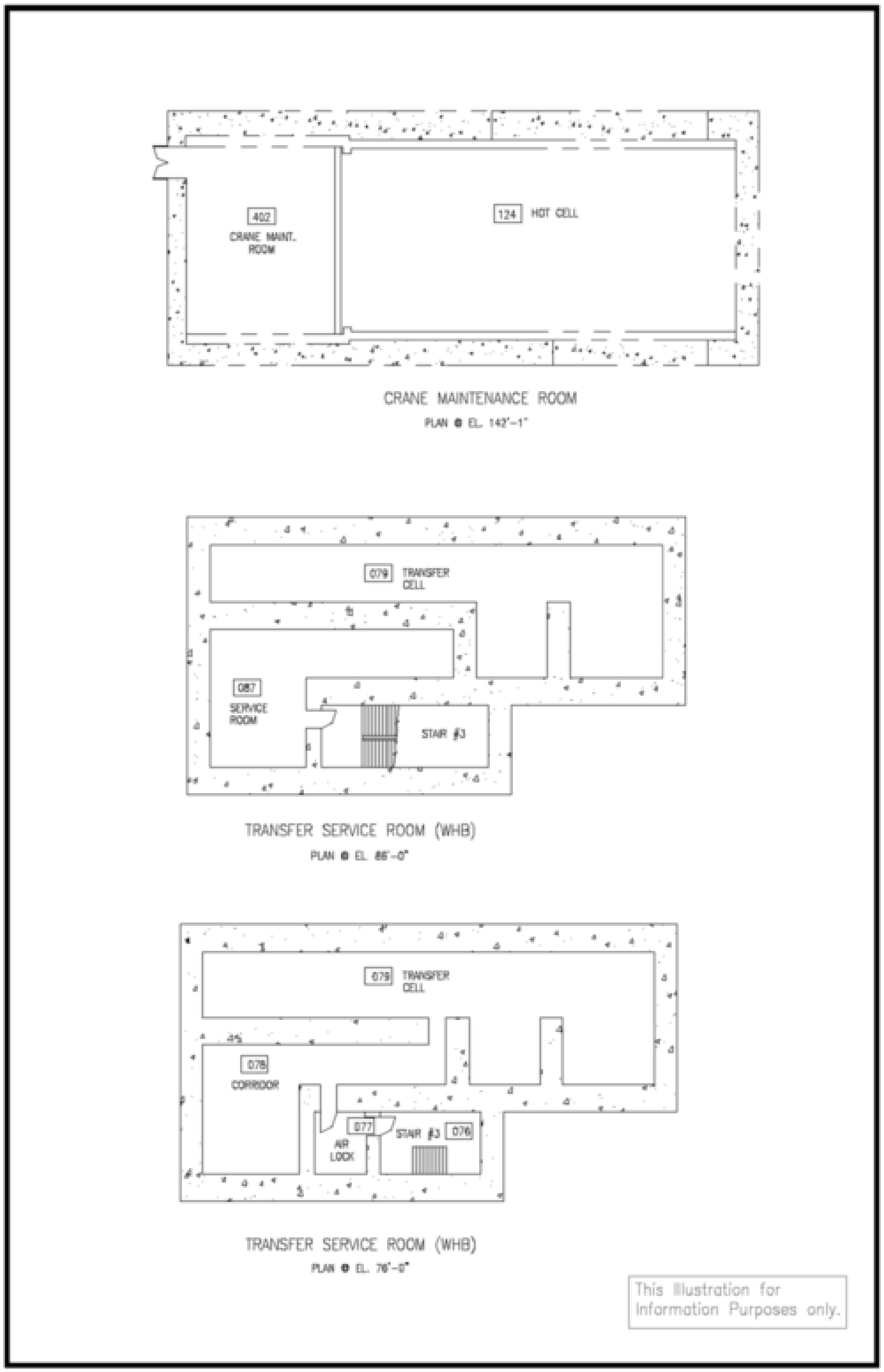

FIGURE HV II-2: Location of RH Areas Served by HV02 HVAC (Cont'd)

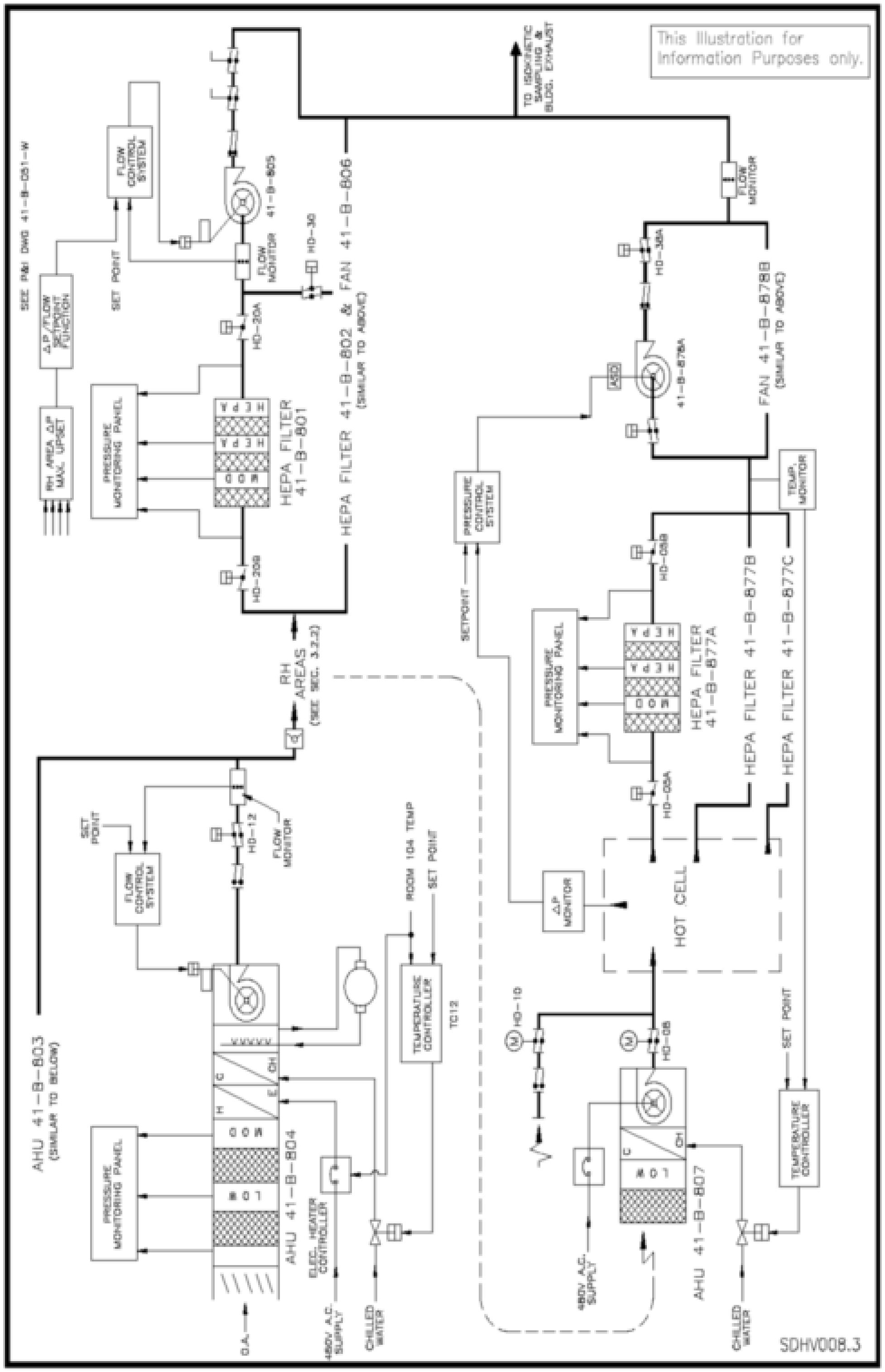

FIGURE HV II-3: Subsystem HV02 RH Areas Block Diagram

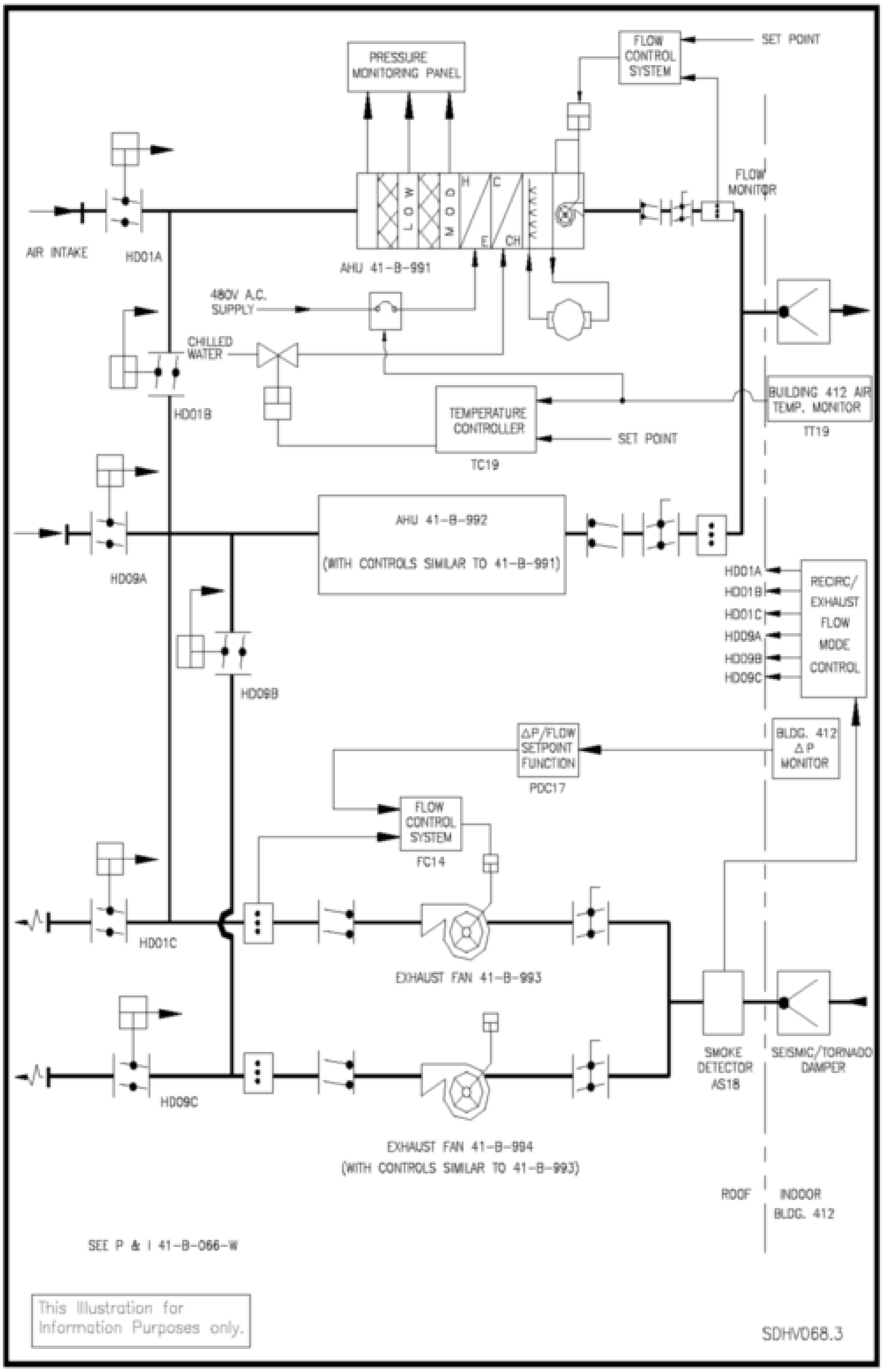

FIGURE HV II-4: Subsystem HV02 TRUPACT Maintenance HVAC Block Diagram

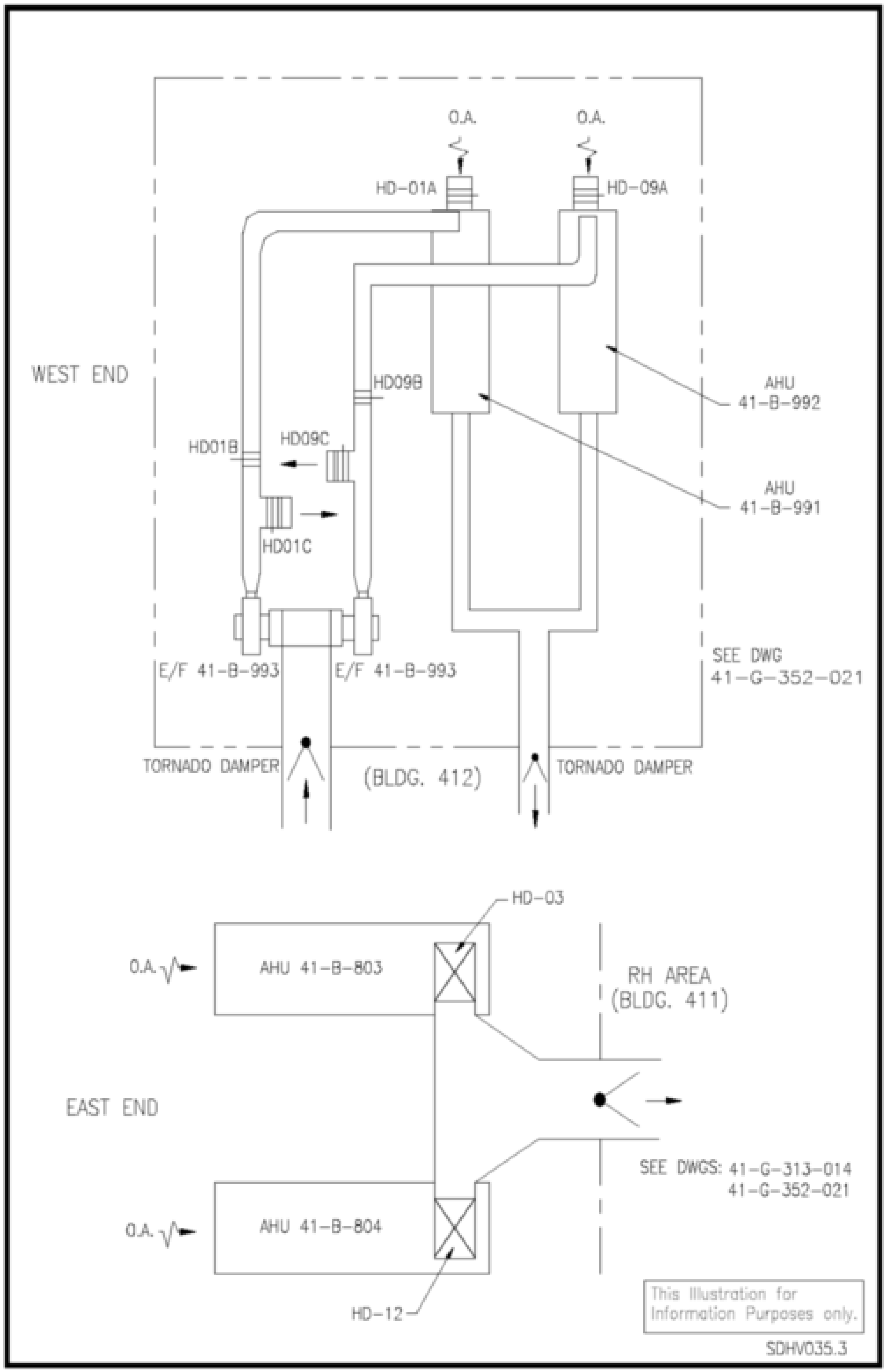

FIGURE HV II-5: Roof Layout of HV02 Components

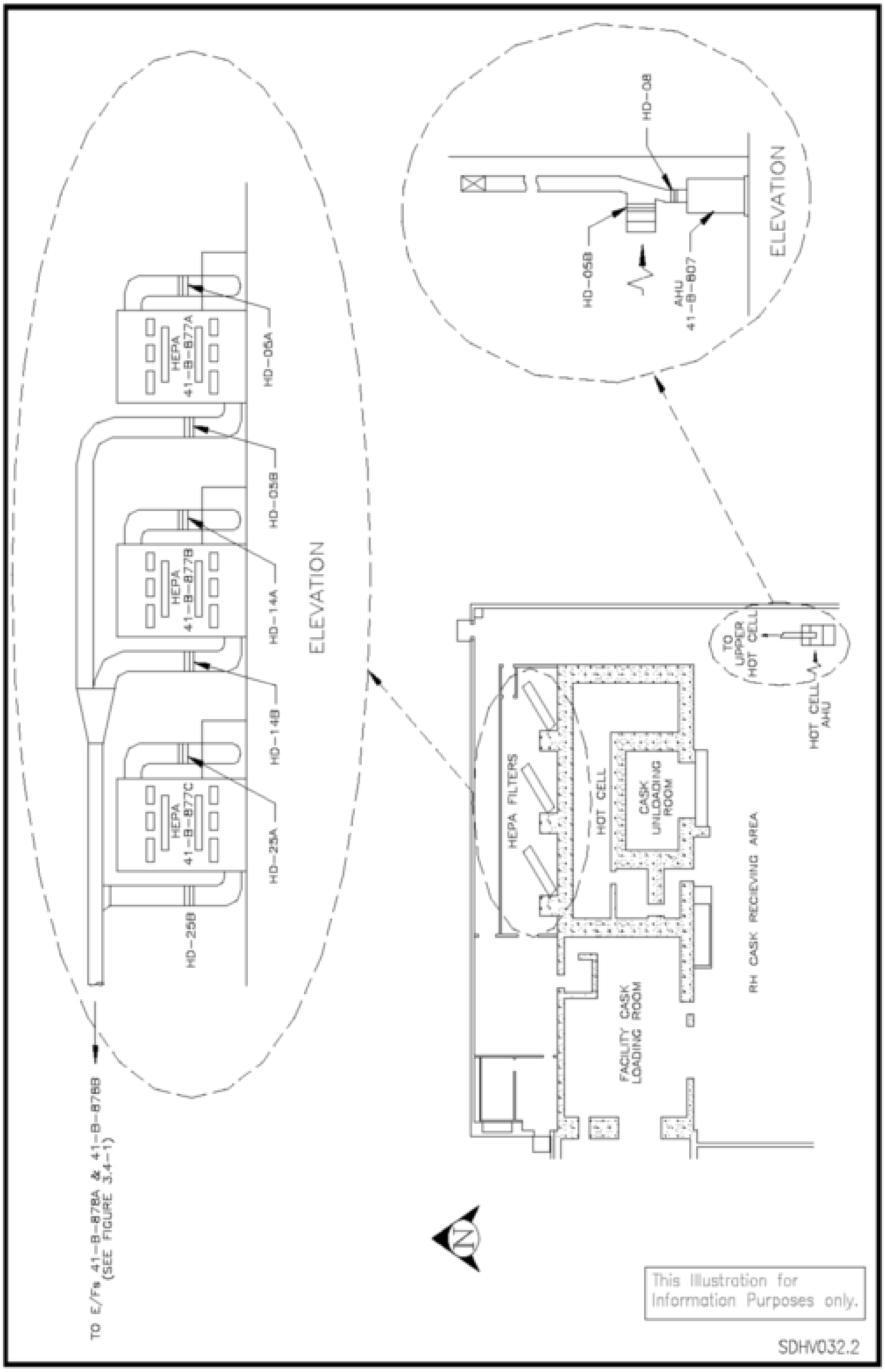

FIGURE HV II-6: Layout of HV02 Hot Cell HVAC Components at the WHB 100' Level

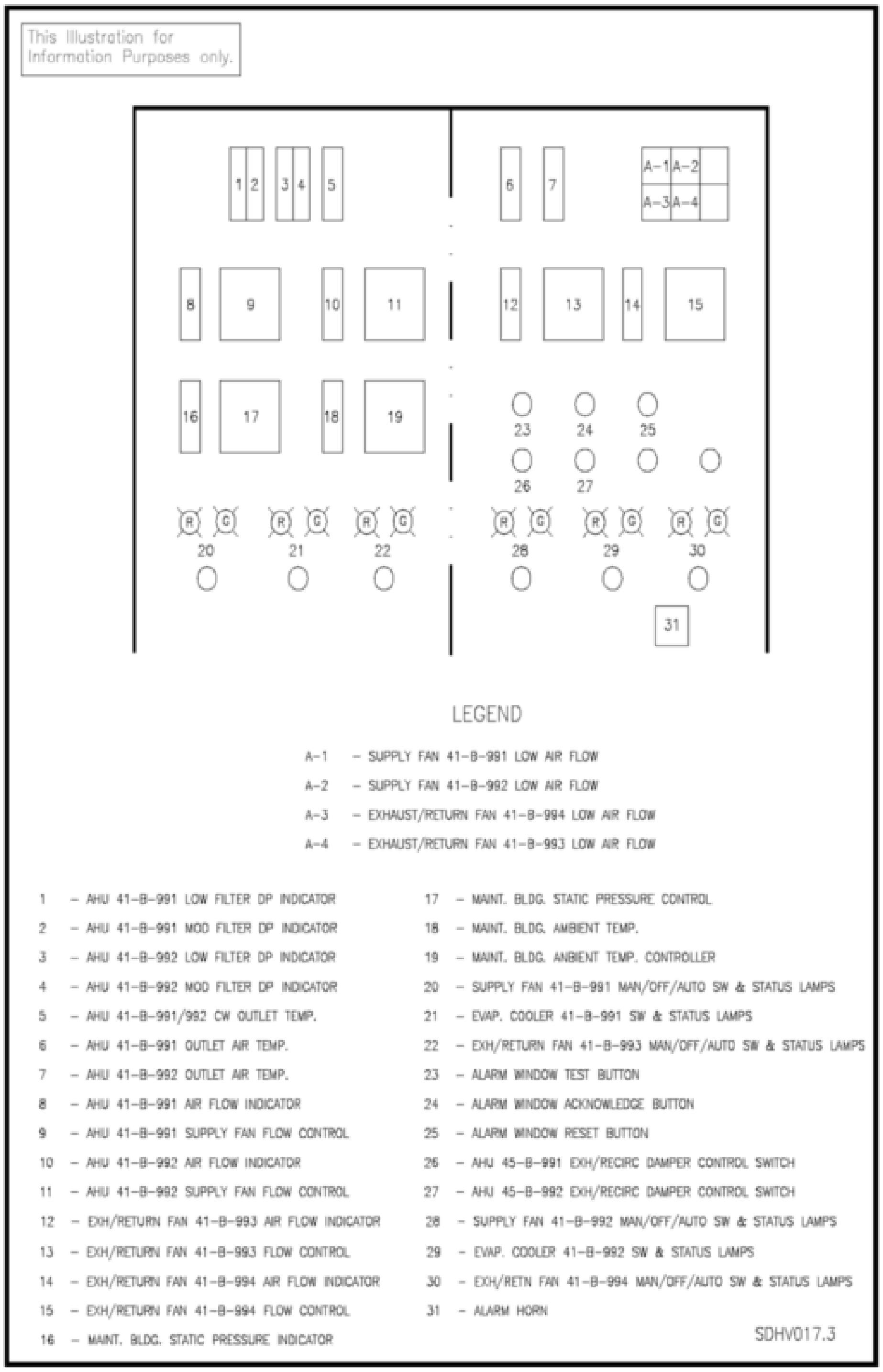

FIGURE HV II-7: TRUPACT Maintenance Facilities HVAC Control Panel 412-CP-066-01 Layout

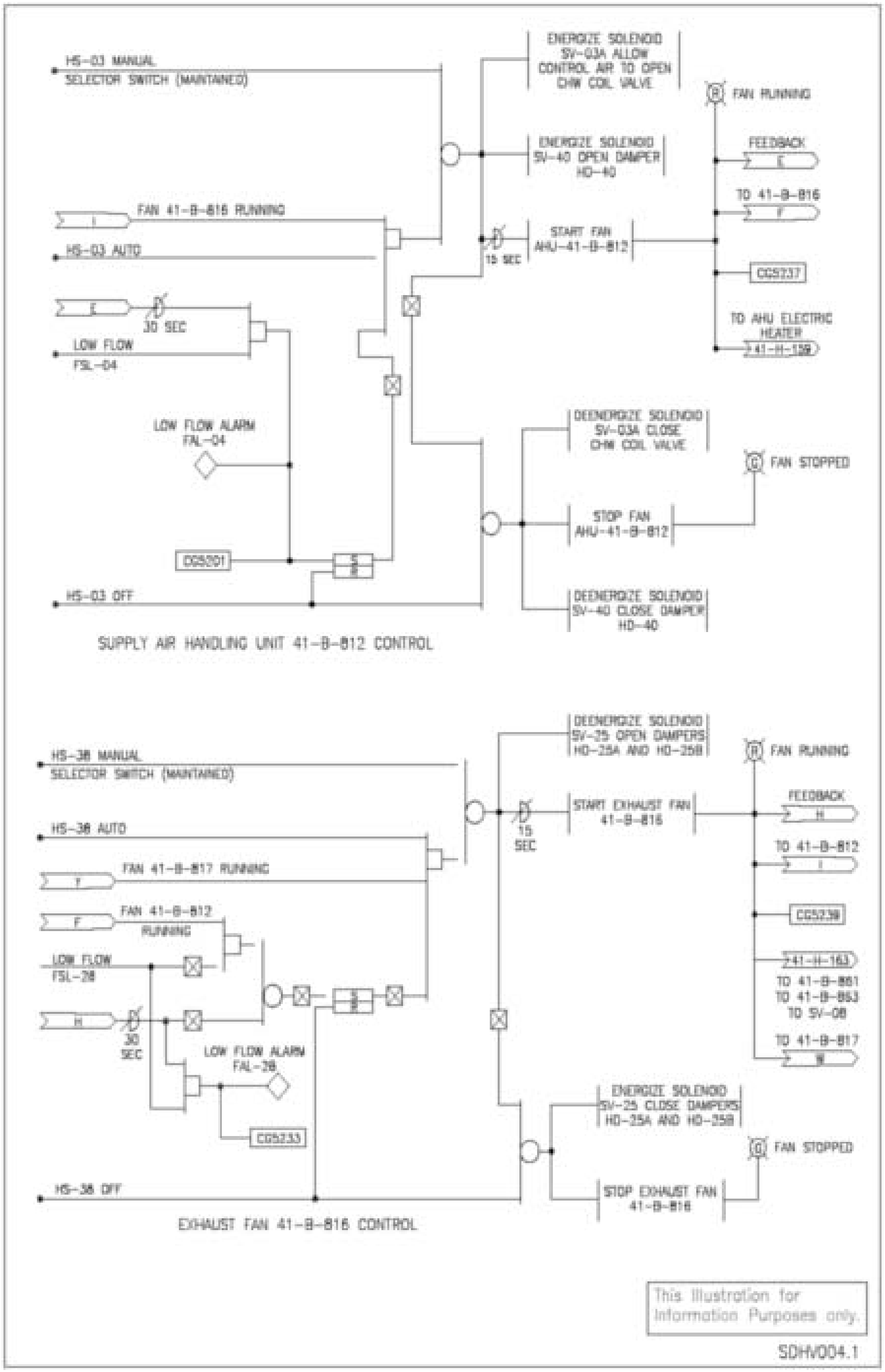

FIGURE HV II-8: Control Logic Diagram for AHU 41-B-812 & Exhaust Fan 41-B-816

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 back up 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.

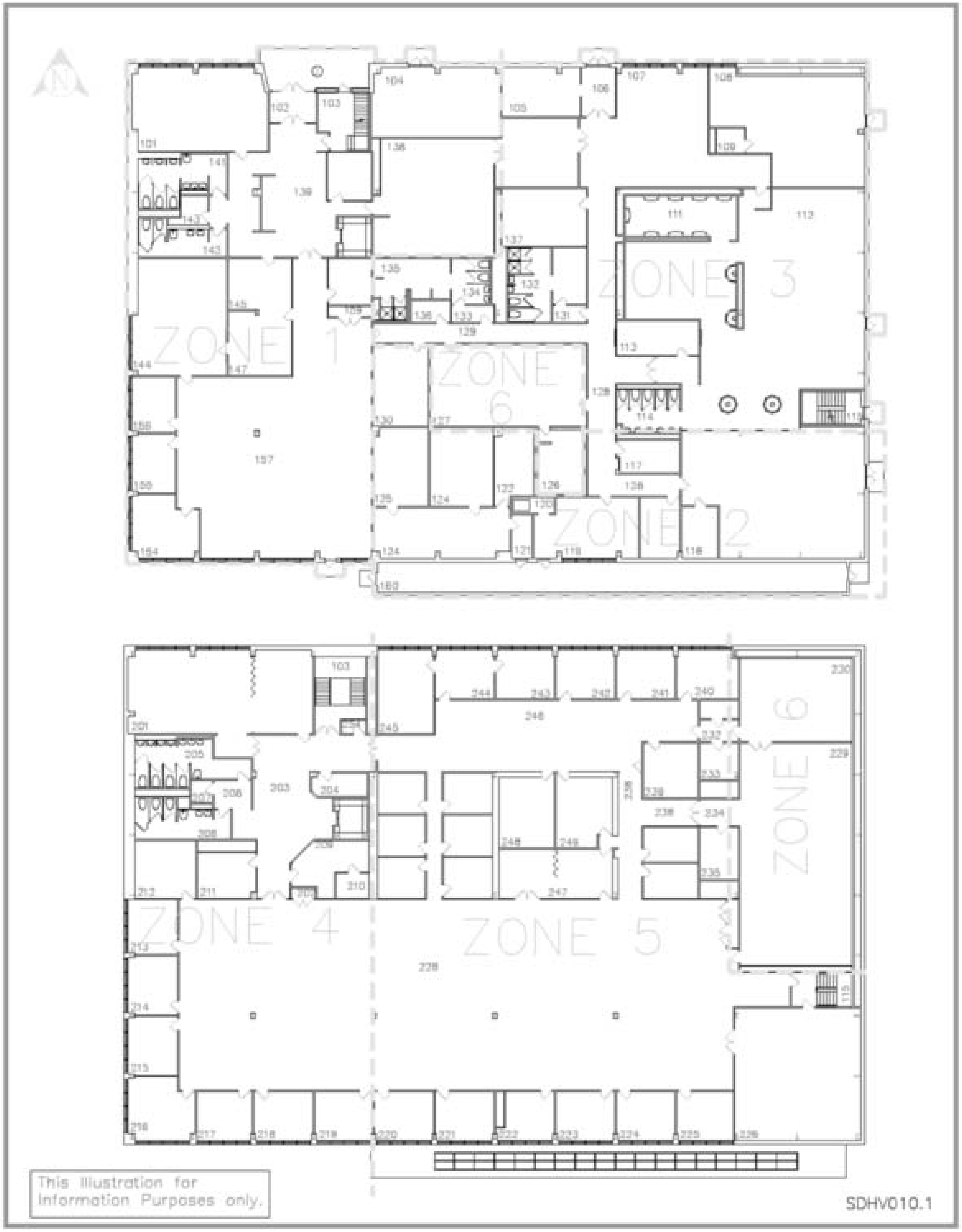

FIGURE HV III-1: HV03 Zone Boundaries for Support Building HVAC

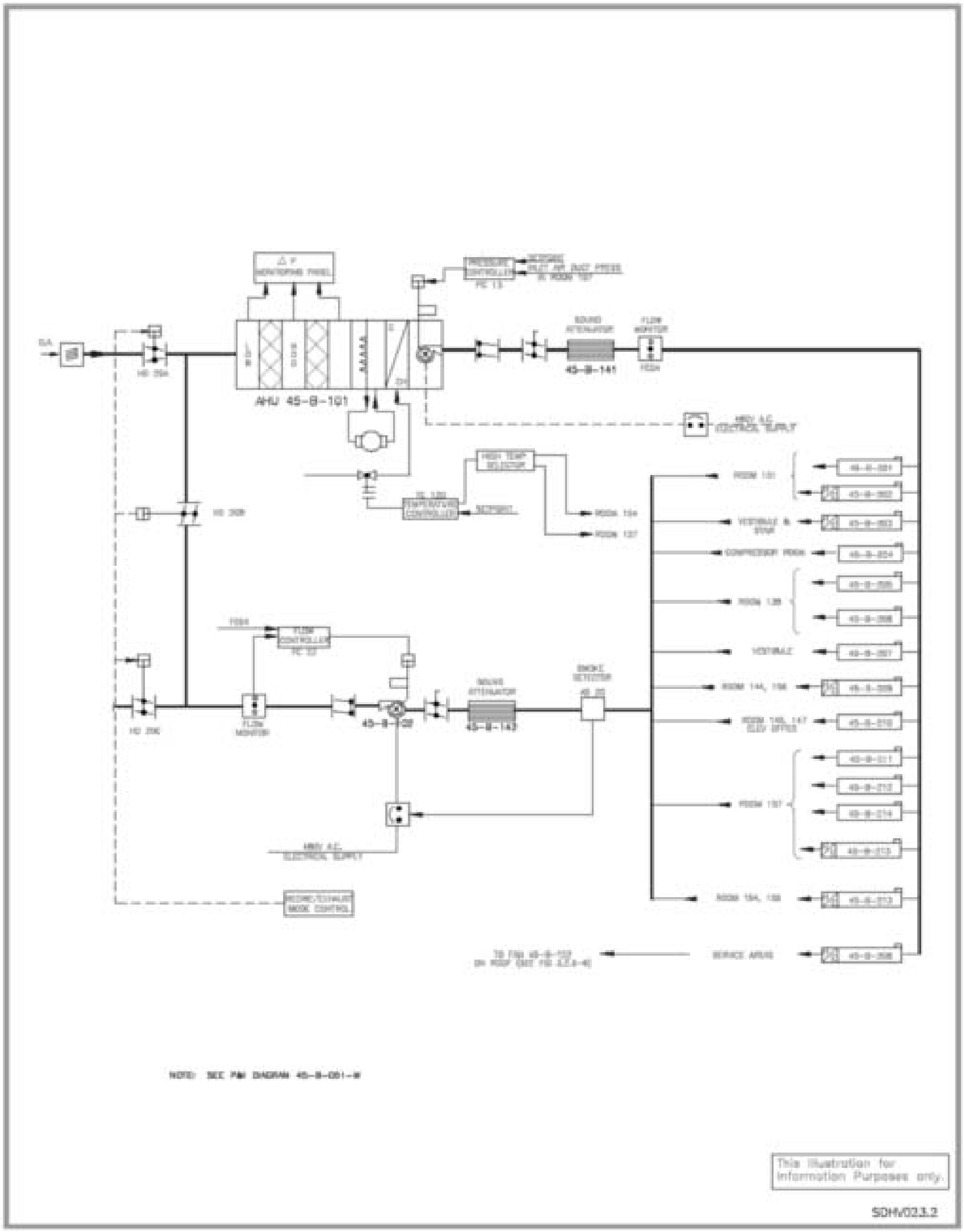

FIGURE HV III-2: HV03 Support Building Zone 1 First Fl. West HVAC Block Diagram

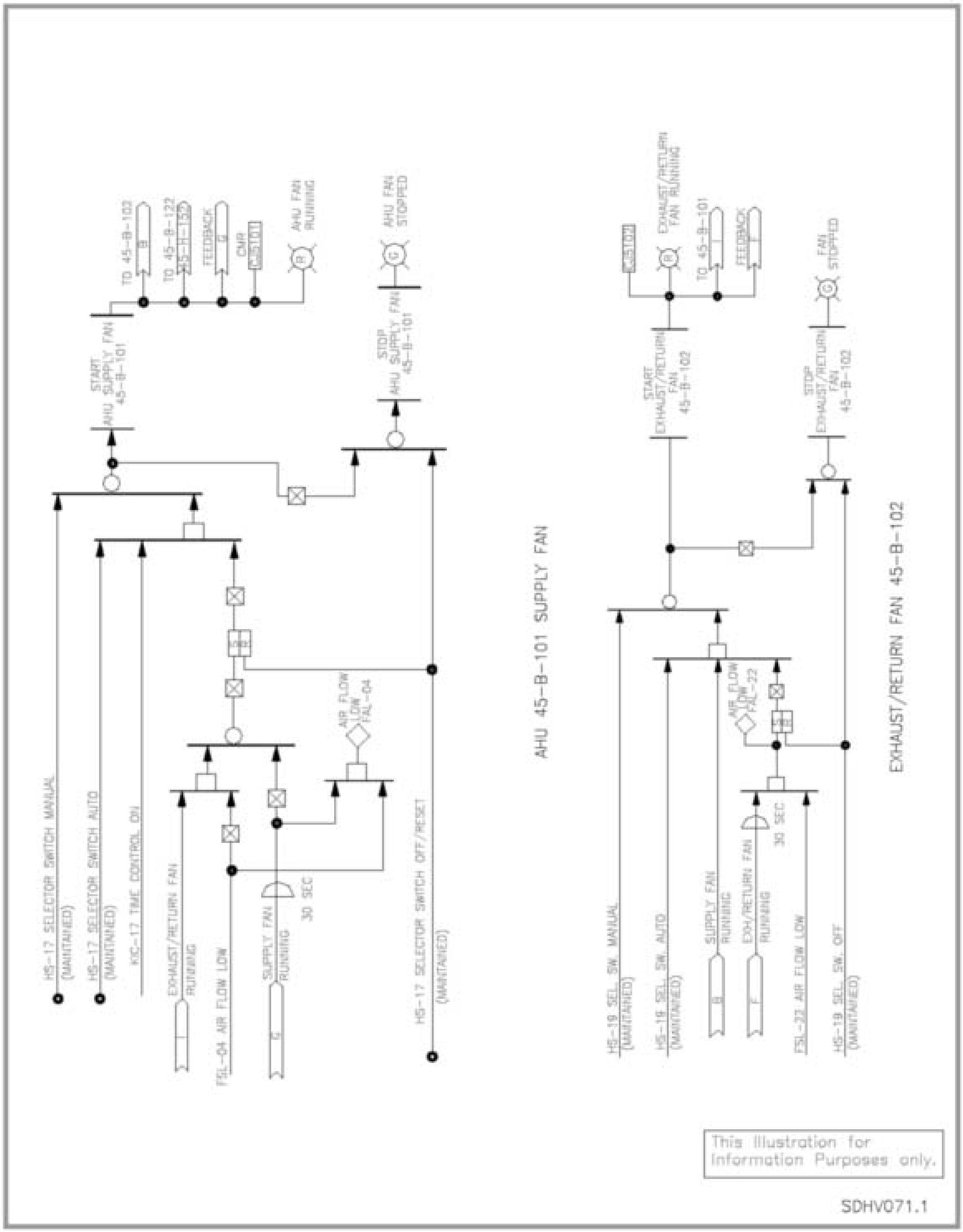

FIGURE HV III-3: HV03 Support Building Zone 1 HVAC Logic Diagrams

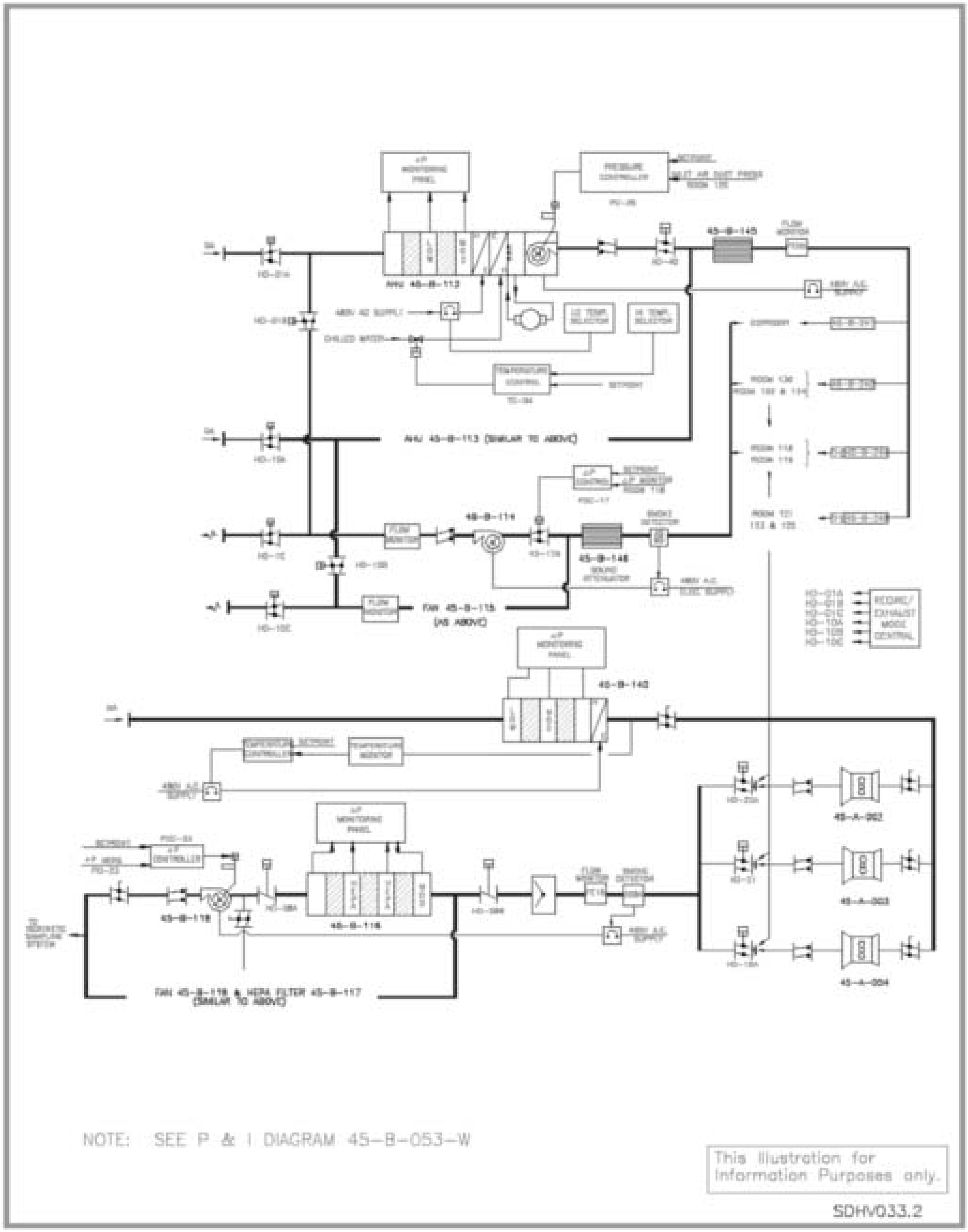

FIGURE HV III-4: HV03 Support Bldg., Zone 2 Laboratory HVAC Block Diagram

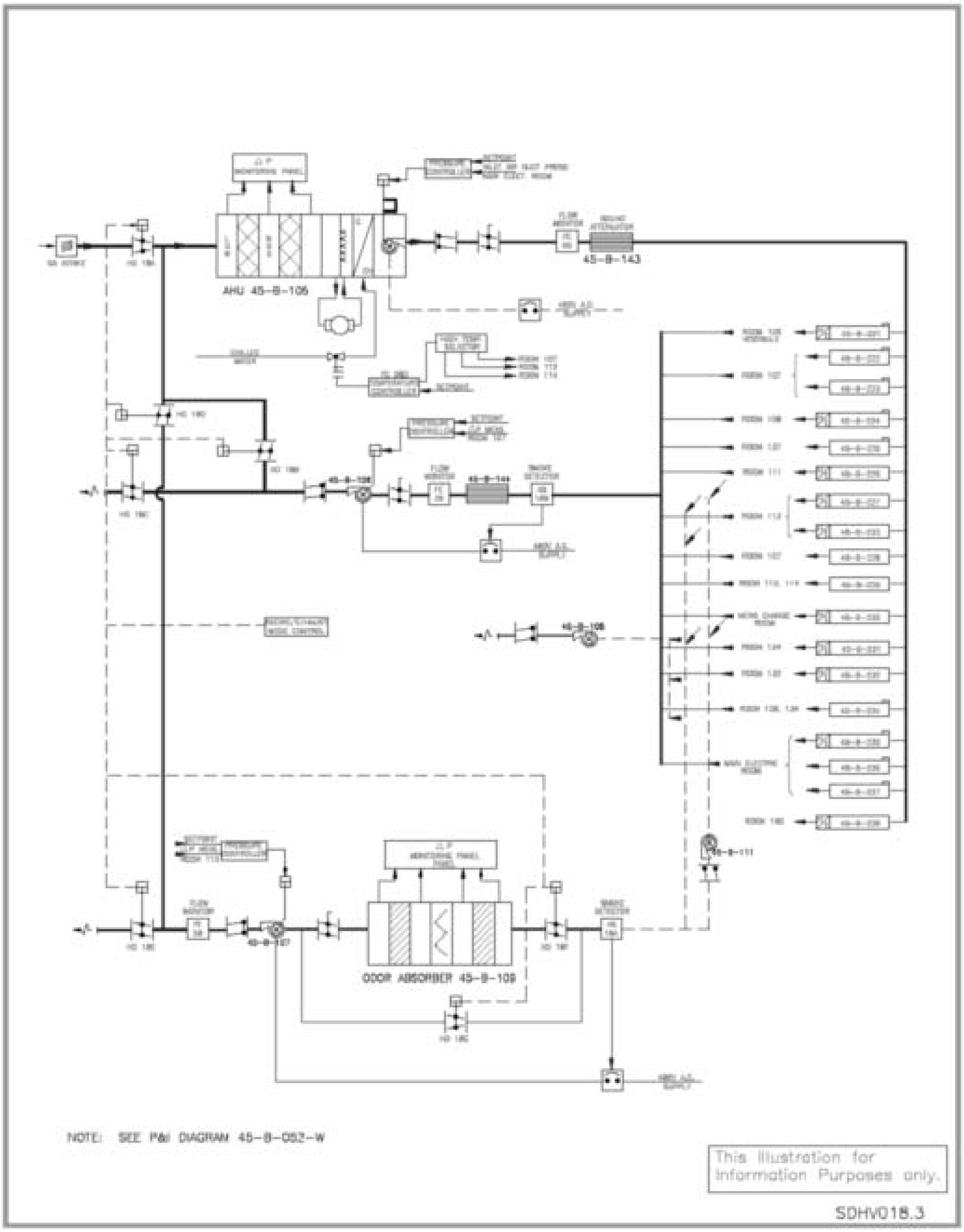

FIGURE HV III-5: HV03 Support Bldg. Zone 3 First Fl. East HVAC Block Diagram

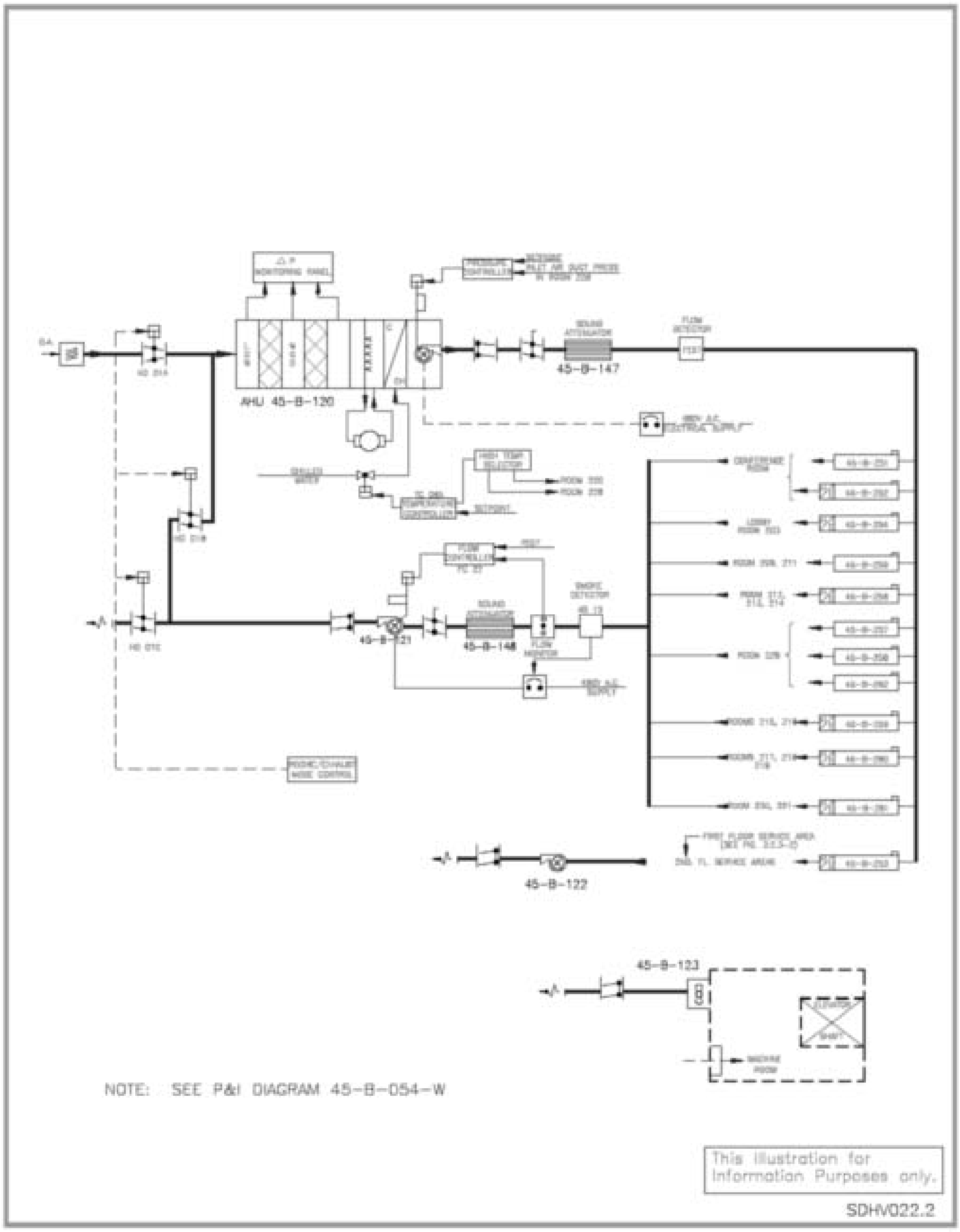

FIGURE HV III-6: HV03 Support Bldg. Zone 4 2nd Fl. West HVAC Block Diagram

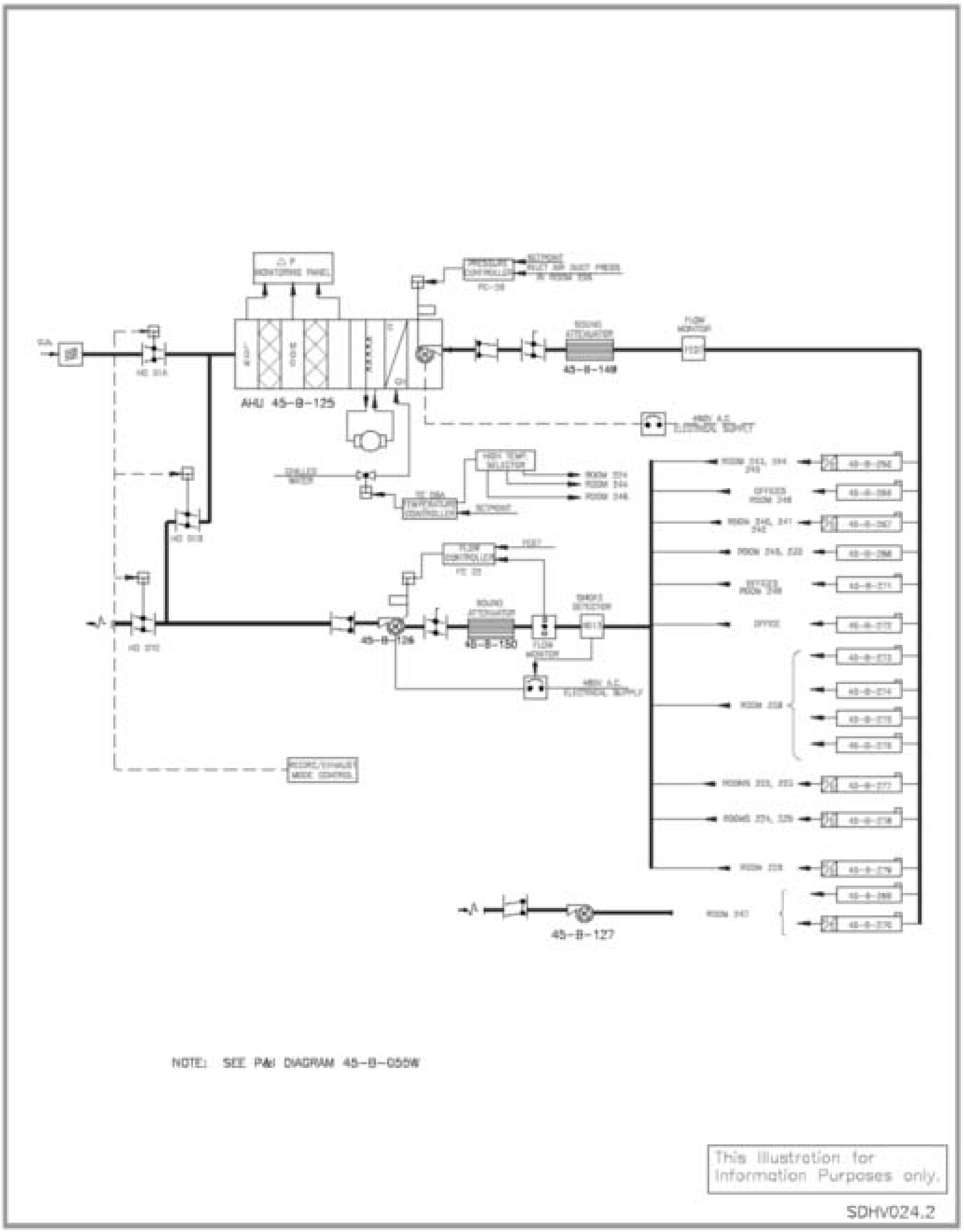

FIGURE HV III-7: HV03 Support Bldg. Zone 5 2nd Fl. East HVAC Block Diagram

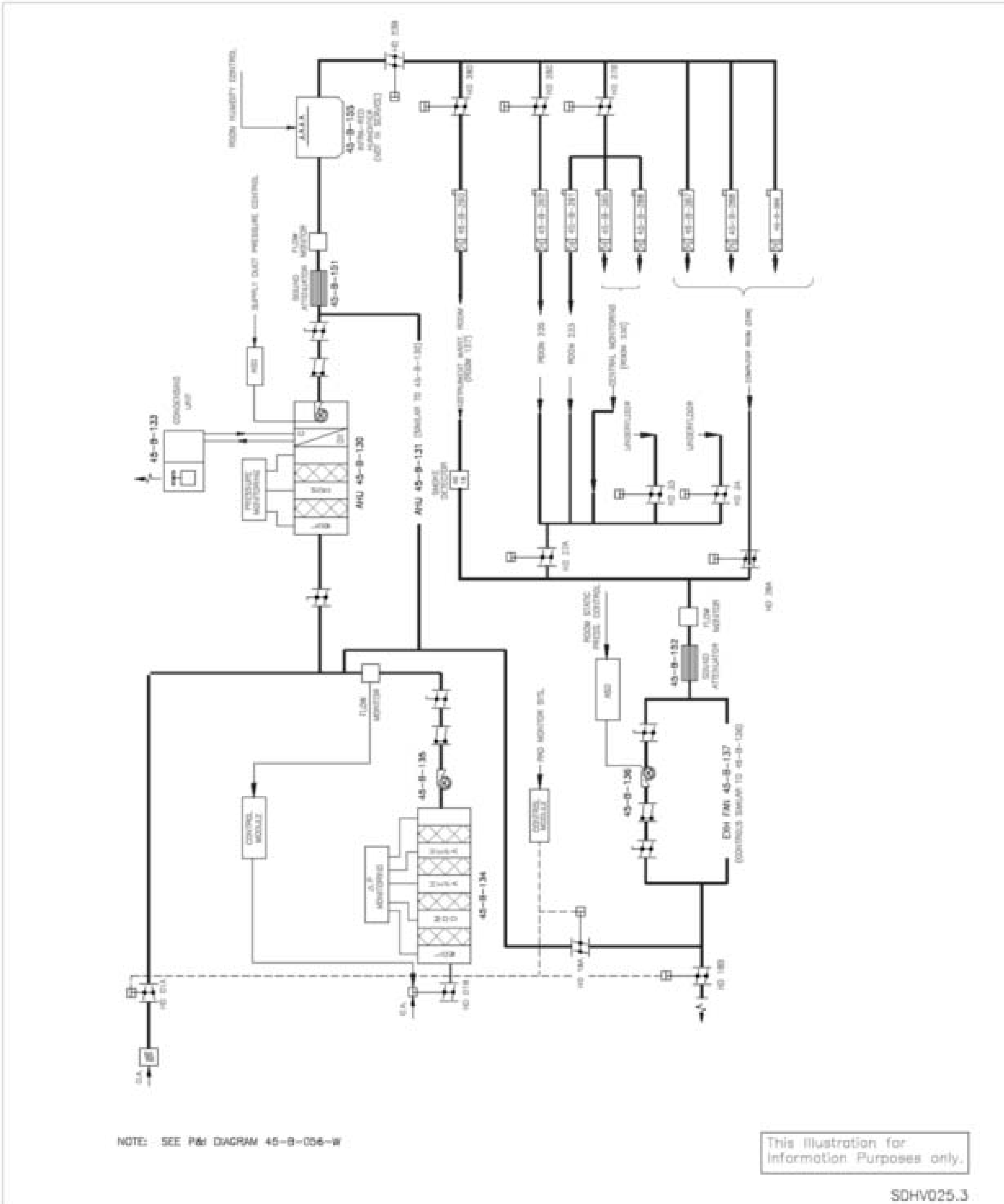

FIGURE HV III-8: HV03 Support Bldg. Zone 6 CMR & Instr. Shop HVAC Block Diagram

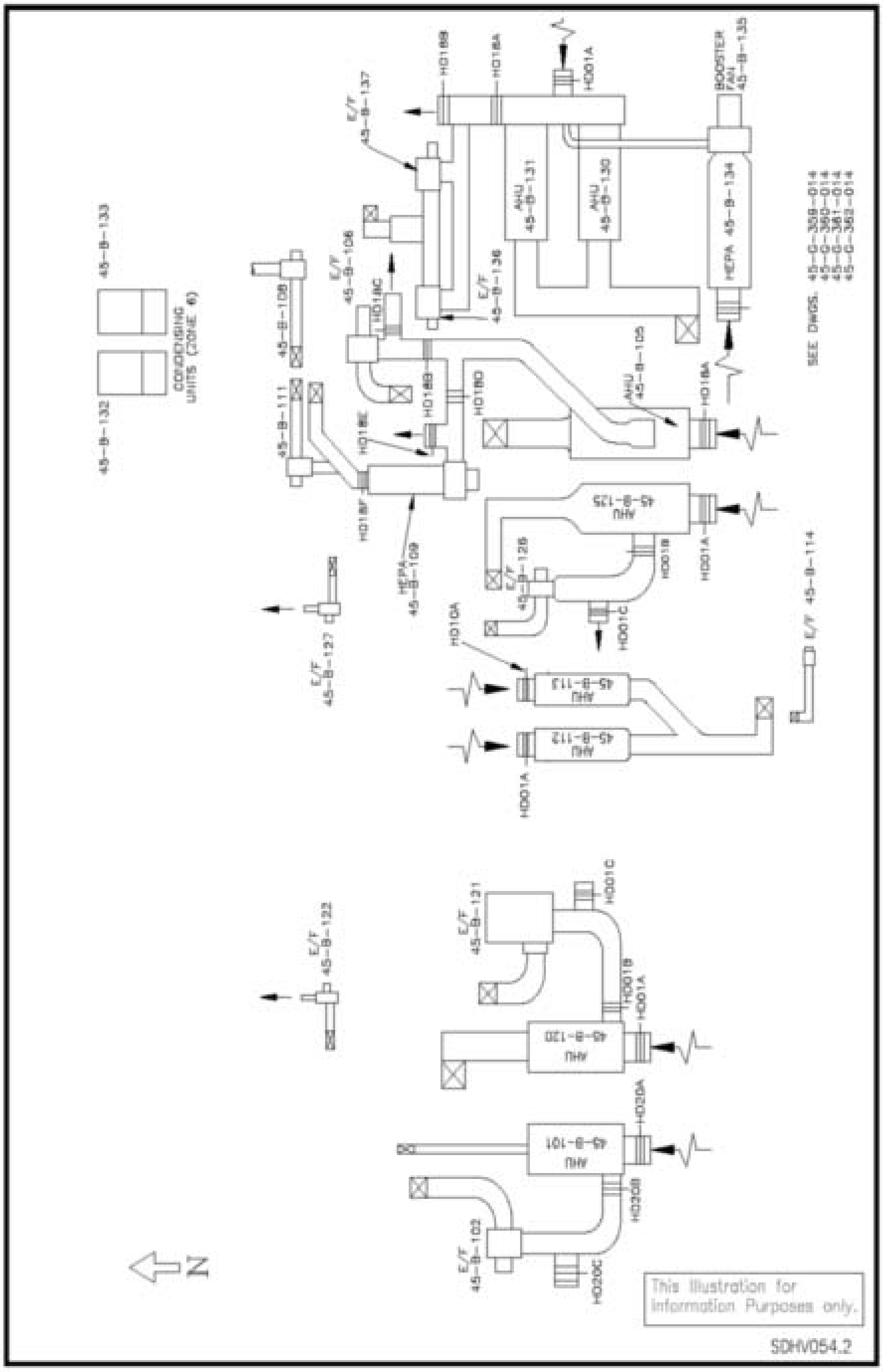

FIGURE HV III-9: Layout Plan of HV03 Components on Roof of Support Bldg.

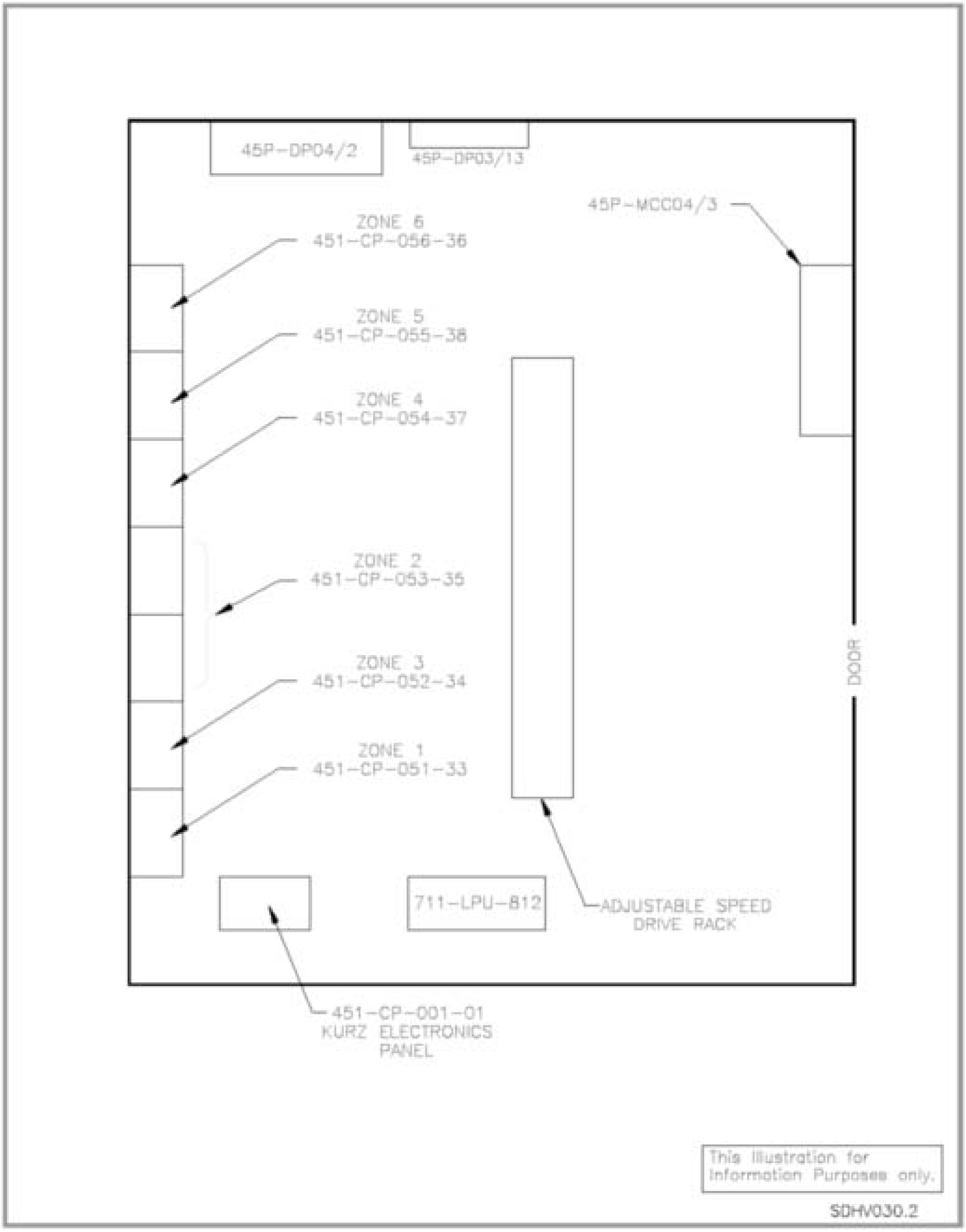

FIGURE HV III-10: Layout of HV03 Panels in the Support Bldg.

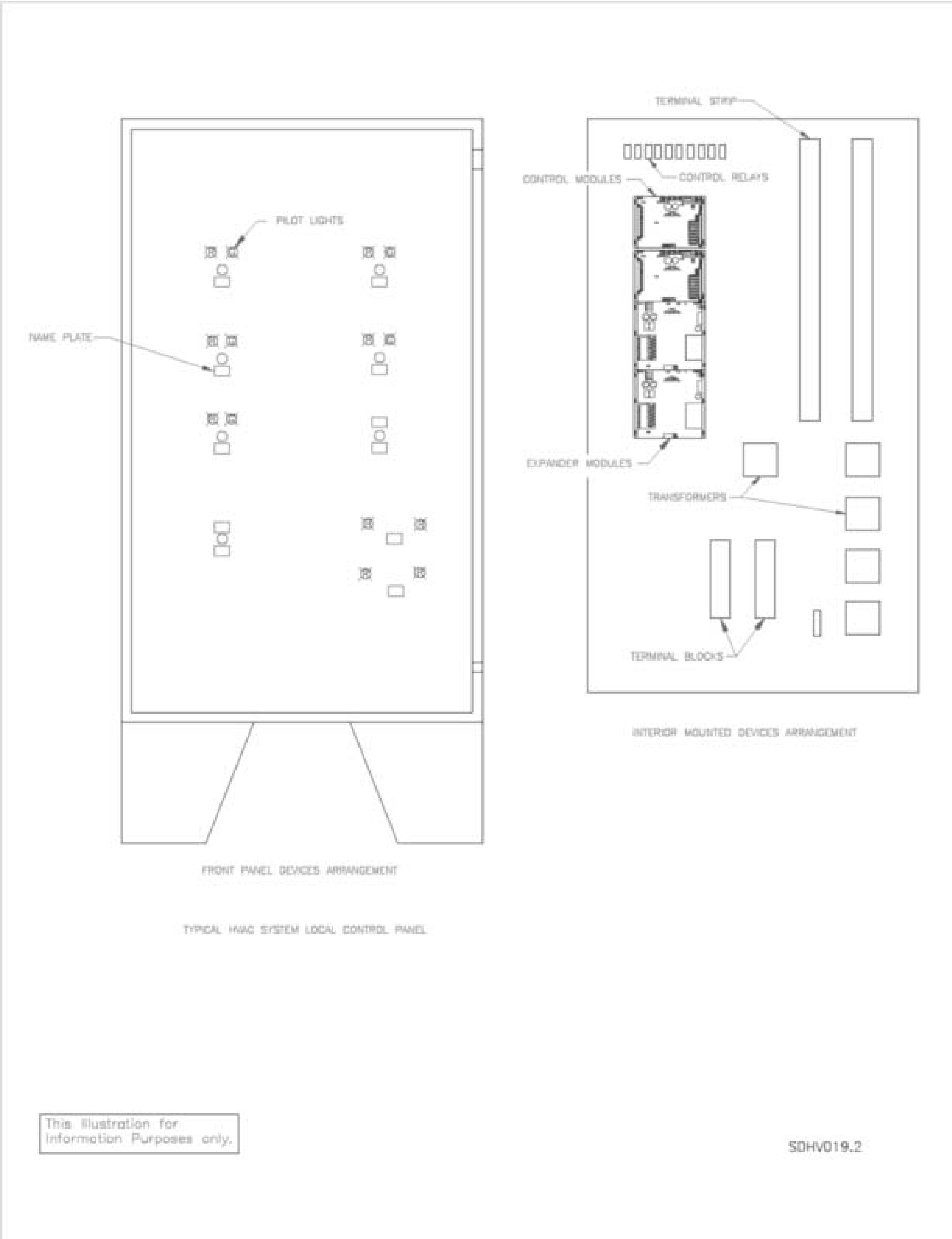

FIGURE HV III-11: Typical HV03 Control Panel Layout

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, evaporative cooler, 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 evaporative coolers 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 evaporative cooler circulating pump in each AHU can only be energized if its supply fan is running and if the thermostat closes at its high temperature setting.

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.

- Low and Moderate DP indicators for pressure drop across filters in the AHUs and the HEPA filters

- 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 and the AHUs

- 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 and its evaporative cooler pump motor.

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
AHU filters	0.05" wg	Local Only
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.

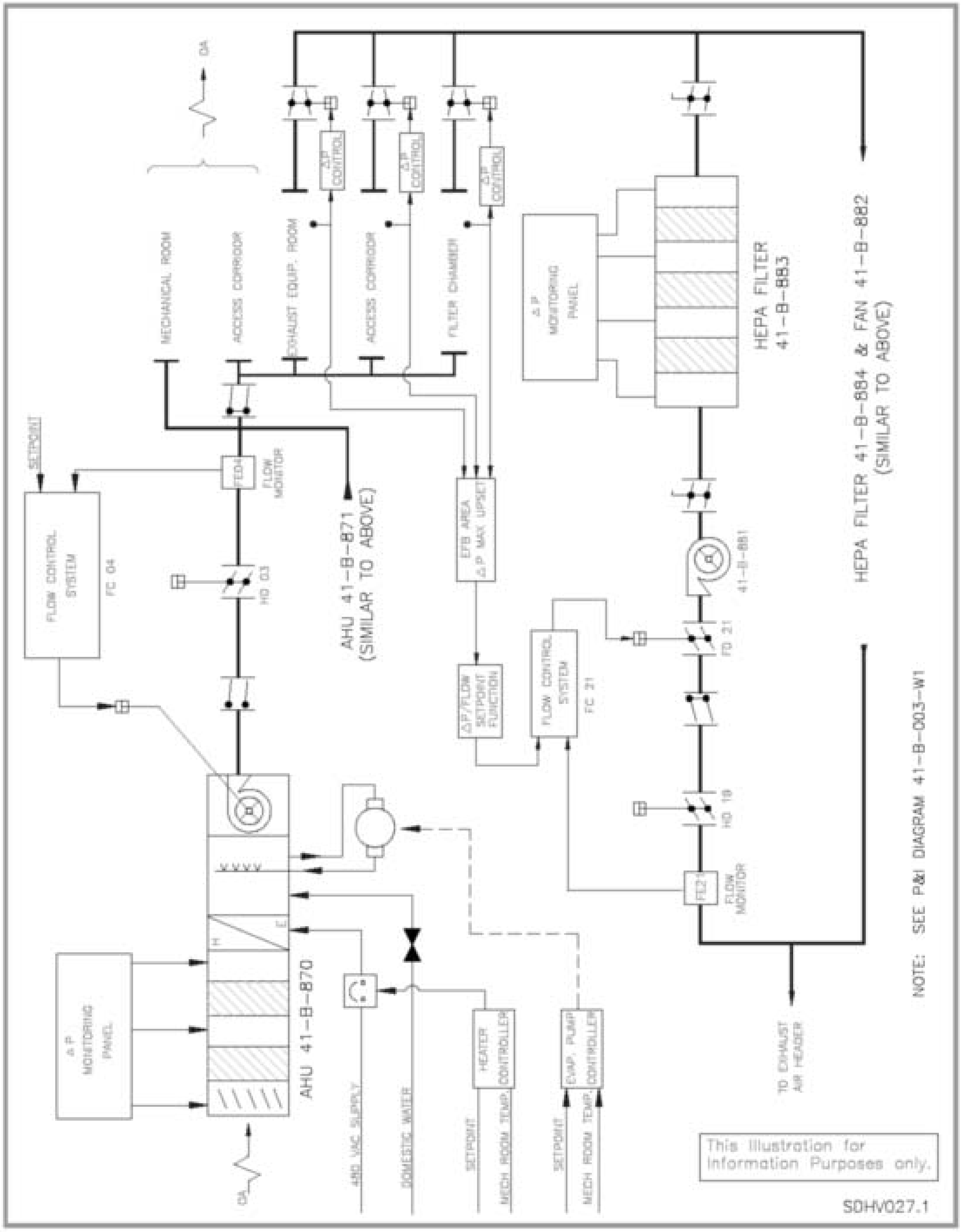

FIGURE HV IV-1: Subsystem HV04 Exhaust Filter Bldg. HVAC Block Diagram

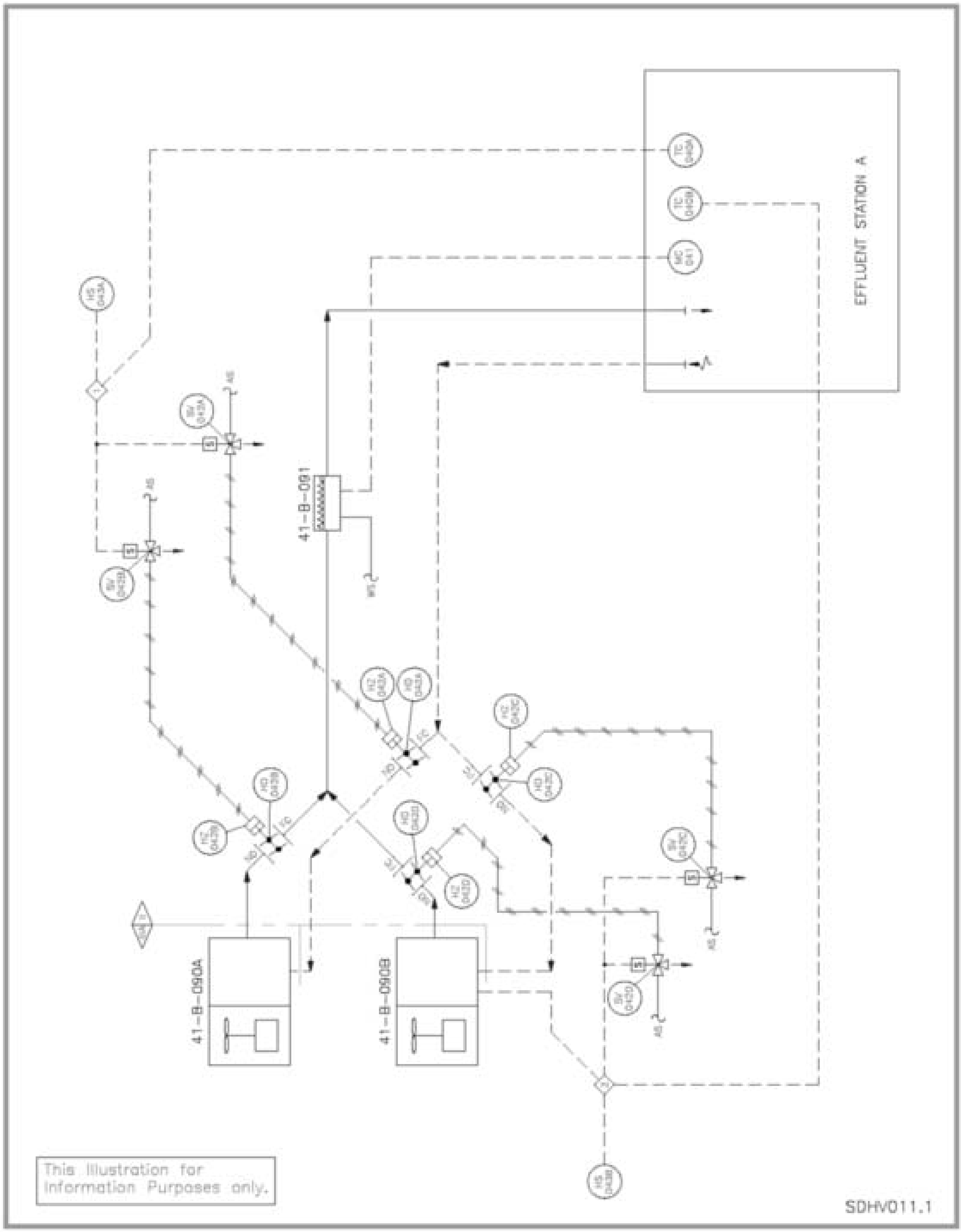

FIGURE HV IV-2: Effluent Station "A" HVAC Block Diagram

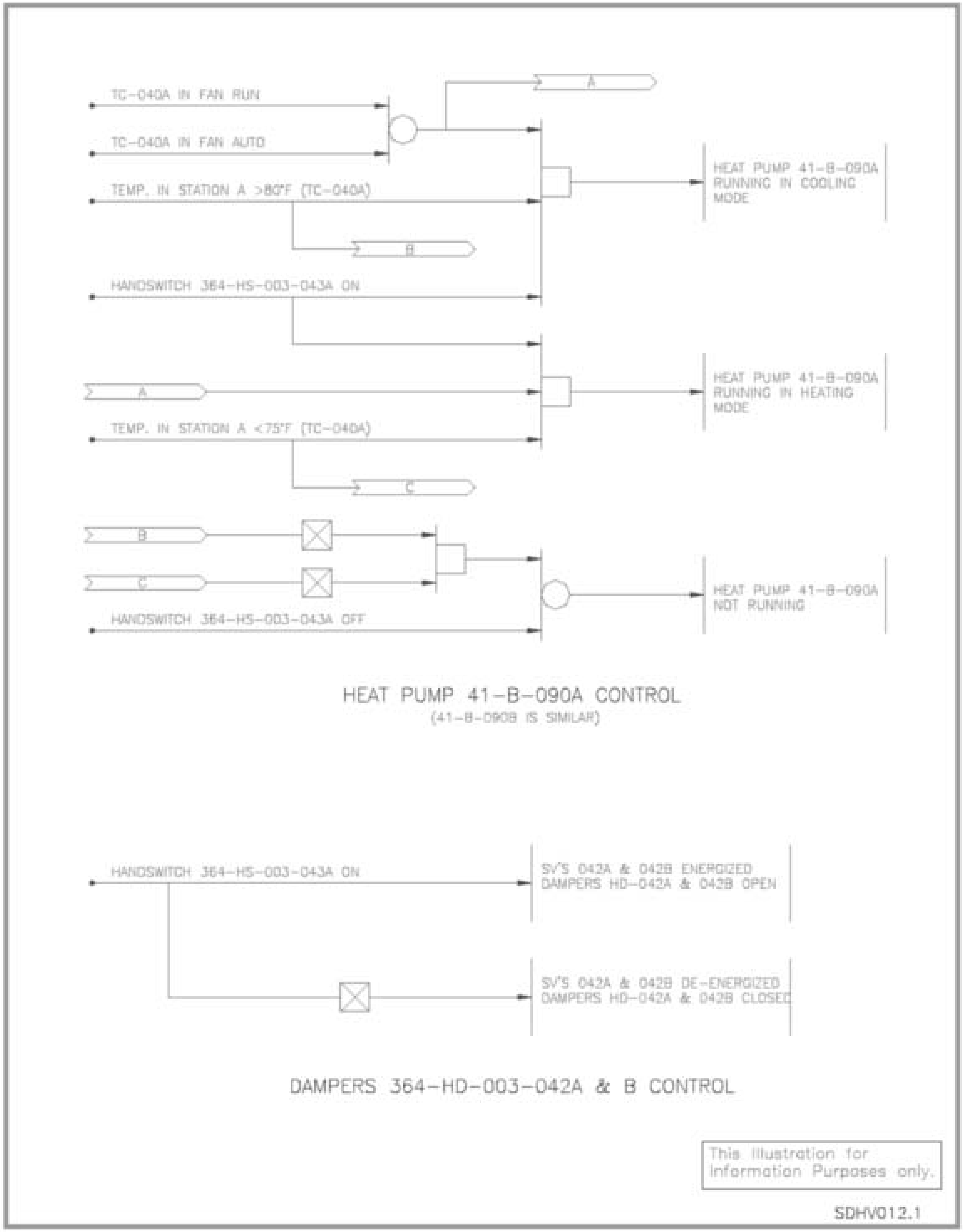

FIGURE HV IV-3: Effluent Station "A" HVAC Control Logic

STATION	EQUIPMENT NO.	INSTRUMENTATION HS	MC	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	–	

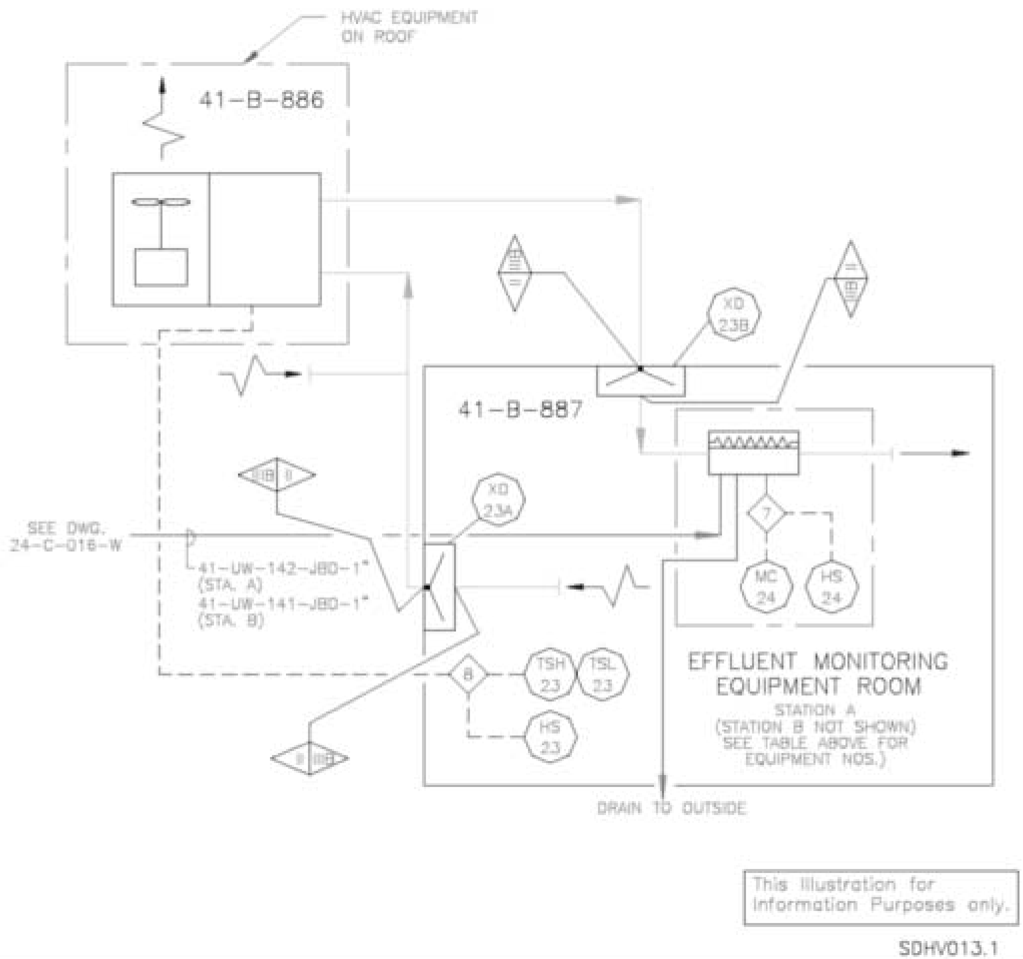

FIGURE HV IV-4: Monitoring Room 413A HVAC Block Diagram

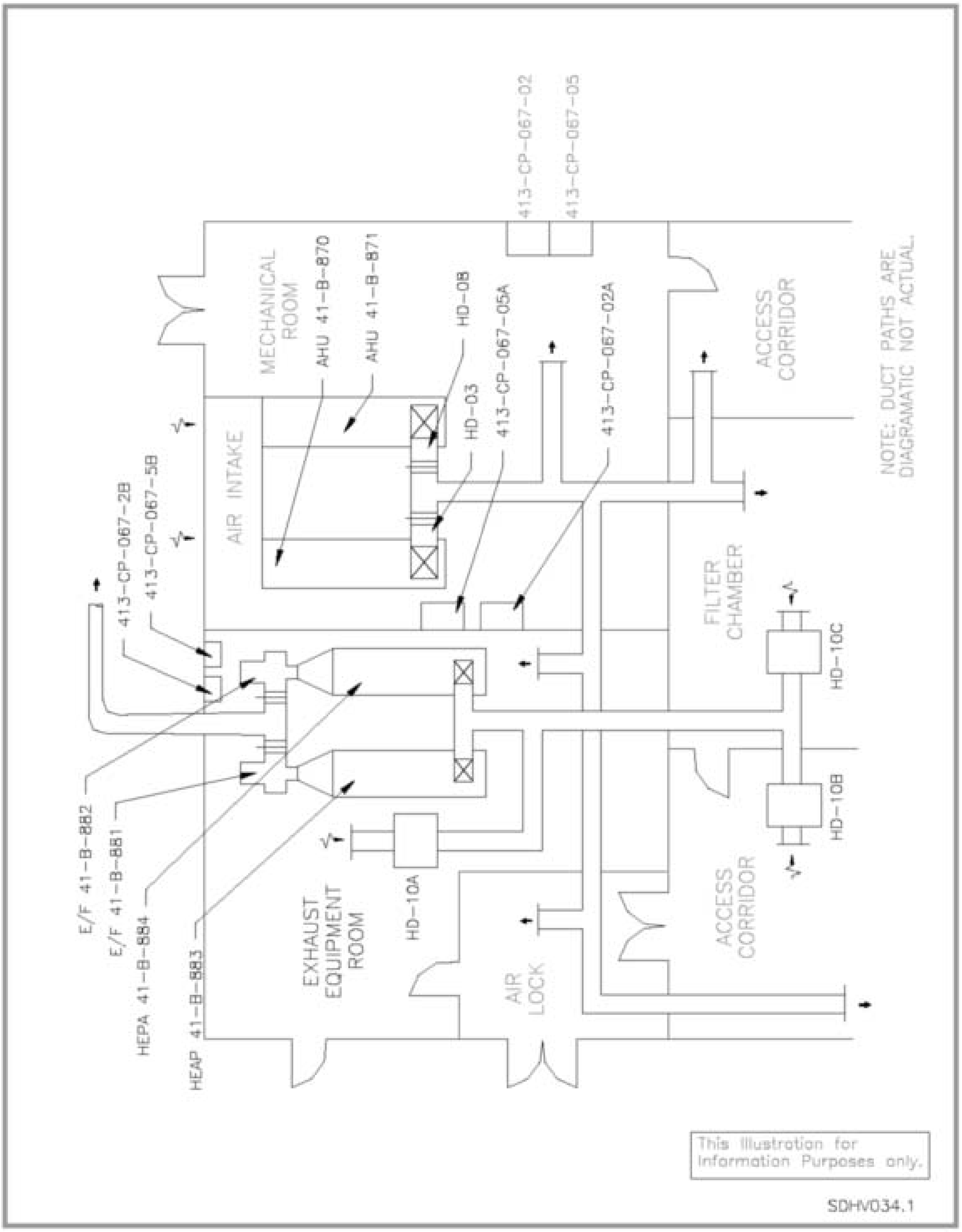

FIGURE HV IV-5: Layout of HV04 in Exhaust Filter Building (413)

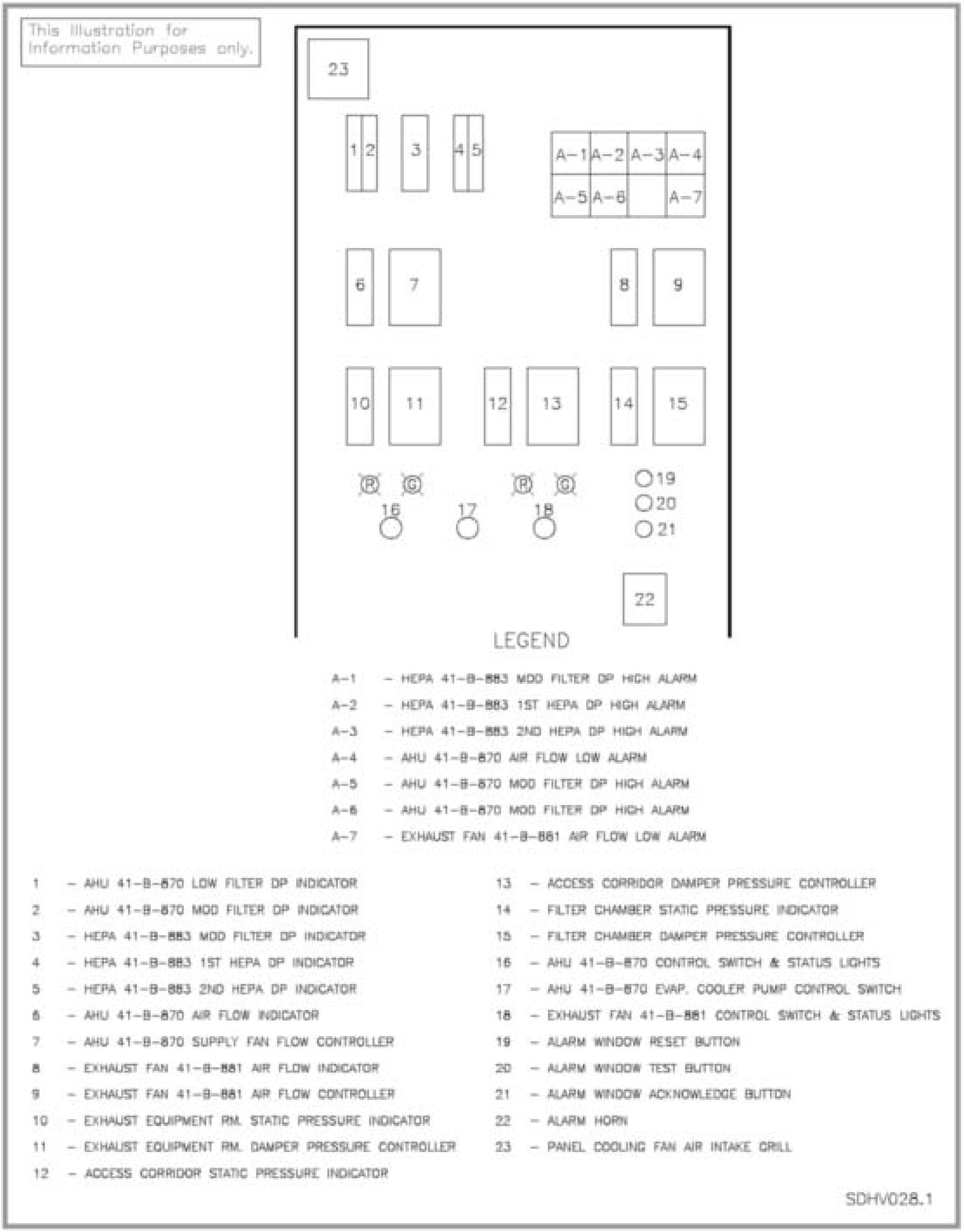

FIGURE HV IV-6: Exhaust Filter Building HVAC Panel 314-CP-067-02 Layout

Chapter V

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<u>Subsystem HV05 HVAC in Buildings 452, 453, and 456</u>

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Chapter V

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.

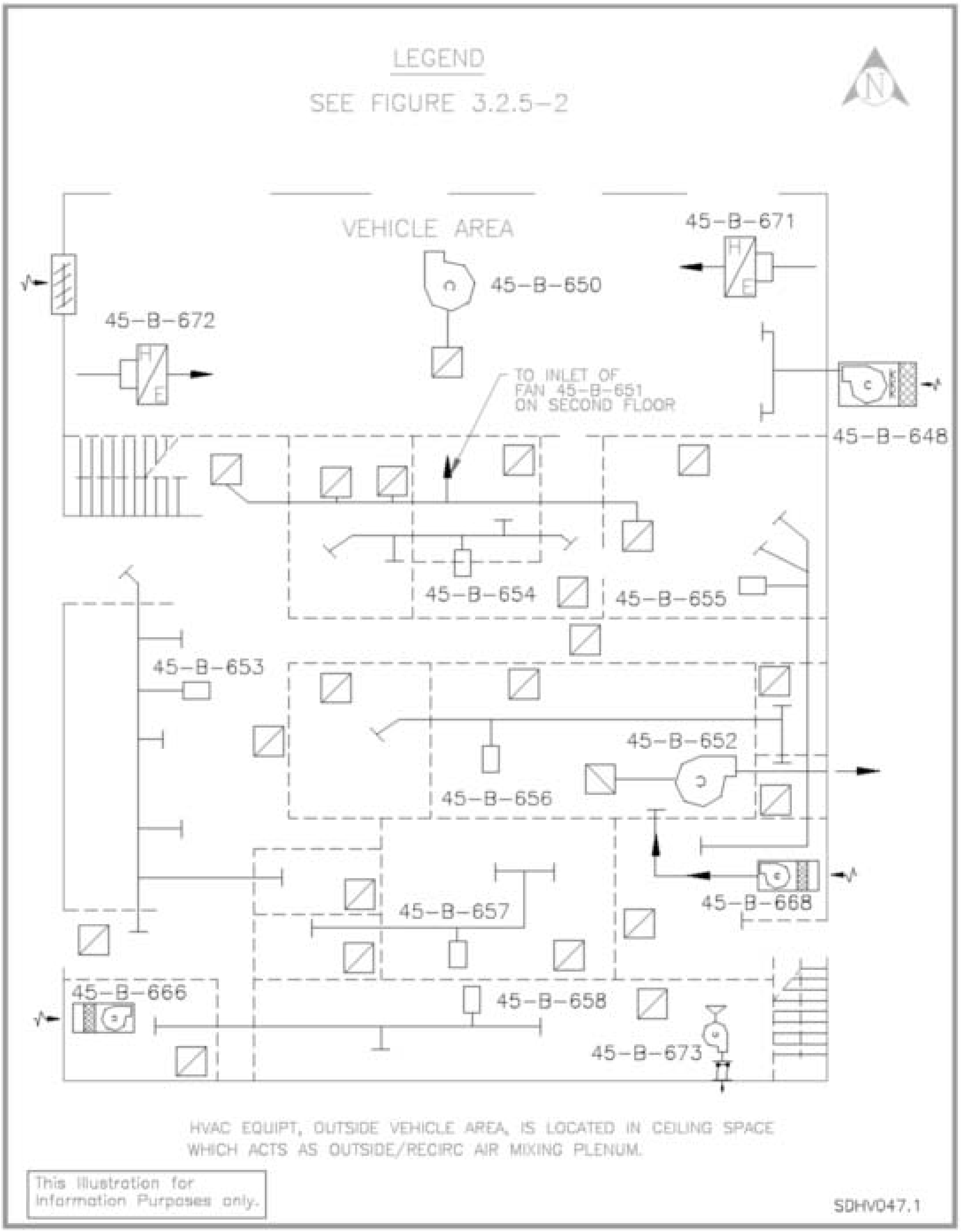

FIGURE HV V-1: HV05 S&E Building Ground Floor HVAC Block Diagram

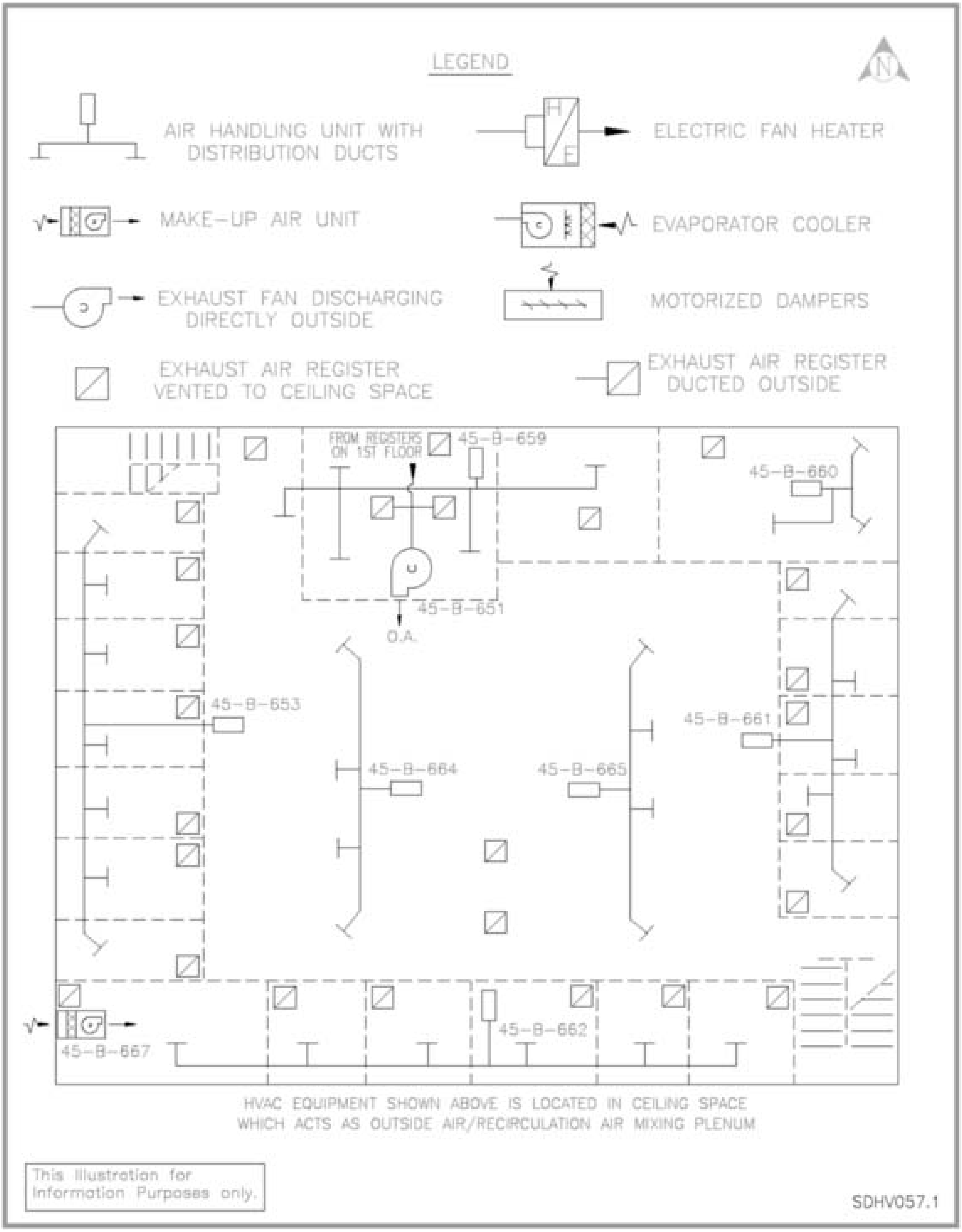

FIGURE HV V-2: HV05 S&E Building Second Floor HVAC Block Diagram

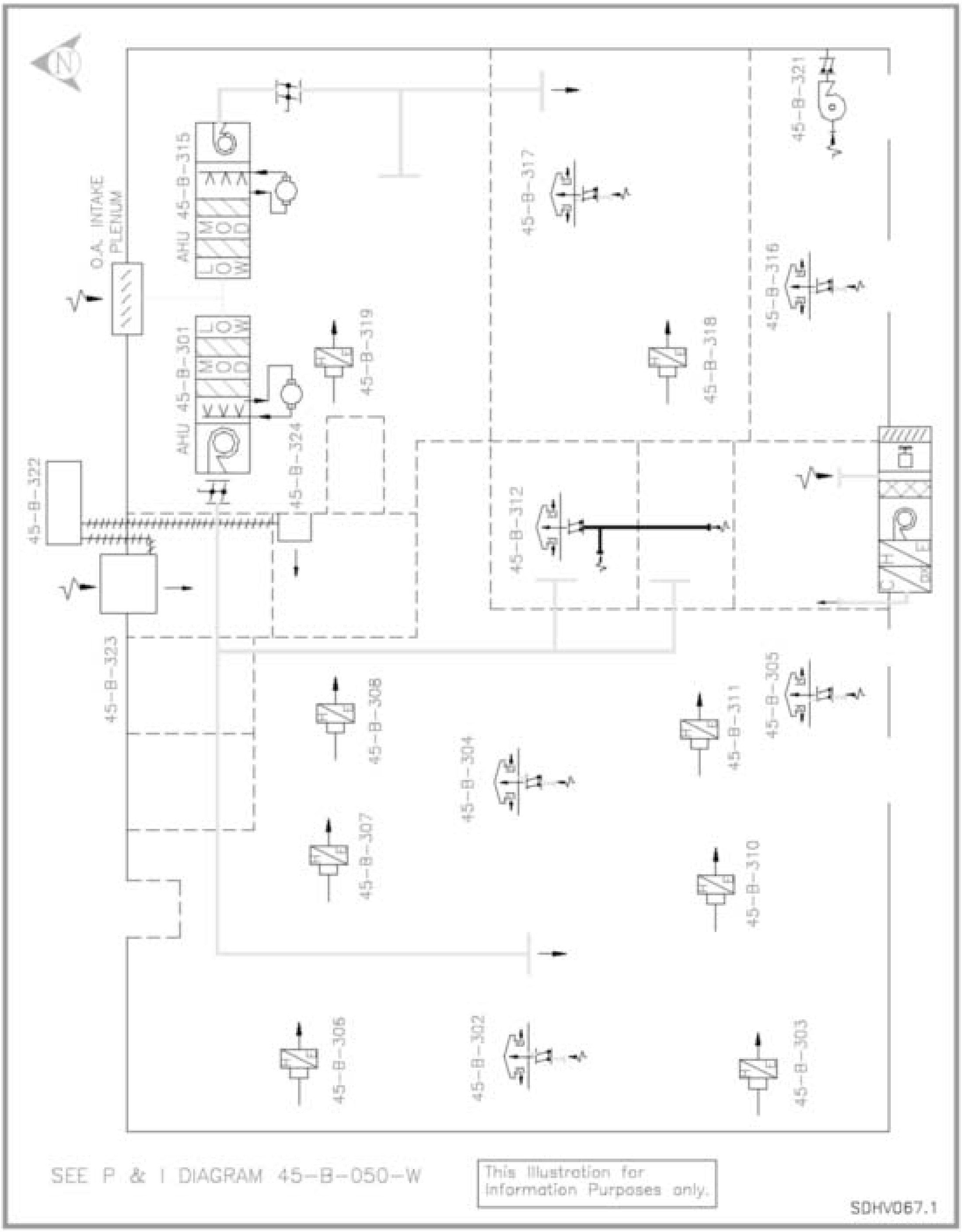

FIGURE HV V-3: HV05 Warehouse Building HVAC Block Diagram

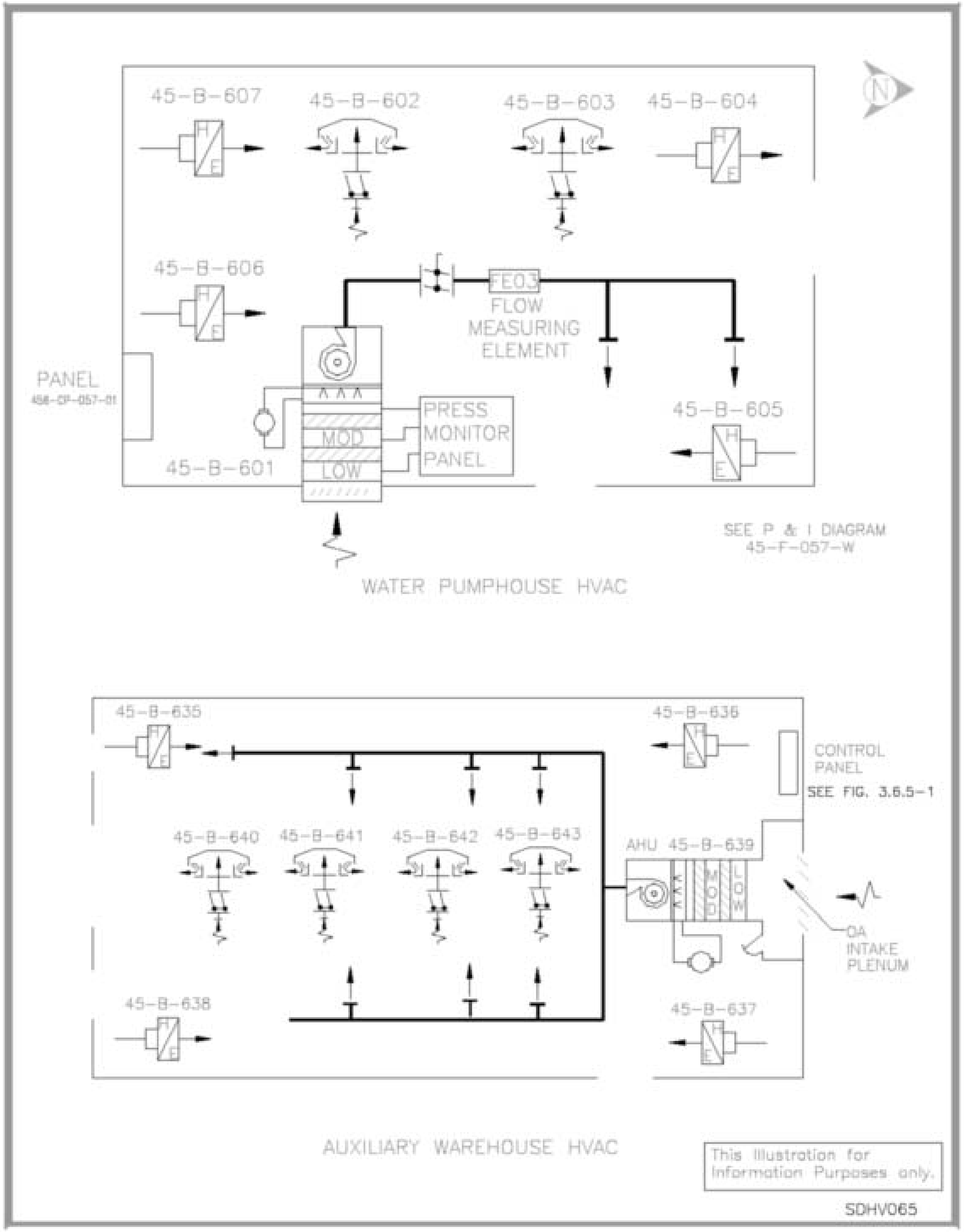

FIGURE HV V-4: HVAC Block Diagrams for Water Pumphouse (HV05) and Auxiliary Warehouse (HV06)

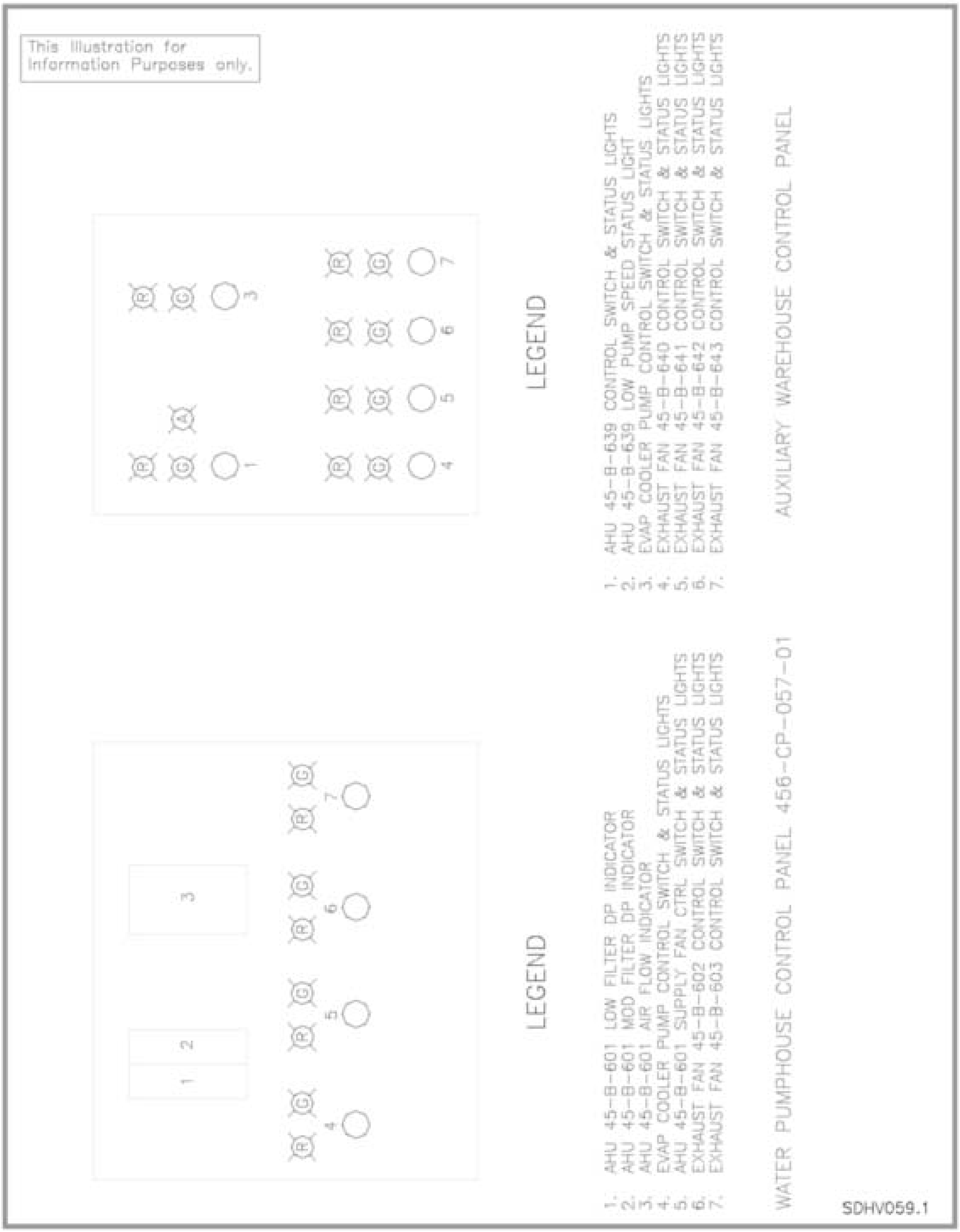

FIGURE HV V-5: Water Pumphouse & Aux. Warehouse Control Panel Layout

Chapter VI

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Subsystem HV06 Miscellaneous Buildings HVAC

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Chapter VI

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 include 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.

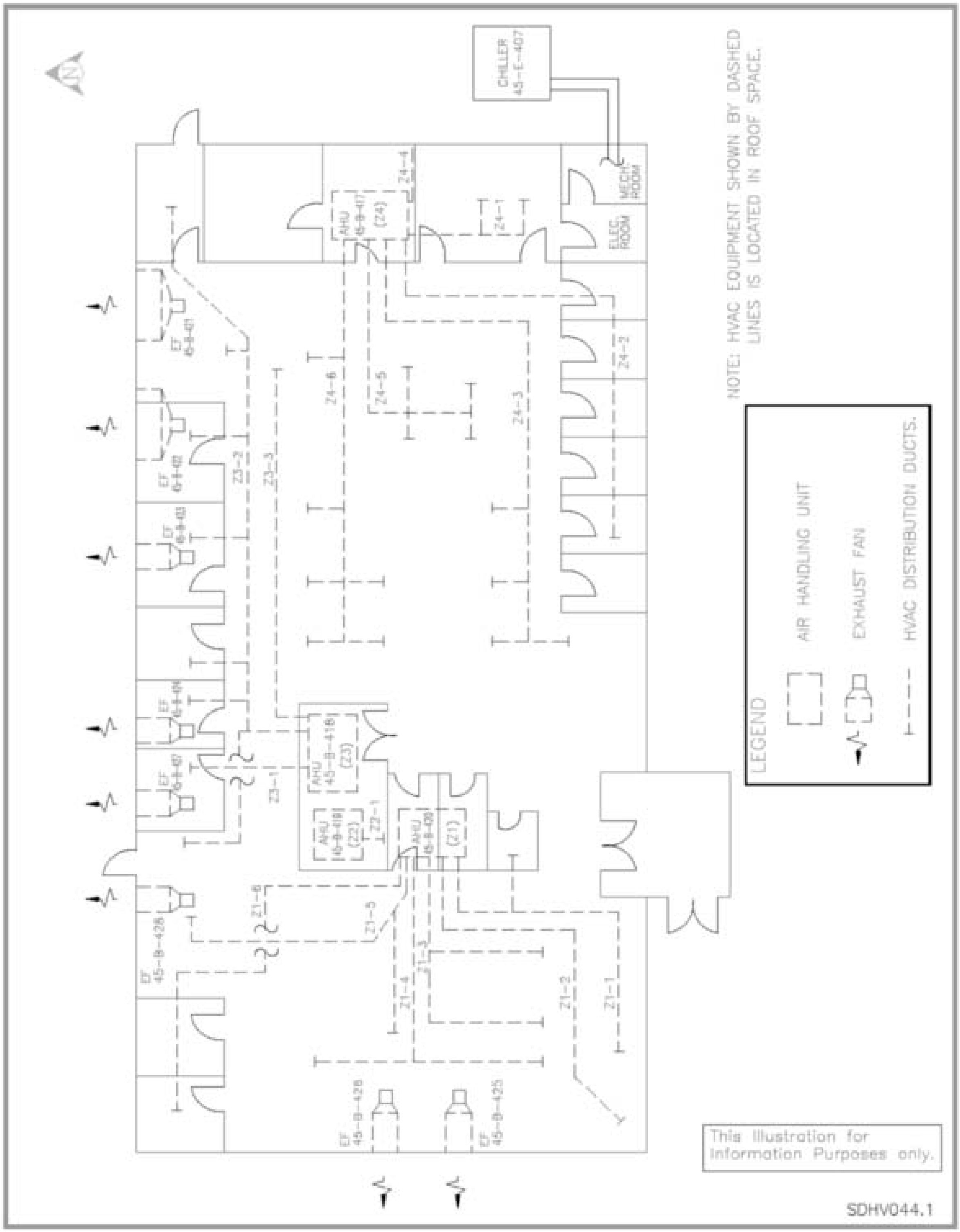

FIGURE HV VI-1: HV06 Engineering Bldg. HVAC System Block Diagram

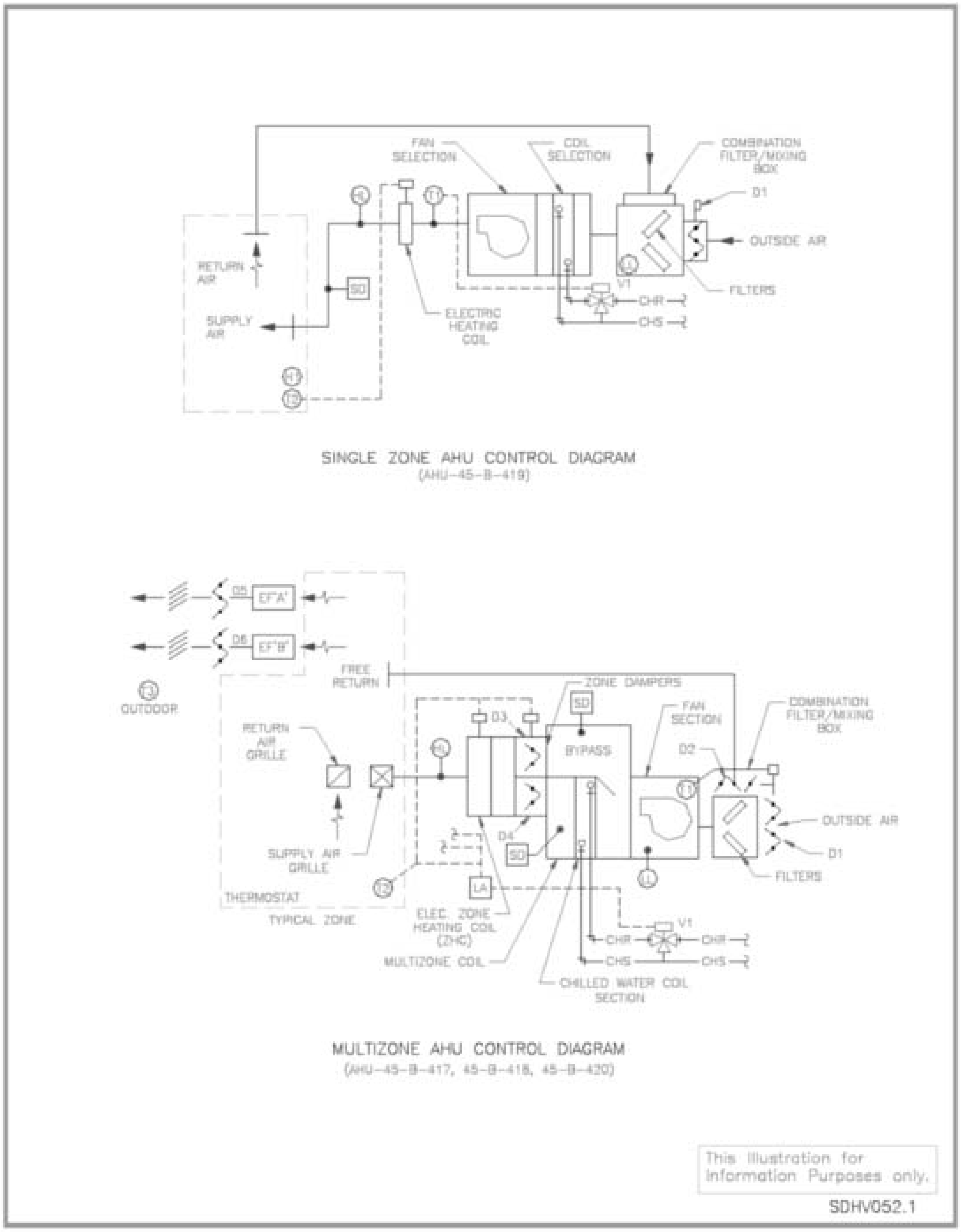

FIGURE HV VI-2: HV06 Engineering Building HVAC Control Diagrams

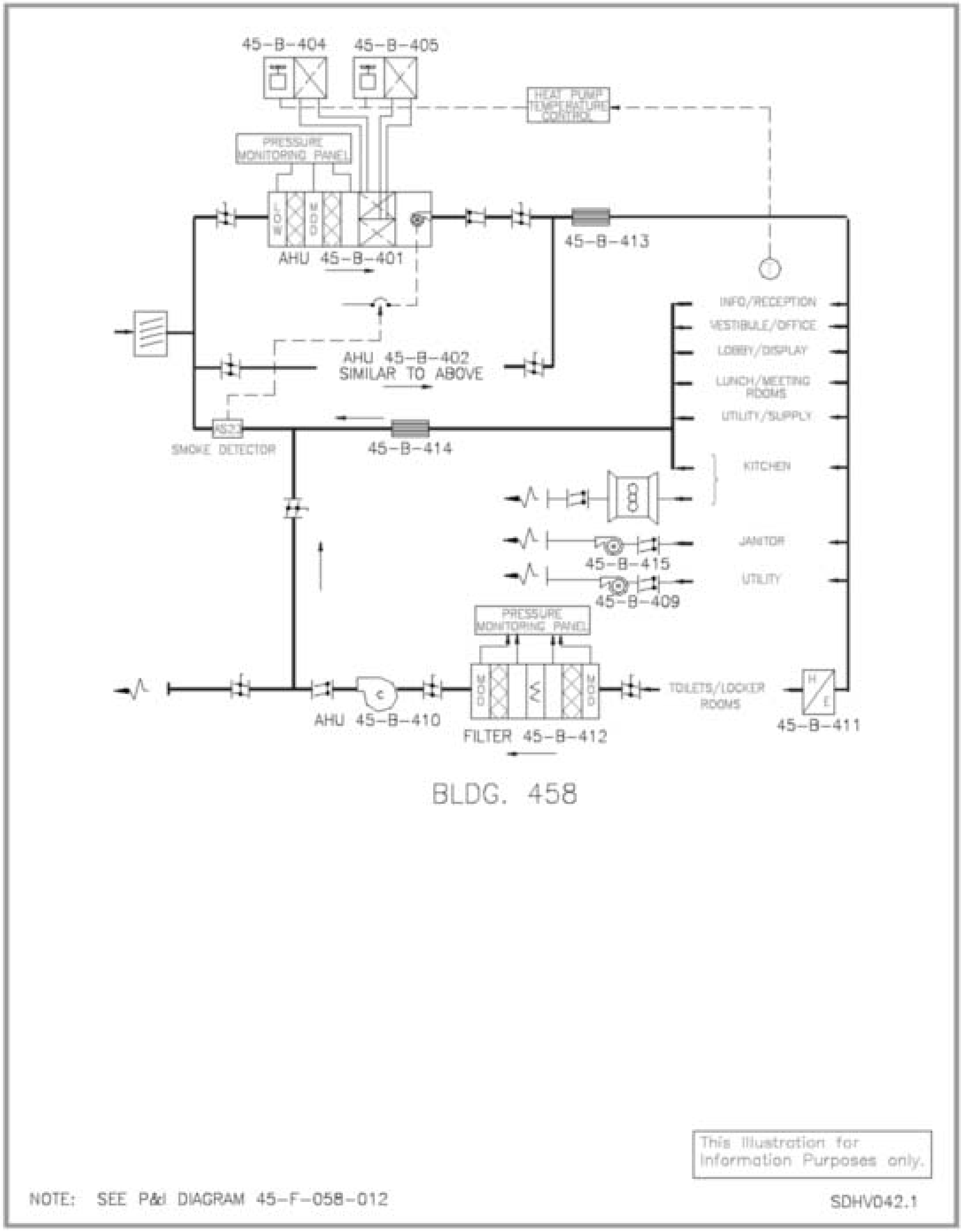

FIGURE HV VI-3: HV06 Guard and Security Bldg. HVAC Block Diagram

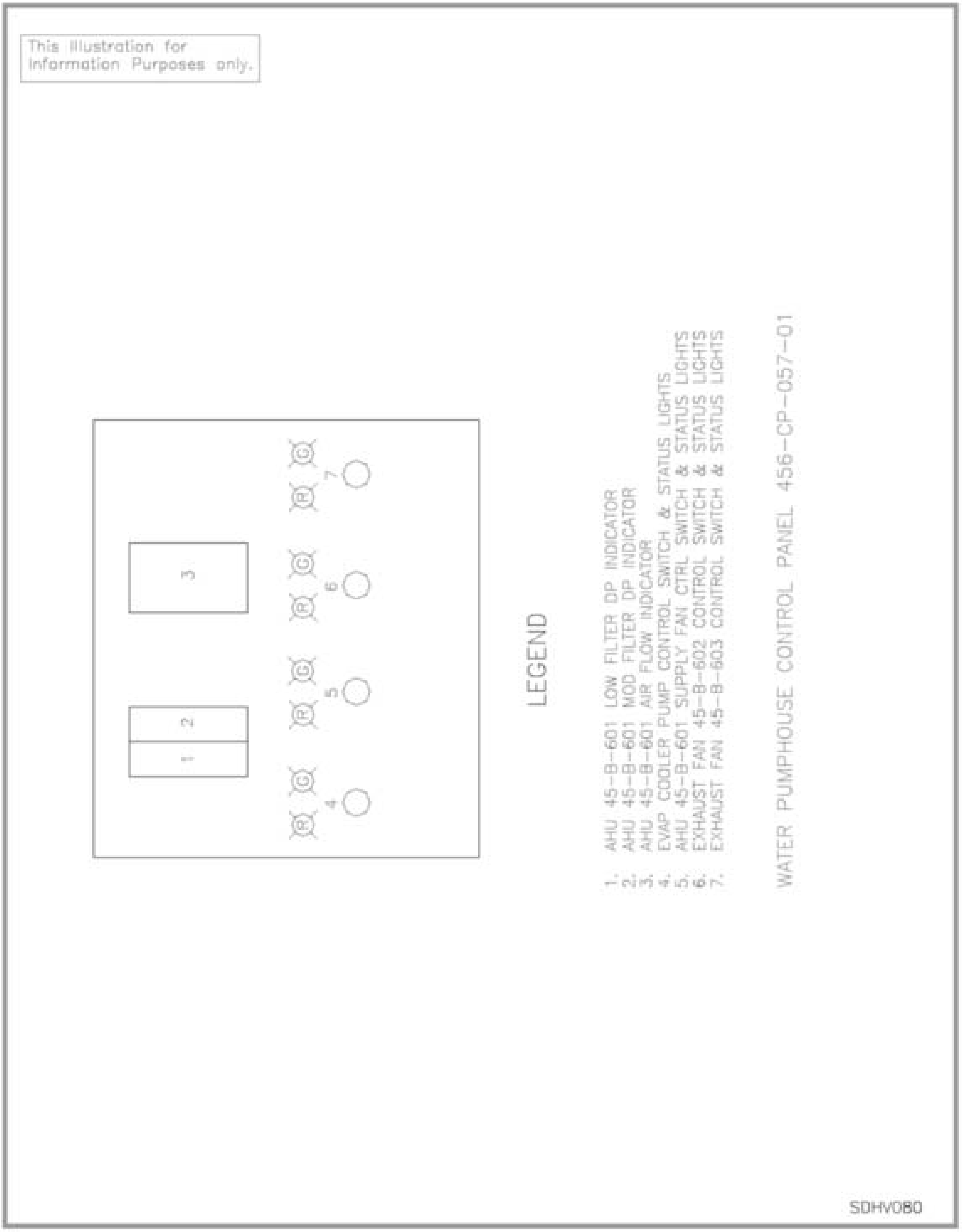

FIGURE HV VI-4: Water Pumphouse Control Panel Layout

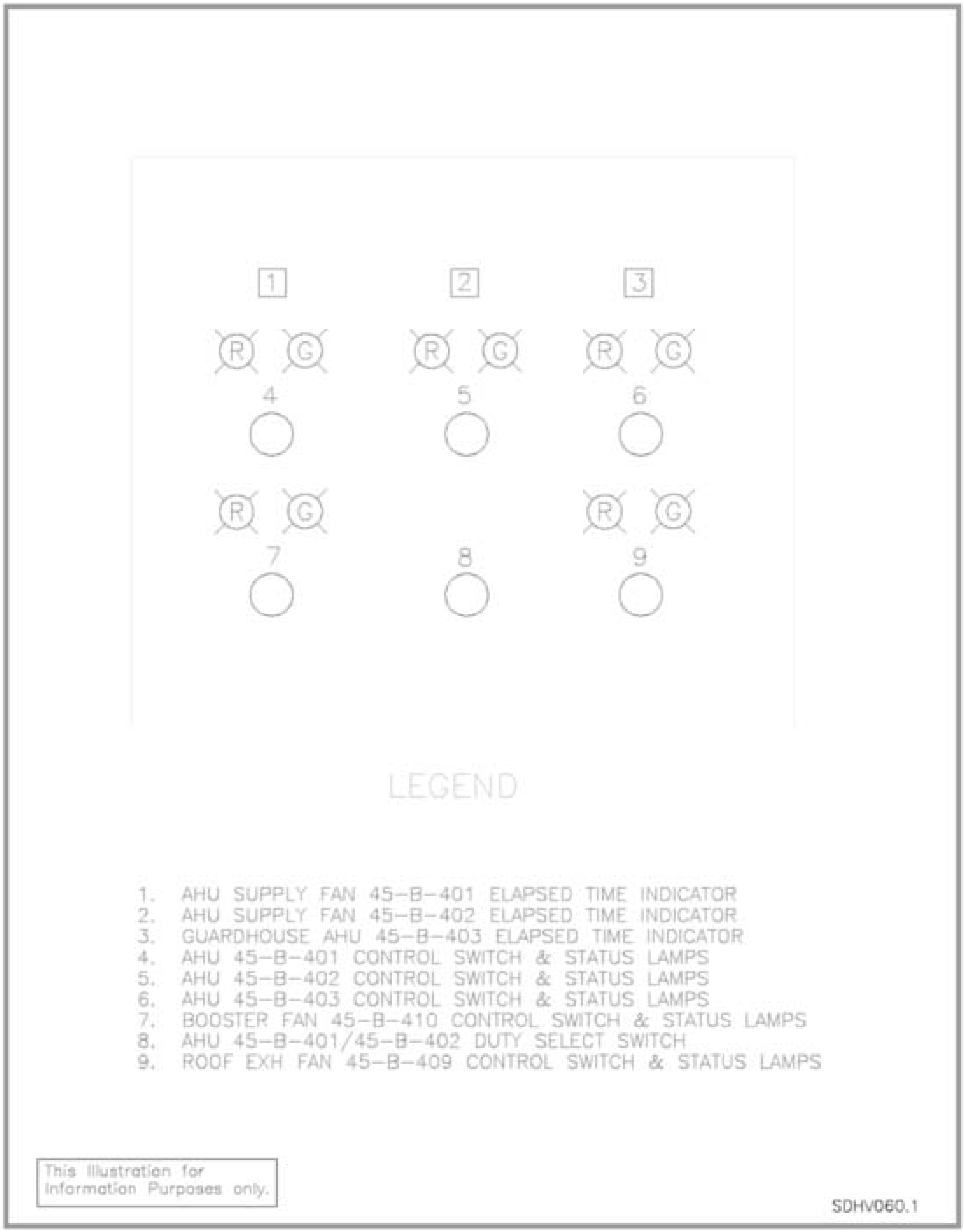

FIGURE HV VI-5: Guard & Security Bldg. HVAC Control Panel 458-CP-058-01

Chapter VII

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Subsystem CW02 Chilled Water Cooling System

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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.

Primary Loop

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.

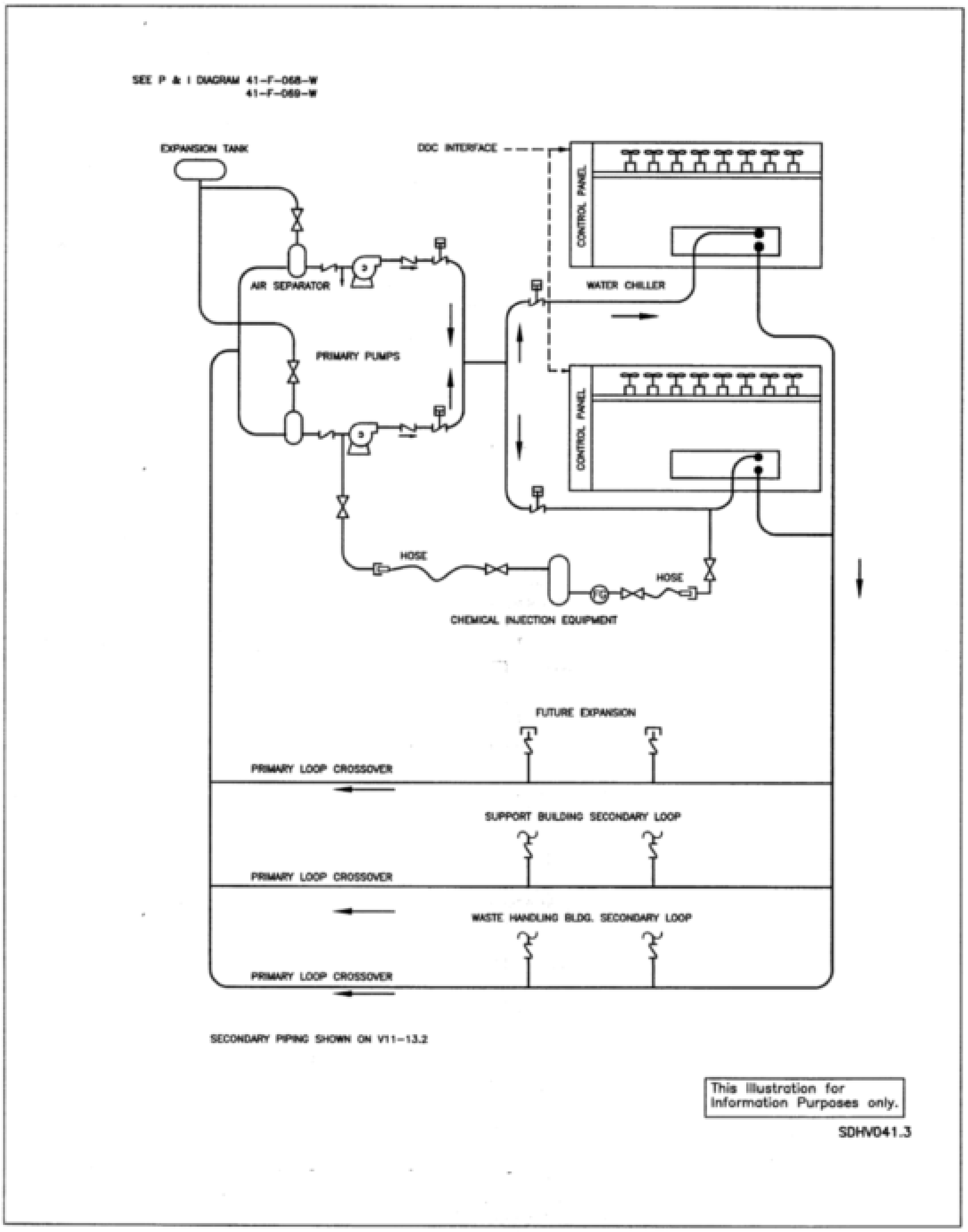

FIGURE HV VII-1: CW02, Waste Hdlg. Bldg. Chilled Water Subsystem Block Diagram

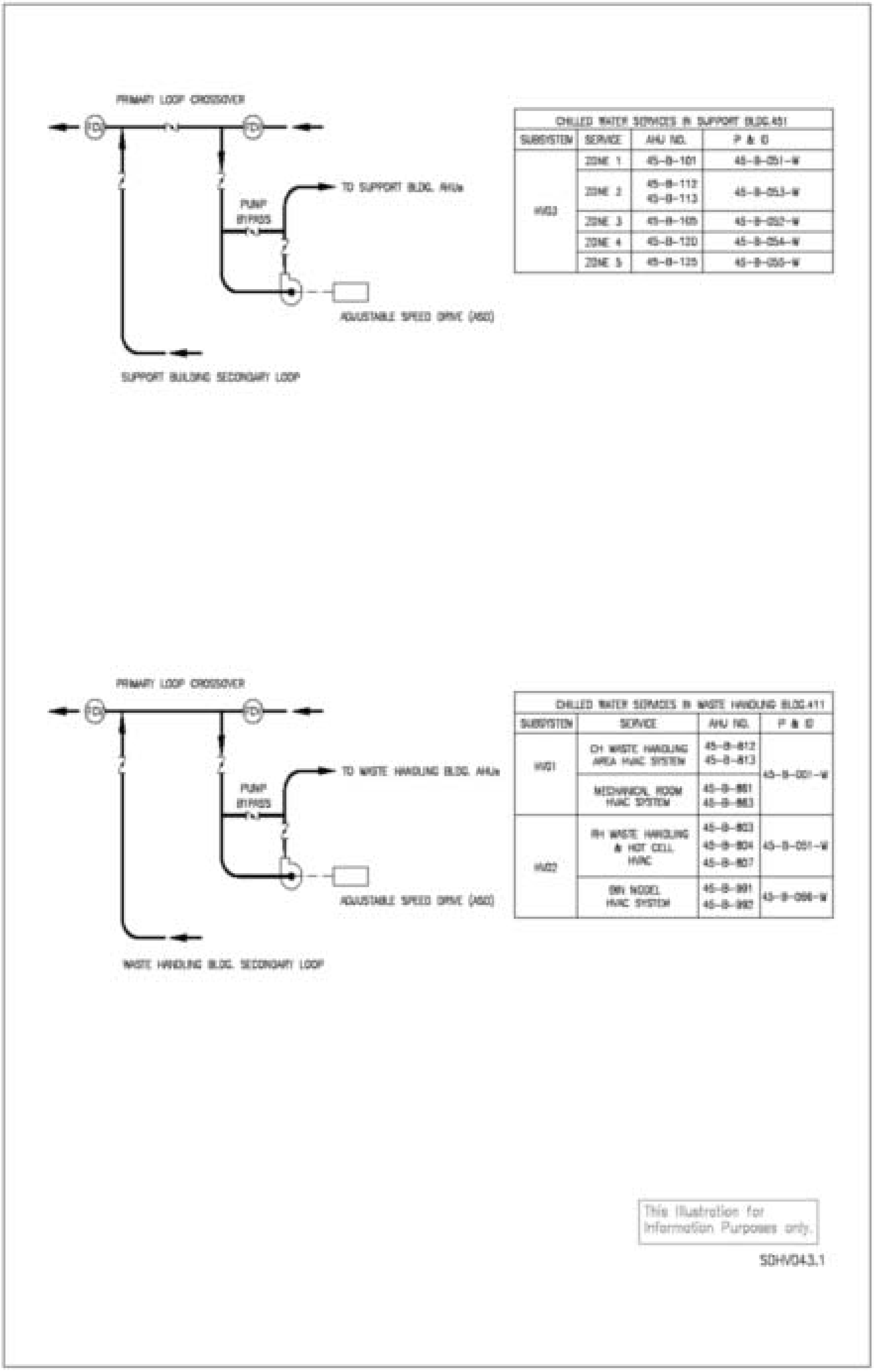

FIGURE HV VII-1A: CW02 Waste Hdlg. Bldg. Chilled Water Subsystem Block Diagram

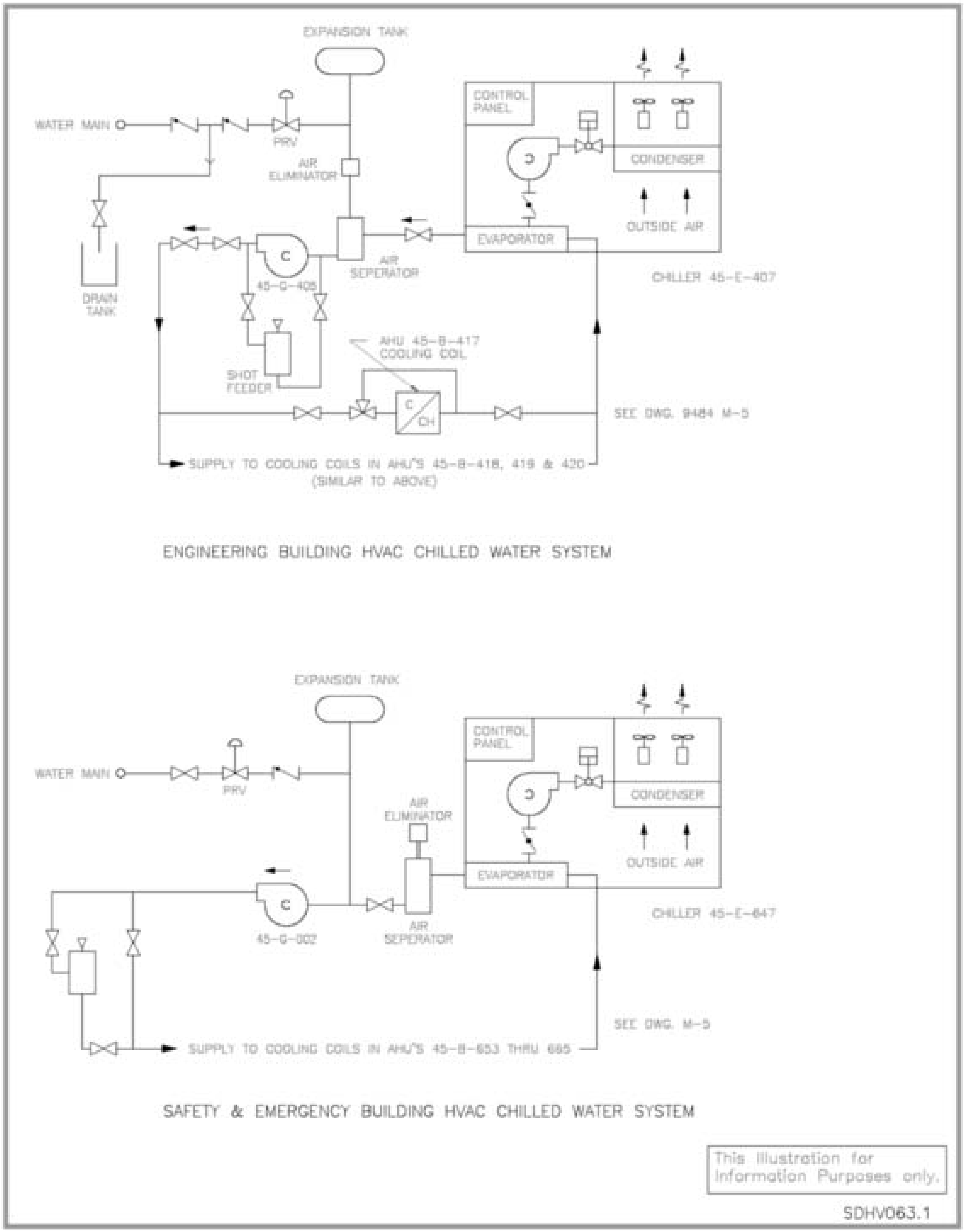

FIGURE HV VII-2: Block Diagrams of Chilled Water Systems in the Engineering and Safety and Emergency Buildings

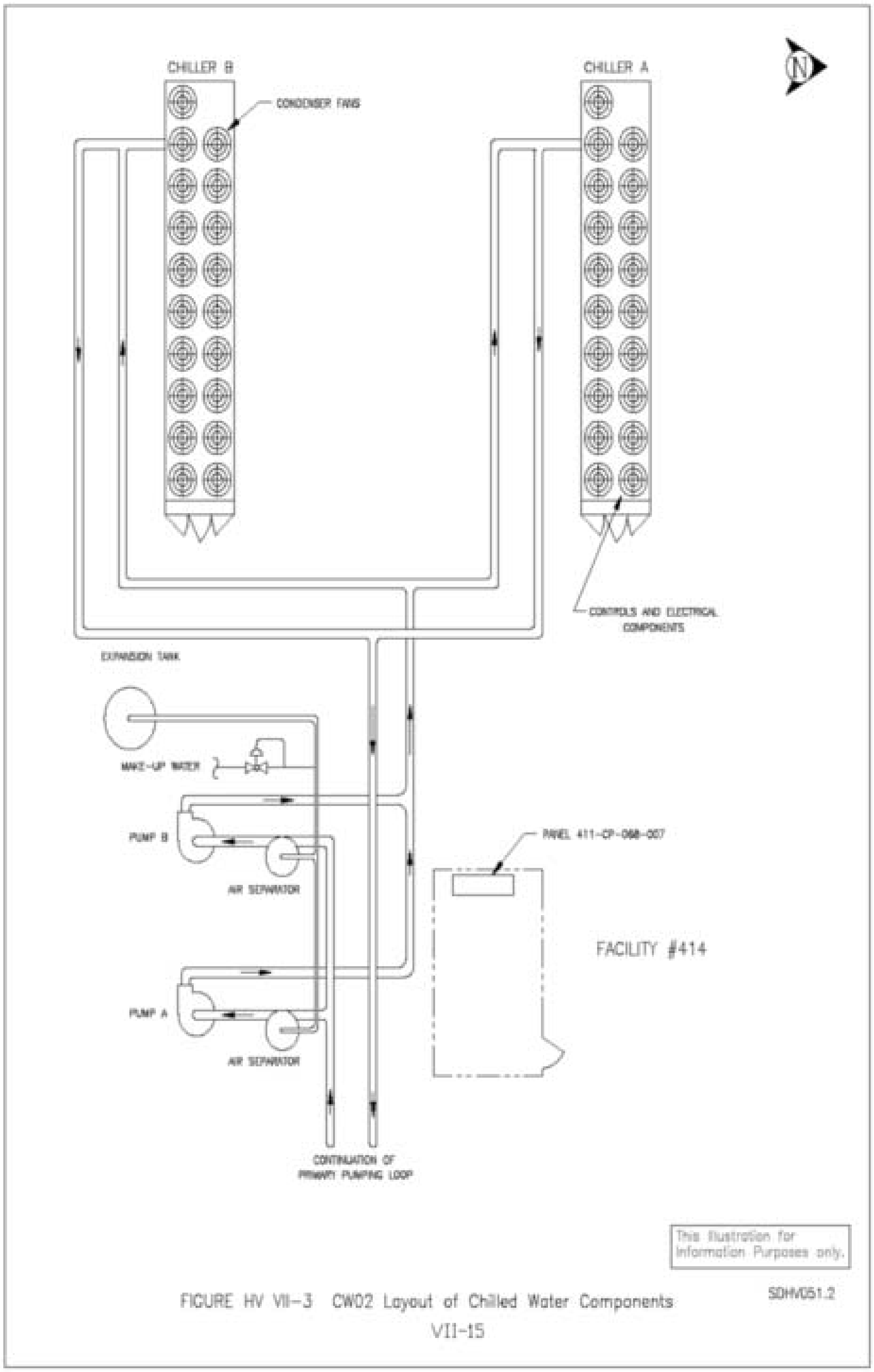

FIGURE HV VII-3: CW02 Layout of Chilled Water Components

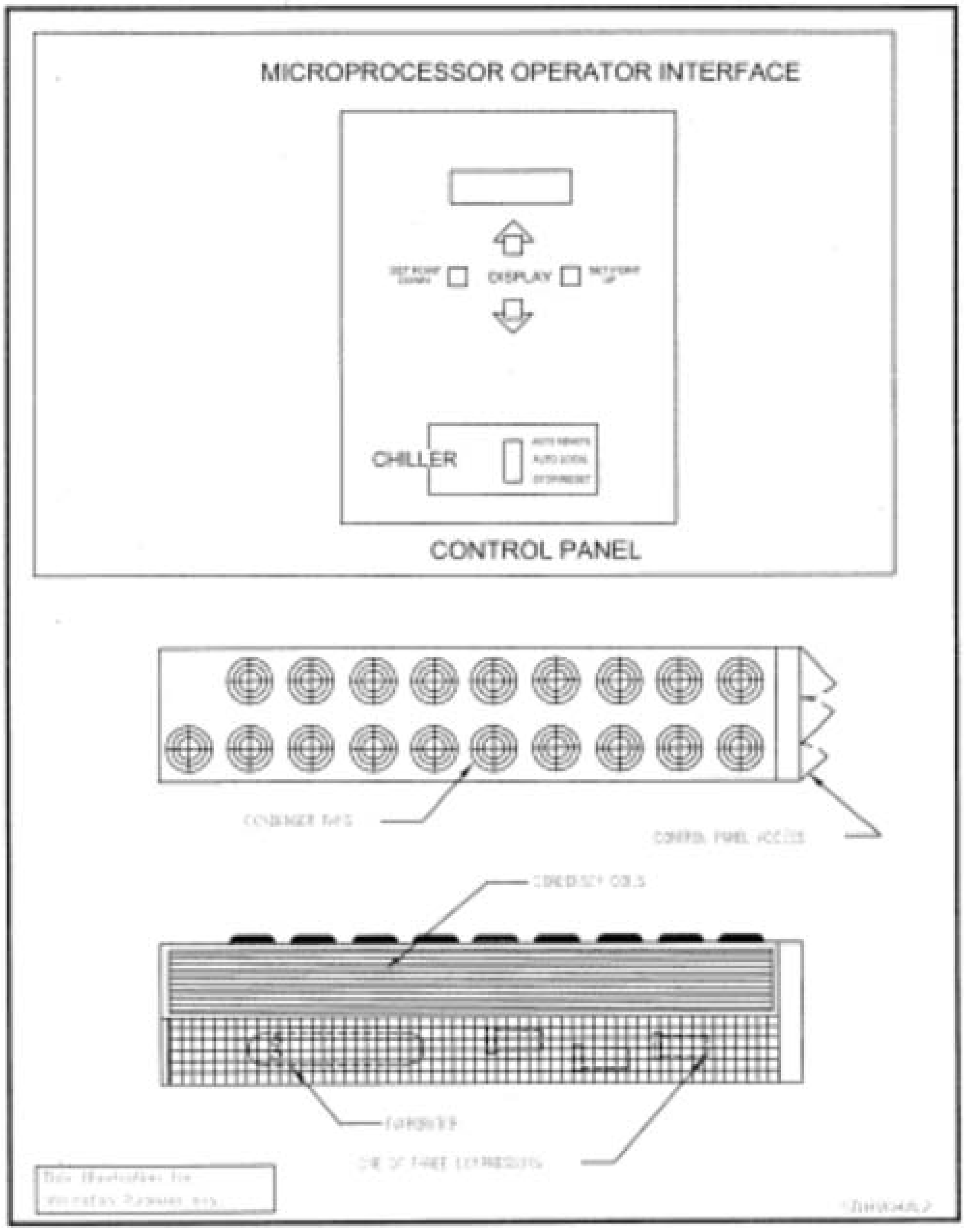

FIGURE HV VII-4: CW02 Chiller, Component Schematic and Panel Layout

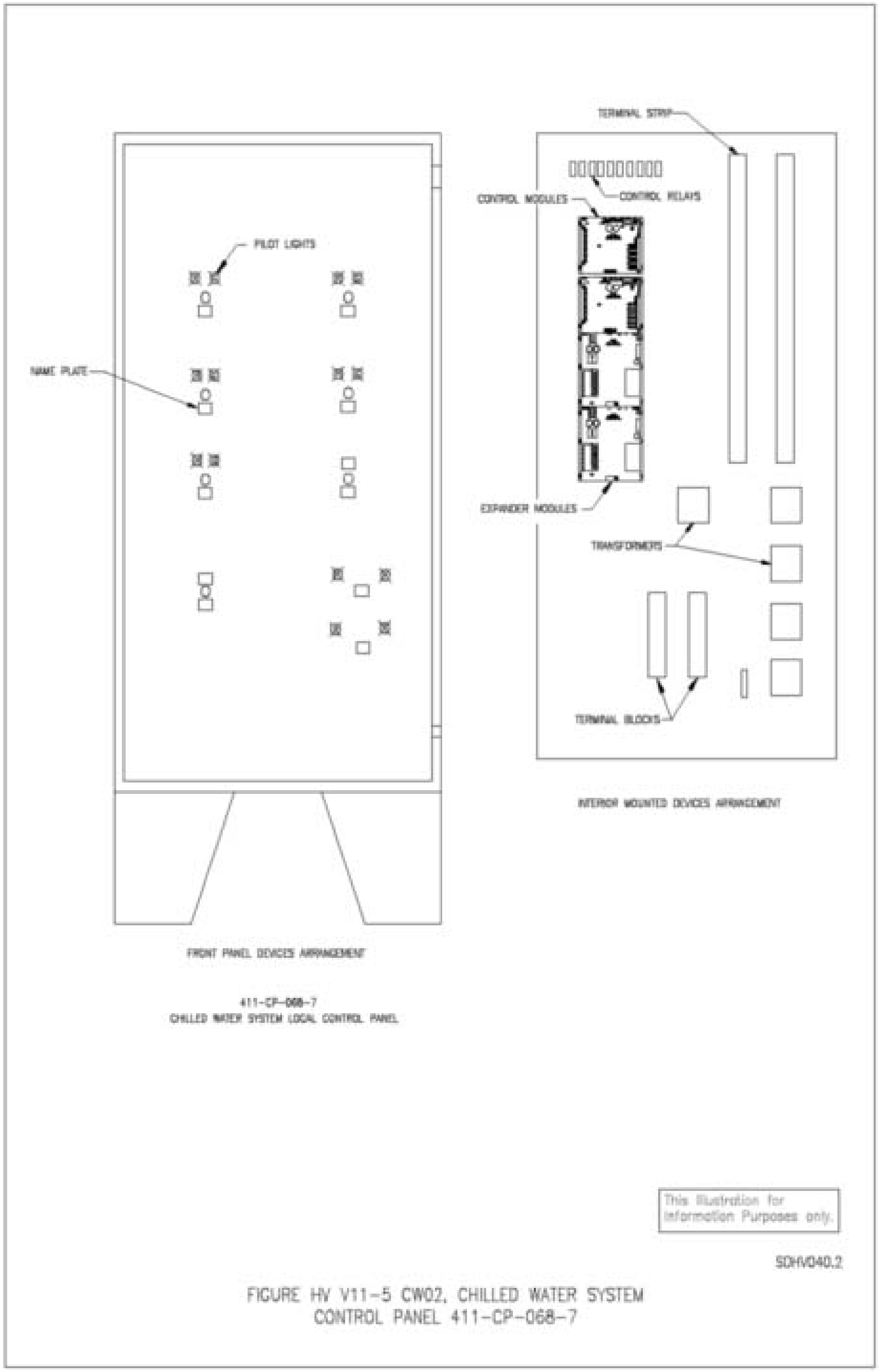

FIGURE HV VII-5: CW02 Chilled Water System Control Panel 411-CP-068-7 Layout

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]	-0.10[2]
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	Overpack and Repair	-0.19[6]	-0.23[6]	-0.20[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.
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	-0.19[6]	-0.23[6]	-0.20[2]
112	Site Generated Waste	-0.12[6]	-0.19[6]	-0.15[2]
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_2O 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

AHU 41-B-803 and AHU 41-B-804

General Service
Area Serviced: RH Area — Outdoor Design Temp: Winter, 19° F; Summer, 100/71° F — Indoor Design Temp: Winter, 65° F; Summer, 80° F
Location: Outdoor on WHB Roof

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 = 58°F 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 = 44/57°F 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 = 100/71°F 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, 100/71°F Summer, 80°F

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 = 57°F 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°F Flow = 100 GPM
Water side p.d. = 8.4 ft
Air Temp in = 100/71°F Air Temp out = 68/61°F 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 = 100/71°F Air Temp Out 75/71°F
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, 19°F
Indoor Design Temp: Winter, 40°F
Location: Indoor, Room 208 (Mech Room Annex) Summer, 100/71°F Summer, 95°F

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 = 21°F 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 = 44/55°F Flow = 20 GPM
Water side p.d. = 1.0 ft
Air Temp in = 100/71°F Air Temp out = 71/63°F 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 = 100/71°F Air Temp Out 75/71°F
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, 19°F   Indoor Design Temp: Winter, 50°F
Location: Indoor, RH Cask Receiving Area: Summer, 100/71°F   Summer, 104°F

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 = 44/54.8°F   Flow = 40 GPM
Water side p.d. = 2.8 ft
Air Temp in = 100/71°F   Air Temp out = 70/62°F   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, 19°F
Indoor Design Temp: Winter, 45°F
Location: Indoor, Hoist Room
Summer, 100/71°F Summer, 104°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 = 100/71°F	Air Temp Out 75/71°F
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.

Appendix C-1 – PRIMARY INTERFACE LIST

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-1 – PRIMARY INTERFACE LIST

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.