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U.S. DEPARTMENT OF ENERGY
WASTE ISOLATION PILOT PLANT

UNDERGROUND VENTILATION
SYSTEM DESIGN DESCRIPTION (SDD)

SDD VU00

Prepared by
Nuclear Waste Partnership LLC
Carlsbad, New Mexico

For

U. S. Department of Energy

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UNDERGROUND VENTILATION
SYSTEM DESIGN DESCRIPTION

SDD VU00

SUBSYSTEM APPROVAL

VU01 - EXHAUST FANS AND FILTERS

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VU02 - BOOSTER FANS & INSTALLED AUXILIARY FANS & DUCTS

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VU03 - VENTILATION CONTROL, BULKHEADS

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VU04 - LOCAL TEMPORARY VENTILATION

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VU05 - AIR INTAKE AND EXHAUST

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VU06 - REMOTE MONITORING AND CONTROL

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1	2/92	Revised Sect.1.0, 2.0, 3.3, & App Added Sect. 3.0, 4.0, 5.0, 6.0, 7.0	ECP 1-VU91-27 ECO NO. 6378
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SUMMARY

The underground ventilation system serves all underground facilities and provides a suitable environment for underground personnel and equipment during normal activities; confinement and channeling of potential airborne radioactive material in the event of an accidental release, or smoke and fumes in the event of an underground fire; and HEPA filtration of exhaust air to minimize any doses to the onsite personnel (within ALARA limits) and to minimize offsite releases. The Underground Ventilation system provides the equipment, controls and monitoring necessary to: 1) ensure that suitable underground air environment is present for underground personnel and equipment; 2) confine and channel potential airborne material resulting from an underground fire or release of radioactive material; and 3) provide HEPA filtration of the exhaust air if needed to minimize radiation dose to site personnel and to minimize offsite radiological release. Under normal operating conditions, the effluent exhaust is not filtered.

The air is supplied to the underground horizon, at 2,150 feet below the surface, through three shafts and exhausted through a single shaft by exhaust fans located on the surface. Standby HEPA filtration, also located on the surface, is engaged upon detection of radioactive particulates in the exhaust air stream.

The air drawn down the Air Intake Shaft (AIS) and the Salt Handling Shaft (SHS) is split into three separate air streams serving the construction, north area and waste disposal areas. The air drawn down the Waste Shaft (WS) serves the Waste Shaft station operation and is exhausted directly to the exhaust shaft station where it joins the exhaust streams of the other three areas. The combined exhaust streams are drawn up the Exhaust Shaft, and discharged directly to the atmosphere under normal operation or via the HEPA filtration system under certain off-normal conditions.

The status of the system equipment is continuously monitored, and the data is provided to the Central Monitoring Room, as well as local stations underground.

This SDD-VU00 includes six sub-systems which cover specific aspects of the Underground Ventilation System. These subsystems are:

- VU01 - Exhaust Fans and Filters
- VU02 - Installed Auxiliary Fans & Ducts
- VU03 - Ventilation Control, Bulkheads & Air Regulators
- VU04 - Local Temporary Ventilation
- VU05 - Air Intake Flow Paths and Exhaust
- VU06 - Remote Monitoring and Control

The organization of this SDD is shown in figure S-1.

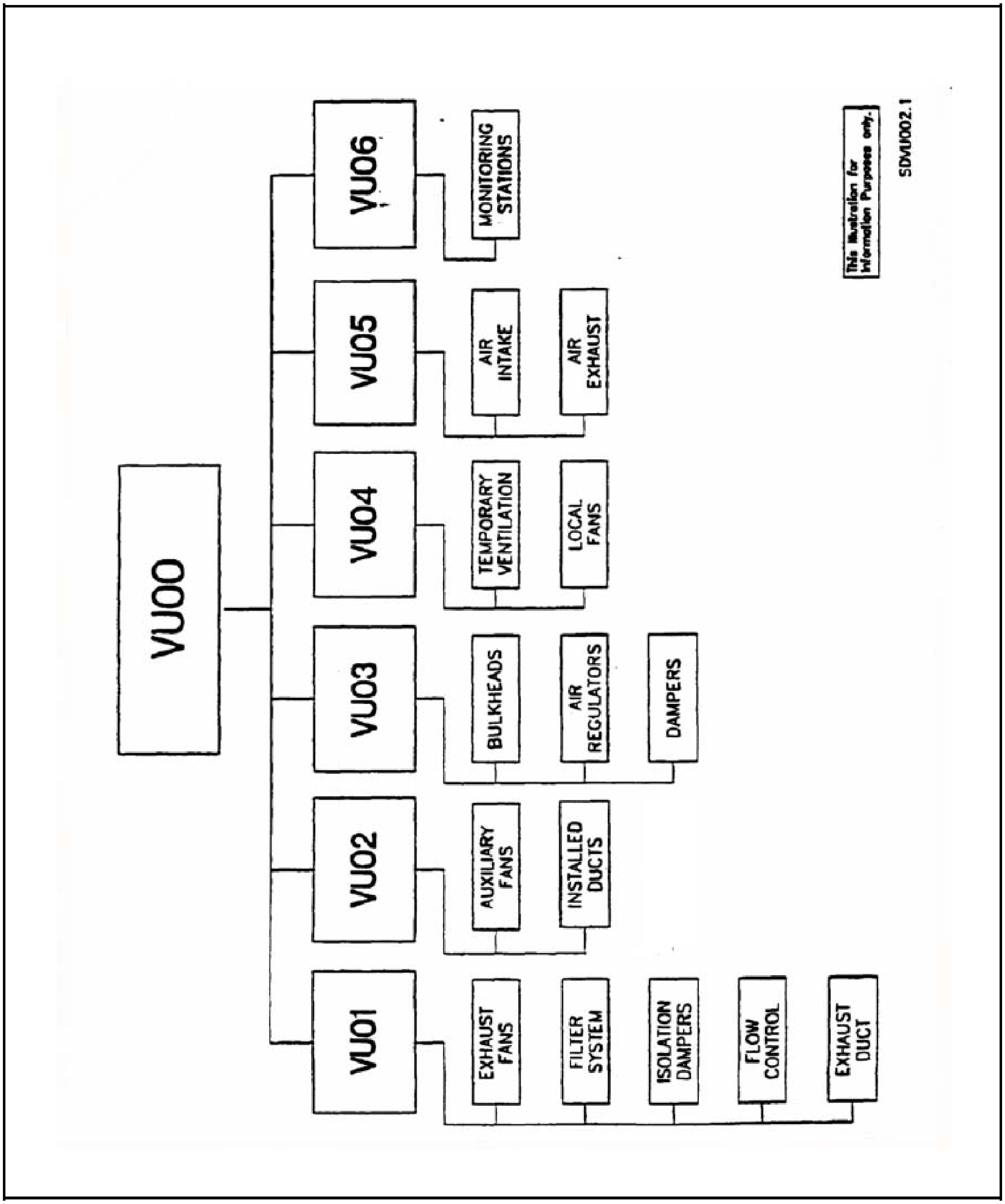

Figure S - 1 – Organization of SDD VU00

Chapter G
VU00 General Functions & Requirements
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Chapter G

UNDERGROUND VENTILATION SYSTEM

1.0 PRIMARY FUNCTIONS

1.1 Underground Ventilation System (UVS)

The UVS provides a continuous flow of fresh air to the array of underground drifts and rooms that constitute the operational disposal facility at WIPP.

1.2 The system provides a suitable environment for personnel and equipment operating underground during the normal site operations, and a life-sustaining environment during foreseeable operational occurrences and postulated waste handling accidents.

1.3 The system provides dynamic barriers that separate and control the flow of air to prevent the uncontrolled release of measurable amounts of radioactive material to the environment in the event that such material is released underground due to an internal accident or a severe natural phenomenon.

1.4 The system maintains a negative static pressure differential between the ventilated chambers underground and the above-ground environment such that all air flow is from the above ground environment.

1.5 Exhaust air containing measurable amounts of radioactivity will automatically be shunted through HEPA filters to remove the source of radioactivity before the air is released to the environment.

1.6 The air flow underground is divided into four separate flow paths having three supply sources and a common exhaust. One flow path supports the underground mining activities, one supports the north area activities, and the third supports the radioactive waste disposal operations. The mining and waste disposal circuits share a common exhaust downstream of the active disposal area. The fourth path supports the waste handling station. Pressure differentials are maintained between flow paths to assure that air leakage is always from areas of lower to higher contamination potential.

1.7 The system includes monitoring capability to show the operational status of all critical operating components of the system at the Central Monitoring Room (CMR).

2.0 DESIGN REQUIREMENTS

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

2.1 General

2.1.1 The UVS shall satisfy Order DOE 5480.1b (Reference 3) with regard to environment, health and safety requirements. It shall satisfy the requirements of the Mine Safety and Health Administration (MSHA), Title 30 CFR Part 57 (Reference 7) and the State of New Mexico Mine Safety Code for all Mines.

2.1.2 The UVS shall operate on a continuous basis to provide safe working conditions for personnel during normal operating conditions and a life sustaining environment during emergency conditions. The system shall be designed to operate under two modes of operation: Normal Mode (HEPA exhaust filtration system bypassed), and Filtration Mode (exhaust passed through HEPA filtration system).

2.1.3 All underground chambers shall be interconnected in a manner that allows circulation of air through the chambers. All chambers shall be located at a single level called the disposal horizon located about 2,150 feet below the surface.

2.1.4 The disposal horizon and surface shall be connected by four vertical shafts. The main air supply shall be brought down the Air Intake Shaft (AIS) with some air brought down the Salt Handling Shaft (SHS) and a relatively smaller amount of air flow shall be downcast through the Waste Shaft (WS) to preclude any potential contamination escaping through the WS and the Waste Hoist Tower to the atmosphere. Ventilation air from all underground areas shall be exhausted through the up-cast Exhaust Shaft (ES) by exhaust fans located on the surface, during Normal & Filtration Operations.

2.1.5 The system shall be designed to provide, with the AIS unobstructed, sufficient air to permit construction, waste handling and disposal, and north area operations to occur simultaneously on the same shift or shifts. With the AIS obstructed by the Galloway, there shall be sufficient air to permit construction and waste disposal operations to occur on separate shifts.

2.1.6 The fresh air flow from the UVS shall be divided into four separate streams. One stream supports construction (mining) activities, a second supports north area activity, and the third and fourth supports waste handling activities.

This separation shall commence as close to the Air Intake Shaft (AIS) Station and the Salt Handling Shaft (SHS) station as practical and be maintained through the air distribution streams to the Exhaust Shaft (ES) Station drift where all exhaust streams are combined.

2.1.7 A pressure gradient shall be established so that any air leakage is from the construction and north area streams to the waste handling areas.

2.1.8 The UVS shall have instrumentation and monitoring equipment to determine the status of specific components of the system on a continuous basis. The data shall be collected and monitored at a Central Monitoring Room (SDD CM00). Air quality shall be monitored locally with hand held equipment.

2.2 Subsystem Requirements

The Underground Ventilation System consists of six subsystems with separate subsystem designators. The subsystem-specific design requirements are presented in Section 2.2 within the SDD chapters identified in footnote G-1[1].

2.3 Operational Requirements

2.3.1 Normal Mode (Exhaust Filtration Bypassed)

The Normal Mode of ventilation shall be with the exhaust filtration system bypassed. Five different levels of Normal Mode ventilation can be established to provide five different air flow quantities. These five levels of air flow are achieved by the use of the various exhaust fans as follows:

- Normal Ventilation: Two of three main exhaust fans operating to provide 425,000 scfm unfiltered.
- Alternative Ventilation: Any one of the three main exhaust fans operating to provide 260,000 scfm unfiltered.
- Reduced Ventilation: Two of three filtration fans operating as ventilation fans to provide 120,000 scfm unfiltered.
- Minimum Ventilation: Any one of three filtration fans operating as a ventilation fan to provide 60,000 scfm unfiltered.

[1] G-1

[1] G-1	Chapter I:	Subsystem VU01; Exhaust Fans and Filters
	Chapter II:	Subsystem VU02; Installed Auxiliary Fans and Ducts.
	Chapter III:	Subsystem VU03; Ventilation Control, Bulkheads and Air Regulators.
	Chapter IV:	Subsystem VU04; Local Temporary Ventilation.
	Chapter V:	Subsystem VU05; Air Intake and Exhaust.
	Chapter VI:	Subsystem VU06; Remote Monitoring and Control

- Maintenance Ventilation: Any one or two of the three main exhaust fans operating in parallel with one or two of the filtration fans to provide approximately 260,000 to 425,000 scfm unfiltered.

2.3.1.1 The UVS shall generally operate in the Normal Ventilation Mode with two of the three main exhaust fans operating, the HEPA filter bypassed, the HEPA inlet shutoff damper closed, and the underground flow divided into four flow streams.

2.3.1.2 After an event involving shutdown of the ventilation system, and the ventilation fans have been shutdown in excess of two hours, entrance of personnel to the underground shall be controlled by the requirements of 30 CFR Part 57.

2.3.2 Filtration Mode

2.3.2.1 The filtration mode of ventilation is designed to confine airborne radiological contamination released by a breached waste container in the underground, minimizing any release to the environment.

Filtration shall be automatically initiated by detection of radioactive airborne contaminants above the set point(s) as described in SDD RM00.

2.3.2.2 Upon receiving an activating signal, the controls shall:

- Automatically shutdown
- Block-in and isolate the main exhaust fans
- Close the bypass dampers
- Start a filter exhaust fan, open the isolation block valves in the HEPA filter exhaust system
- Open the shut-off damper in the filter inlet plenum inlet duct.

To achieve an adequate confinement boundary, at least one isolation damper on each of the 700 series fans must close, and both of the bypass dampers must close. Interlocks are used to ensure the proper sequencing of the associated SSC operations. Periodic testing of the shift to filtration function shall be performed to ensure appropriate system operation. The Filtration Ventilation Mode shall also be capable of being established by the Central Monitoring Room (CMR) operator or by an operator at the local control panel in the Exhaust Filter Building (EFB).

2.3.2.3 In the event of a power loss, the UVS shall shut down, and if determined necessary, the Filtration Ventilation Mode shall be initiated manually at the local control panel in the EFB. This includes starting one of the filtration fans utilizing backup power. Upon power loss, the UVS dampers located on the surface, automatically align for filtration.

2.3.2.4 The flow quantity for this mode shall be compatible with the capacity of the HEPA filter system. This quantity of air will be considerably less than for the Normal Mode and all other underground operations shall be curtailed.

2.3.3 Design Conditions

2.3.3.1 UVS designs shall be based on the following surface ambient conditions:

- Design summer dry bulb 100°F
- Design summer wet bulb 71°F
- Design winter dry bulb 19°F

2.3.3.1.1 The thermodynamic effects of air moving down the shafts and up the shafts shall be taken into consideration in design calculations.

2.3.3.1.2 Mechanical cooling or heating of the air is not needed to maintain acceptable working conditions.

2.3.3.2 Air flow quantity shall be determined as follows:

2.3.3.2.1 Provide 100% cfm for each piece of operating diesel equipment.

The MSHA certified rating for each piece of equipment shall be used to determine flow rate requirements. If the certification is not available, 125 cfm/BHP shall be provided.

2.3.3.2.2 Personnel access into various areas shall be determined by MSHA air quality listed in 30 CFR Part 57, Subpart D.

2.3.3.2.3 A minimum velocity of 60 FPM shall be maintained in the active disposal room where rooms are being prepared for disposal.

2.4 Structural Requirements

2.4.1 All underground materials shall meet 30 CFR Part 57 requirements.

2.4.2 Ventilation exhaust filters shall have UL or equivalent rating.

2.4.3 Ventilation doors shall comply with the requirements of 30 CFR 57 Subpart G.

2.4.4 All bulkhead frames shall be constructed of noncombustible material. Special purpose bulkheads, such as fire-rated or insulated, shall be provided as required for a specific room.

2.4.5 All components used to maintain the separation of the four ventilation streams shall be adequate to support the maximum pressure differential that may occur.

2.4.6 Underground structures, with proper inspection, maintenance and adjustment shall be designed and installed in such a manner that they can accommodate ground movement (creep) without loss of function.

2.5 General Arrangement & Essential Requirements

2.5.1 The main exhaust fans shall be in multiple parallel arrangement.

2.5.2 System operations shall be controlled through and monitored by the Central Monitoring System (CMS). The airflow regulators (dampers) can be controlled through the CMS or locally at the damper. This is determined by the position switch at the damper (local/remote).

2.5.3 The mobile equipment, mechanical shop, and the fuel station shall be located on air circuits which exhaust directly into the exhaust stream.

2.5.4 Fire protection of the system shall be in accordance with the Fire Protection System, SDD-FP00.

2.5.5 Electric power supply to the UVS is maximum 4.16kv, 3 phase, 60 Hz power as described in SDD-ED00, Electrical System Surface and Underground. The UVS surface dampers shall fail safe (i.e., underground systems shall fail as is, and the exhaust fans shall fail off and isolated).

2.5.6 Backup Power for the system shall be provided by the backup power system diesel generators, described in SDD-ED00.

2.5.6.1 Upon loss of offsite power, any one filtration exhaust fan shall have the capability of being manually switched to the backup power system to maintain minimum ventilation of underground areas.

2.5.6.2 The exhaust fans used for the normal operating mode are not required to be connected to the backup power system.

2.5.6.3 The power source(s) for the damper position indicators, the differential pressure indicators, and the air velocity indicators shall be protected by uninterruptible power and shall operate without data loss for 30 minutes after a power failure.

2.5.7 Capability for stopping the main exhaust fans, and starting and stopping the filtration fans shall be provided both locally and remotely from the Central Monitoring Room (CMR) reference SDD CM00.

2.5.8 The design of the ventilation system shall accommodate backfilling and waste retrieval operations in the waste disposal room and drifts.

2.5.9 Backfilling of the waste disposal rooms shall be performed in a manner which will minimize the quantity of salt dust suspended in the disposal exhaust air. Similar steps shall also be taken during waste retrieval operations.

2.5.10 Decommissioning may include disassembly of the system components and decontamination as required. Alternate decommissioning could entail mothballing all or portions of the system.

2.5.11 The exhaust filter building (EFB) chambers that are in the flow stream path shall be designed for a negative pressure to atmosphere. A high efficiency shut off damper shall be used upstream of the inlet plenum to prevent positive pressure spikes from reaching the filters when switching fans or ventilation modes.

2.5.12 The system shall be designed to minimize the effects of natural ventilation pressure (NVP) considering both positive NVP, and negative NVP.

2.5.13 The auxiliary air intake tunnel (AAIT) shall have pressure relief dampers at the inlet to provide over-pressure protection to the Waste Handling (WH) tower. These dampers shall be normally closed, fail as is, and shall be configured to prevent a pressure differential across the walls of the WH tower greater than -3.0 in W.G. with respect to the outside.

2.5.14 The UVS shall have local ventilation ducts and auxiliary fans which are locally installed and operated to increase the air circulation in specific work areas. The operating status of these fans is not required to be monitored by the CMS.

2.6 Maintenance Requirements

2.6.1 Standard commercial maintenance shall be performed in conformance with manufacturer's recommendations.

2.6.2 Additional maintenance as required shall be performed following routine inspection. Calibration of instruments shall be in conformance with manufacturer's recommendations unless mining practice dictates increased frequency.

2.6.3 All components shall be arranged so that they can be isolated for normal and emergency maintenance.

2.6.4 Filters shall be designed for contact handling during filter replacement. Adequate space shall be provided between filter banks to permit inspection and replacement of filters. Filter arrangements shall be such as to permit testing of each stage of HEPA filters in accordance with Reference 1.

2.6.5 Contaminated filters shall be bagged and sealed per procedure.

2.7 In-Service Inspection Requirements

2.7.1 Equipment instrumentation shall provide notification of off-normal operation.

2.7.2 Periodic inspection of system components shall be performed at intervals recommended by equipment manufacturers.

2.7.3 The accuracy and proper operation of instruments shall be checked on a schedule to be determined by the operating contractor.

2.7.4 Locally mounted instruments shall be provided to permit periodic monitoring of the system reliability and impending malfunctions which could impair operations.

2.7.5 Each bank of HEPA filters shall be tested prior to operation and periodically thereafter to verify efficiency of 99.95 percent. Testing shall be in conformance with Reference 1.

2.7.6 A means to measure the static pressure drop due to airflow in the air intake shaft will be provided.

2.8 Instrumentation and Control Requirements

The Underground Ventilation System instrumentation and controls for the WIPP facility shall be designed in accordance with the requirements of 30 CFR Part 57 Subpart K as appropriate.

2.8.1 The UVS instrumentation and controls shall be designed to:

A. Control the start and stop of the UVS equipment to provide the required underground environmental conditions for normal operations.

B. Actuate valves, dampers and main regulators that control the flow of air underground.

C. Provide local controls for major components with limited manual and automatic controls at the Central Monitoring Room.

D. Provide regulators, bulkhead doors, local fans etc., as needed to balance and regulate the overall underground flow between working areas.

E. Initiate the automatic operation of the fans, dampers and shut off valves in the filtration system when off-normal concentrations of airborne radioactivity are indicated by continuous air monitors (CAMs) located in the underground.

F. Reconfigure the UVS following notification of underground fire, so as to restrict and redirect the spread of smoke resulting from the spread of fire and assist in the evacuation of underground personnel. This operational sequence shall not be automatic. It requires a considered decision by Operations.

G. Monitor the status of valves, dampers, motors, filters, doors, differential air pressures across bulkheads, air flow velocities and psychrometric conditions at selected stations.

H. Provide alarms in the event of unacceptable operating conditions.

2.8.1.1 The overall accuracy and repeatability of the instrumentation shall be as stated in appendix C "Instrument List" of this SDD.

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

2.8.1.3 Instrumentation installed into the underground ventilation system shall be designed and/or selected so that the manufacturers recommended operating conditions for temperature, relative humidity and pressure fall within the expected ambient range(s) of conditions in the repository.

2.8.1.4 Unless otherwise indicated, the instrumentation equipment shall be designed and installed to withstand the conditions that its related equipment has been designed to accommodate.

2.8.1.5 In-line instruments shall meet the design code of the components of the UVS or subsystem into which they are installed.

2.8.1.6 Underground ventilation air flow shall be controlled by the variable pitch inlet vanes of the centrifugal exhaust fans and by adjusting the air regulators at strategic locations underground.

2.8.1.7 Exhaust filtration can be initiated from the CMS or Local Control Panel.

The central monitoring system (CMS) monitors the ventilation system. Measurement and equipment status signals are connected to local panel and Local Processing Units (LPUs) in various locations, and data are passed between the LPU and the CMS via a data highway. Where required, control functions are fitted to the LPUs. See Plant Monitoring and Communication System SDD-CM00.

2.8.2 The following items shall be monitored:

- Flow rate quantities
- Differential pressure across each filter bank
- Differential pressure across selected bulkheads underground
- Psychrometric data for air intaking and exhausting each shaft
- Access doors in selected bulkheads (open or closed)
- Ventilation doors and regulator status
- Isolation valve and damper position status
- Fan operating status (on and off)
- Bypass or filtration mode
- Main fan vibration levels

2.8.2.1 Major underground and surface air regulators and ventilation doors shall be capable of being monitored and operated remotely from the Central Monitoring System (CMS) in the Support Building. In addition, underground control stations shall be provided so that air regulators can be adjusted locally. Manual overrides shall be provided, where appropriate.

2.8.2.2 Air flow quantity shall be monitored and displayed in the CMR and locally.

2.8.2.3 An unacceptable operating condition of the ventilation system shall result in automatic notification to the CMS.

2.8.2.4 For fire protection controls see Fire Protection Systems, SDD-FP00.

Operating status of major equipment, flow at central locations, pressure differentials across HEPA filters and pressure differentials between critical points shall be monitored.

2.9 Interface System Requirements

The interfacing systems are divided into primary and secondary interfaces defined as follows:

A. Primary System Interfaces

The primary system interfaces are requirements placed on other systems by the Underground Ventilation System.

B. Secondary System Interfaces

The secondary system interfaces represent requirements placed on the Underground Ventilation System by other systems.

System VU00 is the primary system in interfaces with the systems listed below. A brief description of each primary interface is provided in section 3.7 of each VU subsystem chapter.

System	Title
AU00 U/G	Facilities and Equipment
CA00	Compressed Air System
CF00	Plant Buildings, Facilities & Misc. Equipment
CM00	Plant Monitoring and Communication System
ED00	Electrical Distribution System
EM00	Environmental Monitoring System
FP00	Fire Protection System
GC00	General Civil and Structural
PC00	Plant Communications System
RM00	Radiation Monitoring
UH00	Underground Hoisting System

System VU00 has a secondary interface with the systems listed below. A brief description of each secondary interface is included in section 3.7 of each VU subsystem chapter.

System	Title
AU00 U/G	Facilities and Equipment
CF00	Plant Buildings, Facilities & Misc. Equipment
CM00	Central Monitoring System
EM00	Environmental Monitoring System
FP00	Fire Protection System
RM00	Radiation Monitoring
UH00	Underground Hoist System

2.10 Quality Assurance Requirements

2.10.1 To assure that the required quality is achieved for all aspects and activities of the WIPP, A comprehensive Quality Assurance program shall be implemented and controlled in conformance with 10 CFR 830.120, and General Plant Design Description (GPDD) as set forth in the U.S. Department of Energy Carlsbad Area Office (DOE-CAO) *Quality Assurance Program Description* CAO-94-1012.

2.10.2 Design specifications, equipment specifications, technical specifications, and drawings for the system, its components and equipment, structures, and services related thereto shall contain Quality Assurance (QA) program requirements appropriate to the item or scope of work being defined or specified. These specifications shall also define quality assurance practices such as inspections, examinations, and tests appropriate to the specified item or service.

2.10.3 A graded approach for application of QA requirements shall be used. Application of the requirements as specified in 2.10.1 shall be determined in a manner consistent with the relative risk and functional importance of the item or service involved.

2.11 Codes and Standards Requirements

The design, construction, and operation of the UVS shall be in accordance with the following documents, using the latest issues or revisions in effect at the time of contract placement:

Title 30 CFR Part 57	"Safety and Health Standards - Underground Metal and Non-Metal Mines"
10 CFR 830 §A	"Quality Assurance Requirements"
DOE Order 420.1B	*Facility Safety*
DOE Orders 430.1B	*Real Property Asset Management*
DOE-STD-3020-2005 Contractors	Specification for HEPA Filters Used By DOE
ANSI N509	*Nuclear Power Plant Air-Cleaning Units and Components*
ANSI N510 Systems	*Standards for Testing of Nuclear Air Treatment*
AWS Welding Code	(D1.1, D1.3, D9.1, etc....)

UBC	Uniform Building Code
AISC M011	*Manual of Steel Construction*, 8th Edition

2.12 Reliability Requirements

2.12.1 All components of the underground ventilation system, with appropriate maintenance, shall have A design life of 25 years.

2.12.2 The filtration exhaust fans for filter mode operation shall have 200 percent redundancy (three fans with 100% capacity each).

2.12.3 Any two of the three main exhaust fans can be operated in parallel. The loss of a main exhaust fan can place operational restrictions on underground activities.

2.12.4 During a loss of offsite power, the exhaust filter system shall fail safe. The bypass valves and main exhaust fan isolation valves shall fail closed, and the HEPA filter isolation valves and shutoff damper shall fail open.

2.12.5 The exhaust filtration fans shall be electrically connected to permit manual switching to backup power. At least one of three filtration fans can be run on backup power.

2.12.6 The underground air flow regulator motorized dampers shall fail as is.

3.0 DESIGN DESCRIPTION

3.1 Summary

The Underground Ventilation System (UVS) provides safe and effective ventilation to the personnel and equipment in the underground facilities of the WIPP.

Air is drawn into the underground works through three vertical shafts, distributed throughout the underground horizon, drawn up through the exhaust shaft, filtered if necessary, and returned to the atmosphere by the exhaust fans.

Figure VU G-1 is a pictorial diagram of the underground ventilation of the WIPP facility. This figure illustrates the split of the fresh air into separate air streams to supply the waste disposal area, the construction (mining) area and the north area, and the Waste Shaft (WS) station.

Figure VU G-2 is a simplified isometric drawing of the underground air flow system. This illustrates the physical relationships of the main parts of the system.

Air is drawn down through the Air Intake Shaft (AIS) and the Salt Handling Shaft (SHS), split into three air streams to feed the waste disposal area, the construction area and the north area. These three air streams converge and are drawn up by the fans on the surface.

Additional air is drawn through the Auxiliary Air Intake Tunnel (AAIT) and down the WS to supply the unloading station at the base of the WS and exhausted directly to the ES.

Air flow dampers and regulators provide the capability to adjust the absolute and relative air flow rates in any of the air flow streams.

System VU00 has six subsystems which act in concert to provide the complete underground air system.

Refer to section 3.1 of the subsystem chapters (see footnote G-1) for subsystem-specific summary design descriptions.

3.2 Detailed System Description

The six subsystems of the underground ventilation system together provide safe, effective and controlled ventilation to the underground operations of the WIPP facility.

The WIPP underground has been mined with nearly all drifts and rooms running north to south or running east to west. Locations in the underground are identified with a coordinate system centered on the Salt Handling Shaft. A drift which runs north-south and is located 300 feet east of the SHS is identified as E300. A location in drift E300 which is located 90 feet south of the SHS is identified as E300/S90. The ES is located at S400/E475 and the AIS is located at N0/W625.

Refer to section 3.2 of the subsystem chapters (see footnote G-1) for subsystem-specific detailed design descriptions.

3.3 Performance Characteristics

There are multiple operational modes for underground ventilation depending on which equipment is available and whether off-normal conditions exists, such as a radiation release. The operational modes can be identified as:

1. Normal Modes - Surface Fans Without Filtration

1a)	Normal	Two Main Exhaust Fans
1b)	Alternate	One Main Exhaust Fan
1c)	Reduced	Two Filtration Fans
1d)	Minimum	One Filtration Fan
1e)	Maintenance	One Main Exhaust and One or Two Filtration Fans

2. Filtration Mode - Filters + One Filtration Exhaust Fan

3.3.1 Air Flow Surface/Underground

Air flow values for the underground in this section are given in actual local flow values. The air is compressed as it moves down the shafts by 6% to 10% so that the volumetric flow at the disposal horizon is smaller by that same percentage than the free air at the surface. The air is heated or cooled as it passes through the underground, resulting in additional volumetric flow changes. The air stream distribution values given are not completely independent measurements because of air leakage past bulkheads.

Therefore, in general, the sum of the air stream distribution values will not match the shaft air flows.

Filtration and Minimum Flow Modes are special cases. The Natural Ventilation Pressure effects, combined with leakage, result in the air flow in the AIS and SHS being undefined in the tables except that the net flow is the difference between the WS and ES flows.

3.3.2 Air Pressure Limits

The air pressure differential limitations arise from the nuclear requirements not from the mining requirements.

The handling of radwaste in the underground begins as it is unloaded from the Waste Hoist at the Waste Shaft Station. From there it is moved east through S400 to E140, then south through E140, then east or west through the cross drift leading to the active disposal panel and stored in a waste disposal room. All of this area is potentially a source of airborne radioactivity if an off-normal event occurs.

The fresh air from the WS flows through S400 to the ES with some diverted into E140 and returned to S400 by ducts and fans. Fresh air from the AIS and the SHS flows south through W30 with no possibility of direct contamination until this stream is split at W30/S1000. The waste disposal air stream splits off at W30/S1000, flows through E140, into the active disposal panel, through the active disposal room and returns to the ES via E300. The mining air is further split into two parts. Air used to ventilate the working face (where the continuous miner is excavating salt) is routed to the ES via E300 where it merges with the disposal area air. Air not used to ventilate the face is routed via W170 to the ES.

The potential for contamination and the air flow patterns define the following areas as the Radioactive Materials Area (RMA):

A. The S400 drift

B. The E140 drift south of S90 along with open side drifts

C. The E300 drift south of S90

D. The waste disposal panels

E. S90 drift between E140 and E300

Operationally it is important to ensure that leakage between air streams does not transport contamination to areas outside the Waste Handling Area. During forced flow it is required that the mining airflow side be 0.05 inch wg positive with respect to the Waste Handling Area side where the potential for contamination exists. This is monitored and regulated at locations as described in chapter VI, section 3.5.

3.3.3 Normal Ventilation

Full ventilation is the normal operating condition for the facility. Normal ventilation uses two of the three main exhaust fans with all other fans isolated.

3.3.3.1 Air Flows

Operation of any two of the three main exhaust fans results in underground airflows substantially in excess of the minimum requirements defined in section 2 and allows simultaneous operations at the design level in all areas.

NOTE

The airflow distribution down-casting the three (3) intake shafts does vary according to changes in the surface ambient psychrometric conditions. The total quantity up-casting the exhaust shaft does not vary significantly. For the typical airflow quantities refer to the most recent version of the document "Testing and Balancing of the Underground Ventilation System at the WIPP facility" and the WIPP drawing 54-W-001-W latest Revision.

The main air flow pattern of the underground distribution for this mode is illustrated on figure VU G-3. Approximate air flows in the different air streams are shown in table VU G-1.

Table VU G - 1– Underground Full Ventilation Air Stream Distribution

Disposal Area	170,000 ACFM
Construction Area	140,000 ACFM
Waste Shaft Station	70,000 ACFM
North Area	80,000 ACFM
	460,000 ACFM

Refer to the current version of the Mine Ventilation Plan, Document 00CD-0001 for air stream configuration.

3.3.3.2 Air Pressure Levels

For typical flow conditions in normal full ventilation the air pressure differential requirement is met. Hot surface air (100°F or greater) could cause the differential pressure from drift W30 at S400 to the waste shaft station to decrease and the differential pressure constraint might be violated. The pressure chamber in drift S400 will be activated, if necessary to maintain desired differential pressure, during waste handling operations in the waste shaft and/or waste shaft station area. See section 3.5.3 of VU03. The pressure is maintained in the chamber until waste handling operations in the waste shaft and/or the waste shaft station area is completed. With pressure in the pressure chamber at least 0.05 inch wg above that at the WS station, no leakage from the Waste Shaft Station into W30 will occur.

3.3.4 Alternate Ventilation

Alternate operation has one main exhaust fan operating and conveying all air flow from the underground. This produces approximately 260,000 CFM total flow. All other fans are isolated. See note 1 in section 3.3.3.1.

3.3.4.1 Air Flows

The alternate ventilation mode results in reduced airflows in each circuit except the North Area. Underground operations are restricted to utilization of the air flow present. The operational effect of this is a limit on the operation of diesel powered equipment.

The main air flow pattern of the underground distribution for this mode are the same as figure VU G-3. The magnitude of the air flows in the different air streams are shown in table VU G-2.

Table VU G - 2 – Underground Alternate Ventilation Approximate Air Stream Distribution

Disposal Area	100,000 ACFM
Construction Area	60,000 ACFM
Waste Shaft Station	50,000 ACFM
North Area	80,000 ACFM
	290,000 ACFM

3.3.4.2 Air Pressure Levels

With the lower air flows associated with alternate ventilation mode the differential pressures between circuits is reduced. The differential pressure between W30 and the WS Station may fall below the minimum acceptable level on hot days. The pressure chamber operation will protect this point during waste handling operations in the waste shaft and/or waste shaft station area.

3.3.5 Reduced Ventilation

Two of the three filtration exhaust fans are operated in parallel to achieve 120,000 CFM with the bypass dampers open. The three main exhaust fans, the remaining filtration exhaust fan and the HEPA filters are isolated. See note 1 in section 3.3.3.1.

3.3.5.1 Air Flows

The main air flow paths of the underground distribution for this mode are the same as figure VU G-3. Approximate air flows in the different air streams are shown in table VU G-3.

Table VU G - 3 – Underground Reduced Ventilation Approximate Air Stream Distribution

Disposal Area	42,000 ACFM
Construction Area	41,000 ACFM
Waste Shaft Station	14,000 ACFM
North Area	25,000 ACFM
	122,000 ACFM

3.3.5.2 Air Pressure Levels

With the lower air flows associated with reduced ventilation mode the differential pressures between circuits are reduced. The differential pressure between W30 and the WS Station may fall below the minimum acceptable level on hot days. The pressure chamber operation can maintain differential pressure at this location as required.

3.3.6 Minimum Ventilation

One of the three filtration exhaust fans is in operation to achieve 60,000 CFM with the bypass dampers open. The three main exhaust fans, the remaining filtration exhaust fans and the HEPA filters are isolated. The normally open doors in the bulkhead in E300 at S350 are closed and the regulators in the bulkhead in S1000 at E20 are closed. These two changes in the underground regulation, which are performed automatically in the transition to filtration mode, are performed manually for this mode. See note 1, section 3.3.3.1.

3.3.6.1 Air Flows

At this level of air flow the distribution between the air supply shafts is radically different from full ventilation. If no change is made in the underground air regulation, the bulk of the flow comes down the WS and goes directly over to the ES. A small amount of flow from the AIS and the SHS will pass through the remainder of the underground. Note that at this level of air flow, the actual air flow values are strongly influenced by surface temperatures; see the discussion of Natural Ventilation Pressure below. Underground operations are restricted to utilization of the air flow present. The operational effect of this is a limit on the operation of diesel powered equipment.

The minimum ventilation underground distribution is illustrated on figure VU G-4. The air flows in the different air streams are as shown in table VU G-4.

There is very little air flow in the active disposal panel in this mode unless an administrative decision is made to divert flow. This can be accomplished by locally opening the air lock in E140 to allow air flow from the WS Station to go south through E140. Simultaneously closing the air regulators in S400 at E300 forces nearly all the WS flow into E140, through the disposal panel and back to the ES.

Table VU G - 4 – Underground Minimum Ventilation Approximate Air Stream Distribution

Disposal Area	10,000 ACFM
Construction Area	0 ACFM
Waste Shaft Station	50,000 ACFM
North Area	0 ACFM
	60,000 ACFM

Note: Disposal Area flow may be increased to 60,000 CFM by diverting the WS flow.

3.3.6.2 Air Pressure Levels

With the low flows of minimum ventilation the differential pressures would be reduced. With the bulkheads in E300 and S1000 closed to isolate the north and mining areas from the ES, there is no problem with leakage. The S400 and E140 drifts will be running at a reduced pressure close to the ES Station pressure and will prevent leakage from the Waste Handling Areas. If flow is diverted through the disposal area, E140 pressure is still acceptably low.

3.3.7 Filtration Ventilation

Filtered operation is only used when the underground CAMs signal that radiation has been detected in the underground or when deemed necessary by the Central Monitoring Room Operator.

The system dampers on the surface are set so that the air from the ES is ducted into the inlet plenum of the HEPA filter banks. One of the three filtration exhaust fans is in operation to achieve 60,000 CFM flow through the underground and the HEPA filters. The normally open doors in the bulkhead in E300 at S350 are closed, the regulators in the bulkhead in S1000 at E20 are closed, and the regulators in the bulkhead in E300 between the Construction Circuit and the Waste Handling Circuit are closed. These three changes in the underground regulation are performed automatically in the transition to filtration mode. See note 1 in section 3.3.3.1.

3.3.7.1 Air Flows

The bulk of the flow which comes down the WS goes directly to the ES. A small amount of flow from the AIS and the SHS will pass through the remainder of the underground. Note that at this level of air flow, the actual air flow values are strongly influenced by surface temperatures; see the discussion of Natural Ventilation Pressure below. Underground operations are restricted to utilization of the air flow present. The operational effect of this is a limit on the operation of diesel powered equipment.

The filtered ventilation underground distribution is illustrated on figure VU G-5 and table VU G-5.

Table VU G - 5 – Underground Filtration Ventilation Approximate Air Stream Distribution

Disposal Area	0 ACFM
Construction Area	0 ACFM
Waste Shaft Station	60,000 ACFM
North Area	0 ACFM
	60,000 ACFM

There is very little air flow in the active disposal panel in this mode unless an administrative decision is made to divert flow. This can be accomplished by locally opening the air lock in E140 to allow air flow from the WS Station to go south through E140. Simultaneously closing the air regulators in S400 at E300 forces nearly all the WS flow into E140, through the disposal panel and back to the ES. The result is an airflow distribution as shown in table VU G-5.

3.3.7.2 Air Pressure Levels

The differential pressures are the same as for the case of Minimum Ventilation.

3.3.8 Natural Ventilation Pressure

The air flow in the underground is driven by the negative pressure induced by the exhaust fans. There is a second pressure resulting from the difference in density of the air in the various air shafts. This is called the natural ventilation pressure (NVP) and is a consequence of different air densities in the intake and exhaust shafts.

3.3.8.1 Hot Weather NVP

During hot weather, the air going down to the underground is warmer and less dense (lighter) than the air returning from the underground. Hence in hot weather there is an NVP which opposes the fan pressure.

This reduces the flow and reduces the differential pressures between the Waste Handling Area and the other areas. The air in the WS will be cooler than that in the AIS and SHS which further reduces the WS Station to W30 differential.

3.3.8.2 Cold Weather NVP

During cold weather, the air going down to the underground is colder and more dense (heavier) than the air returning from the underground. Hence in cold weather there is an NVP which augments the fan pressure. The positive NVP reduces the fan (constant flow control) suction pressure, increases the downcast air flow in one or more air shafts and increases the differential pressure between the Waste Handling Area and other areas.

The air feeding the WS comes partly from leakage from the auxiliary air intake tunnel, partly from leakage into the waste hoist tower and partly from the waste handling building. The result is that the air feeding the WS is warmer than the surface air feeding the AIS. The consequences of this are a reduction in flow down the WS and even reverse flow in the WS. Administrative action is required to adjust the underground regulators to avoid reverse flow in the WS.

Lower flow velocities in the SHS compared to the AIS in cold conditions can cause the SHS flow to reverse. This causes no problem.

3.3.9 Dynamic Pressure Effects

The underground ventilation system is basically a steady state system. When it becomes necessary to make change in operating mode there are dynamic pressure changes which must be considered. These are primarily only significant when the two main exhaust fans are started or shut down. Changes in ventilation, such as a shift to filtration may cause temporary localized pulses. The magnitude and location of these may be affected by NVP and the proximity to the shafts.

3.3.9.1 Startup of Main Fans

The ES is in much closer proximity to the WS in flow path length than the SHS or the AIS. Consequently, when the main exhaust fans are started it is possible to momentarily create a significant negative pressure in the WS and the WS tower.

The WS tower is built to withstand a differential pressure of -3 inch wg. To ensure that the pressure capability of the WS tower is not exceeded, a set of pressure relief dampers is installed in the inlet to the Auxiliary Air Intake Tunnel. These dampers are normally closed and will start to open when the pressure differential reaches -2.25 inch wg. The dampers will swing fully open before the limiting differential of -3 inch wg is reached. The additional air flow prevents the WS tower differential from being exceeded. The dampers must be manually closed if they swing full open. The open status of the dampers is indicated in the CMR by the failure to reach the normal pressure in the S400 drift.

There is a differential pressure sensor in the Waste Hoist Tower. If the allowable differential pressure is exceeded the CMS will shut down the main fans.

Administrative controls can be initiated to prevent excessive waste tower pressure during main fan startup.

3.3.9.2 Shutdown of Main Fans

When the main exhaust fans are shut down the associated isolation dampers are designed to close slowly to minimize any pressure pulse back through the system.

3.4 System Arrangement

The VU00 system is divided into six subsystems, VU01 through VU06. These subsystems are outlined on figure S-1 and defined in greater detail in section 3.1 of the subsystem chapters.

3.4.1 Physical Arrangement

Figure VU G-2, Underground Air Flow Isometric, illustrates the overall physical arrangement of the complete system. The Air Intake Shaft, the Salt Handling Shaft and the Waste Shaft are vertical shafts which are used to convey surface air down to the disposal horizon 2,150 feet below the surface. The Exhaust Shaft is a vertical shaft which is used exclusively to return air from the disposal horizon to the surface level. The underground workings are used by system VU00 to convey the air between the air intake shafts and the exhaust shafts and distribute air as required for operations.

Bulkheads and their associated doors and flow regulators are used throughout the disposal horizon to direct the underground air flow as required. The exhaust duct connects the ES to the exhaust fans and the Exhaust Filter Building.

3.4.2 Surface Arrangement

Figure VU V-1, WIPP Surface Plot Plan - VU00 Surface Facilities, illustrates the arrangement of the air shafts, exhaust fans and ducts, and the EFB relative to other surface facilities.

The AIS is located in the northwest quadrant of the facility. The ES is located in the southeast quadrant. The SHS and WS are located on a north-south line near the center of the facility. The exhaust equipment, ducts, fans and filters are located on the east side of the facility north of the ES.

Figure VU I-1, Exhaust flow diagram - Surface Equipment, illustrates the arrangement of the exhaust ducts, fans, flow regulators, filters and fans. The main exhaust duct connects the ES to the filter outlet plenum.

There are two large branch ducts to the east to the main exhaust fans. There is a smaller duct, branching to the west, to the filter inlet plenum. The HEPA filter system is located between the inlet and outlet plena. Three ducts connect the outlet plenum to the filtration fans, which are then connected to the filtered effluent duct.

3.4.3 Underground Arrangement

Figure VU III-1, Underground Horizon Plan View, illustrates the arrangement of the air shafts relative to the total underground workings. All four air shafts are located in a zone called the Shaft Pillar Area. They are interconnected by multiple drifts running east-west and north-south. The air shafts are connected to the north area and to the disposal and construction areas by multiple drifts.

The AIS is located at N0/W625. The SHS is located at N0/E0 and is the reference point for underground locations. The WS is located at S400/E25. The ES is located at S400/E475. The WS and the ES are located along a common drift, S400, and are 450 feet apart. The AIS and SHS do not share a common drift and are 1500 feet apart through the drifts around three turns. This difference influences the dynamic behavior of the system (see section 3.3.10)

3.5 Component Design Description

Refer to section 3.5 of the subsystem chapters (see footnote G-1) for subsystem component design descriptions.

3.6 Instrumentation and Control

Refer to section 3.6 of the subsystem chapters (see footnote G-1) for subsystem instrumentation and control requirement descriptions.

3.7 System Interfaces

System interfaces are of two kinds:

Primary Interfaces – Those requirements imposed on other systems by this system, Underground Ventilation, in order for this system to perform its function.

Secondary Interfaces – Those requirements imposed on this system, Underground Ventilation, by other systems in order for the other systems to perform its function.

Primary Interfaces

System Providing Service	Service to be Provided
AU00	Provide a method for transporting equipment for the Ventilation System underground.

Secondary Interfaces

ED00	Provide the environmental conditions and the associated heat removal required for operation of equipment of System ED00 underground.
FP00	Provide isolation of underground fuel stations.

4.0 OPERATIONS

Refer to the WIPP Site Mine Ventilation Plan and to the Controlled Operating Procedures for normal and off-normal operating modes.

The installation, wiring, piping, ductwork and functions are verified by completion of detailed acceptance tests.

The procedure is based on a system that is known to be operational, with all calibrations up to date and pre-operational testing complete. If maintenance has been performed then any necessary retest has been successfully completed.

Whenever a significant change in the underground ventilation flow is to be made, the underground personnel must be notified. This permits operational restrictions to be imposed or lifted and other necessary responses to be made.

Whenever a flow control setpoint is changed while a fan is operating, the change shall be made slowly enough that the flow does not noticeably lag the setpoint value.

5.0 SYSTEM LIMITATIONS, SETPOINTS, AND PRECAUTIONS

5.1 Introduction

This section describes or refers to the location of operating limits, setpoints, alarms, interlocks, and precautions as related to the operation of the Underground Ventilation System. Consideration is given to general personnel safety, equipment safety and performance, and the overall performance of the entire ventilation system. The information reiterates the limits, setpoints, and precautions imposed either implicitly or explicitly by the system operations described in sections 4, 6, and 7.

WIPP has established conditions for operation of the Underground Ventilation System. These are:

A. Underground Radioactive Material Area (Waste Handling Area) to non-Waste Handling Area differential pressure requirements

B. The operability of the above ground exhaust air filtration system (fans, dampers, and HEPA filters). More detail on UVS related conditions for operation can be found in section 2.3 of G chapter.

5.2 Operating Limits

The operating limits which define the ambient design limits and the system and component limits are listed in table VU G-6. Proper system and component operation cannot be assured if these limits are exceeded.

Table VU G - 6 – Operating Limits

PARAMETER	LIMIT
Design Outside Temperature - Dry Bulb	19°F - 100°F
Design Outside Summer Temperature - Wet Bulb	71°F
Exhaust Filter Building Temperature	50°F - 80°F
Maximum Mine Temperature	110°F
Minimum Mine Temperature	38°F
Minimum Ventilation Flow	57 KSCFM
Maximum Ventilation Flow	450 KSCFM
Maximum HEPA Filter Flow (per filter)	37 KSCFM
Maximum HEPA Filter Housing Pressure	±20 IWG

Maximum HEPA (Astrocel) ΔP	3 IWG
Maximum Prefilter (MOD) ΔP	1.8 IWG
Maximum Prefilter (HIGH) ΔP	2.5 IWG
U/G Non-Waste Handling Area Pressure Higher than Waste Handling Area - Minimum	0.05 IWG
Waste Hoist Tower Vacuum - Maximum	3.0 IWG

Note: °F = Degrees Fahrenheit
KSCFM = Thousand Standard Cubic Feet per Minute
IWG = Inches Water Gage

5.3 Setpoints and Alarms

The major setpoints involved in the controls of the Underground Ventilation System are listed in table VU G-7 and the system alarms are listed in table VU G-8. The hundreds of system status and alarm signals provided to the CMR via the CMS are controlled by Engineering. There are no priority 3 (Urgent) alarms; the priority 2 are listed in table VU G-8 along with the local alarms.

The set points listed in tables VU G-7 and VU G-8 for the exhaust fans flow control point, low fan air flow alarm and the filter differential pressure alarm have no criteria stated as safety requirements.

The filter differential pressure alarms indicate that filter replacement is needed and does not indicate that immediate failure will occur. The alarm point for filter replacement is therefore only 30% of the maximum design pressure of 10.2" H^2O.

These instruments are selected and installed based on standard industry practice for ventilation systems. Current maintenance procedures require calibration of the pressure differential alarm modules and the transmitters to plus or minus 1.0%. The loop accuracy is plus or minus 2.0%.

The normal underground air flow rate is established to satisfy the requirements of the Mine Safety and Health Administration and the State of New Mexico Mine Safety Code for all mines. The only function of the subsystem VU01 (Exhaust fans and filters) is to provide air flow in response to the requirements of the other four systems comprising system VU00.

Since there is no regulatory accuracy requirement, the achievable performance of the flow control system is that which can be obtained through standard commercial type instrumentation.

The accuracy of flow indication has been established in the calibration procedures and plus or minus 5.0% of reference pitot traverse, and the accuracy of flow control is plus or minus 5.0% of set point.

The low flow alarms are non-urgent and indicate that there is a problem requiring investigation by the operators. The low flow alarm does not indicate a specific failure.

Table VU G - 7 – Control Setpoints

PARAMETER	FUNCTION	SETPOINT
Exhaust Fan A Flow (1 Fan Running)	Damper Control	260 KSCFM
Exhaust Fan A Flow (2 Fans Running)	Damper Control	212 KSCFM
Exhaust Fan B Flow (1 Fan Running)	Damper Control	260 KSCFM
Exhaust Fan B Flow (2 Fans Running)	Damper Control	212 KSCFM
Filtration Fan A Flow	Damper Control	60 KSCFM
Filtration Fan B Flow	Damper Control	60 KSCFM
Filtration Fan C Flow	Damper Control	60 KSCFM
Waste Hoist Tower Negative Pressure	Stop Exhaust Fan A	2.5 IWG
Waste Hoist Tower Negative Pressure	Stop All Exhaust Fans	2.75 IWG
*Pressure Chamber activated	Fan(s) On Low alarm manual	0.2 IWG
*Pressure Chamber activated	Fan(s) off High alarm manual	2.10 IWG
*Pressure Chamber inactivated	Fan(s) off High-High alarm automatic	2.5 IWG
HEPA Filter Inlet Plenum	Open 004 Damper	-0.5 IWG

* Pressure chamber to be activated only during waste handling operations in the waste shaft and/or waste shaft station area when the differential pressure falls below 0.2 inches water gage.

Note: KSCFM= Thousand Standard Cubic Feet per Minute
IWG = Inches Water Gage

Table VU G - 8 – Alarms

PARAMETER	FUNCTION	SETPOINT
Waste Hoist Tower Negative Pressure (Priority one alarm)	2.25 IWG	CMR
Fan 700A Low Air Flow	187 KSCFM	MFCP, CMR
Fan 700B Low Air Flow	187 KSCFM	MFCP, CMR
Fan 700C Low Air Flow	187 KSCFM	MFCP, CMR
Fan 860A Low Air Flow	50 KSCFM	FFCP, CMR
Fan 860B Low Air Flow	50 KSCFM	FFCP, CMR
Fan 860C Low Air Flo	50 KSCFM	FFCP, CMR
HEPA-856 MOD Pre-Filter CLOGGED	1 IWG	FFCP, CMR
HEPA-856 HIGH Pre-Filter CLOGGED	1 IWG	FFCP, CMR
HEPA-856 FIRST HEPA Filter CLOGGED	3 IWG	FFCP, CMR
HEPA-856 SECOND HEPA Filter CLOGGED	3 IWG	FFCP, CMR
HEPA-857 MOD Pre-Filter CLOGGED	1 IWG	FFCP, CMR
HEPA-857 HIGH Pre-Filter CLOGGED	1 IWG	FFCP, CMR
HEPA-857 FIRST HEPA Filter CLOGGED	3 IWG	FFCP, CMR
HEPA-857 SECOND HEPA Filter CLOGGED	3 IWG	FFCP, CMR
Pressure Chamber Press. Above Waste Handling Area Press.	0.20 IWG (1)	PCCP, CMR
Pressure Chamber Press. Above Waste Handling Area Press.	2.10 IWG (1)	PCCP, CMR
Pressure Chamber Press. Above Waste Handling Area Press.	2.50 IWG (1)	PCCP, CMR
S-1300/E-140 ΔP	0.12 IWG (2)	DPCP, CMR*
(3) HEPA Filter Status	NA	CMR
(3) Exhaust Fan Status	NA	CMR
(3) Filtration Setup Mode Info.	NA	CMR
(3) Ex. Fan Protective Relay Status	NA	CMR
(3) Pos. of 18 Above-Ground Dampers	N/A	CMR

Notes:

CMR = Central Monitoring Room
DPCP = Diff. Press. Control Panel
FFCP = Filtration Fan Control Panel
IWG = Inches Water Gage
KSCFM = Thousand Standard Cubic Feet/min
MFCP = Main Fan Control Panel
PCCP = Pressure Chamber Control Panel
* = CMS calculated

(1) The non-Waste Handling Area pressure always should be higher than the Waste Handling Area pressure. (The waste shaft and the waste shaft station area is a Waste Handling Area only during waste handling operations in the waste shaft and/or the waste shaft station area.)

The low alarm activates as non-Waste Handling Area-to-the-Waste Handling Area ΔP drops to the alarm set point (0.20 IWG) and continues as the ΔP reduces or until corrective action is taken.

The high alarm activates as the non-Waste Handling Area-to-the-Waste Handling Area ΔP increases to the alarm set point (2.50 IWG) and initiates high pressure fan system shut down.

(2) The non-Waste Handling Area pressure always should be higher than the Waste Handling Area pressure. The alarm sounds as non-Waste Handling Area-to-the-Waste Handling Area ΔP drops to the alarm set point and continues as the ΔP is reduced.

(3) This additional status information is provided to the CMR and classified as "Alarm Priority 2" For a complete listing, see appendix H.

5.4 Interlocks

The logic diagrams for the exhaust and filtration fan controls are shown in Figures VU I-12 and VU I-17, respectively. The logic diagrams for the exhaust and filtration fan isolation dampers are shown in figures VU I-15 and VU I-17, respectively. The fans and isolation dampers are so interlocked that fan motors cannot be energized when isolation dampers are closed and isolation dampers cannot be closed when fan motors are energized. The two fan systems (exhaust and filtration) are interlocked to ensure that filtration takes precedence over exhausting.

Figure VU I-18 shows the control logic diagram for the HEPA filtration isolation damper. When in automatic, the isolation damper cannot be opened unless at least one isolation damper on each main exhaust fan is closed, the HEPA bypass dampers are closed, and at least one filtration fan is running. It is also required that the HEPA filter inlet plenum pressure (Table VU G-7) be at negative pressure gage. The requirement for one isolation damper on each exhaust fan to be closed can be bypassed by closing the maintenance bypass key switch for the associated fan. This bypass allows the filtration function to occur even if control power to one or more of the main exhaust fans is locked out.

The underground airlock door operation logic diagram is shown in figure VU III-7. The two airlock doors are interlocked to prevent both doors from being open at the same time.

5.5 Precautions

The following special precautions shall be observed during all Operations, Off-Normal Events, and Maintenance activities in the Underground Ventilation System:

1. Surface and Underground Services must always be coordinated and informed of actions which affect the other.

2. Mine exhaust air HEPA filtration must always be available when waste is being moved underground.

3. Always keep the underground Waste Handling Areas area 0.05 IWG less pressure than the non-Waste Handling Areas area.

4. Never let the pressure in the Waste Hoist Tower get less than (more negative) ---2.25 IWG.

5. If there is any potential of release of radioactive contamination following an incident, shift ventilation to filtration.

6. Except in an emergency, never operate underground doors, dampers, fans, etc., from remote (i.e., non-visible) locations. Dampers may be operated remotely when authorized.

7. Exhaust and filtration fans are not to be run at the same time, except when operating in maintenance mode.

8. Three filtration fans should not be operating at the same time.

9. From an electrical standpoint, only one fan should be started sequentially.

10. Three main fans shall not be operated at the same time.

6.0 OFF-NORMAL EVENTS AND RECOVERY

An off-normal event is defined as an off-normal system or plant condition which could affect the safety of off-site or on-site personnel or a condition which could affect the integrity or proper functioning or operation of the system or plant. There are two off-normal events defined for VU00 that if not properly handled have the potential to affect the safety of on-site and off-site personnel. In addition, there are events which affect the proper functioning of the system or plant. These off-normal events will be discussed under "Safety Impactive Events" and "System/Plant Impactive Events."

6.1 Off-Normal Events

Operational sequences required to mitigate and control off-normal events and recovery are documented in the WIPP Site Controlled Operating Procedures.

- Loss of Differential Pressure in the Underground
- Inoperability of the Diversion to Exhaust Filtration System

6.1.1 Loss of Differential Pressure in the Underground

System VU00 is required to maintain a pressure differential between the underground Waste Handling Areas and the non-Waste Handling Areas of at least 0.05 inches of water such that air flow is always toward the Waste Handling Areas. The Waste Handling Areas shall always have the lesser pressure. For Waste Handling Considerations, the differential pressure is measured at two primary locations as follows:

- Across bulkhead 324 in S1300 at E130
- Across bulkhead 308 in S400 at E300

In addition, the pressure chamber just west of the waste shaft in S400 at W05 has its own differential pressure monitor. This monitor is used to measure the pressure drop from the interior of the pressure chamber to the waste shaft.

There are several ways to lose the differential pressure in the underground. The most likely way would be loss of operation of the main ventilation fans such as from loss of electric power. Other ways would be by certain bulkhead doors, regulators or dampers being in the open position when they should be closed. Similarly, certain dampers, regulators or doors being closed when they should be open can cause the required differential pressure to be lost.

6.1.2 Inoperability of the Diversion to Exhaust Filtration System

There are two normal methods of diverting to the Exhaust Filtration System. One of these is the automatic; the other is the remote diversion to filtration function. One or both controlled methods of transferring from the unfiltered to the filtered mode of operation may become inoperable. Additionally, HEPA filter banks and/or isolation dampers may become inoperable.

6.1.3 Loss of Electric Power

Electric power may be lost by several means. Among these are the interruptions of the incoming power to the WIPP Site and on-site interruptions of power.

6.1.4 Design Basis Seismic Event/Tornado

There are no designed mitigation features for these events. Should the Underground Ventilation System experience either of these events, operation should continue only after careful review and inspection of the system and repair of any critical damage.

6.2 Recovery from Off Normal Events

6.2.1 Recovery from Loss of Differential Pressure

Loss of differential pressure is recovered as described in the operating procedure for the Underground Ventilation System.

6.2.2 Recovery from Inoperability of the Exhaust Filtration System

Complete Inoperability of the filtration system is considered unlikely given the redundancy of the system (three filtration fans, two filter banks, isolation dampers in series). In the event of Inoperability of the filtration system, the system can be completely isolated (stopping all underground airflow and thus mitigating the contamination to the environment) until such time as the filtration system can be made operational.

6.2.3 Recovery from Loss of Electrical Power

At least one filtration fan may be operated on backup power.

6.2.4 Recovery from DBT/DBE

The duct elbow as well as the building housing the filters are rated to withstand a design basis event. There are no recovery features other than the design rating.

7.0 Maintenance

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

Since the Underground Ventilation System is involved with conditions for safe operations for the WIPP site, maintenance must be coordinated with waste handling operations. Waste handling must be suspended if certain underground differential pressures or exhaust air filtration capabilities do not exist.

The maintenance program for the underground ventilation system shall follow the guidelines of the DOE 4330.4B and 430.1 for the Maintenance Management Program.

7.1 Maintenance Approach

The maintenance program will ensure that the property is maintained in a manner which promotes operational safety, work health, environmental protection and compliance, property preservation, and cost-effectiveness while meeting the programmatic mission. In carrying out this program, a graded approach shall be taken by line management in the development and implementation of the maintenance program. By a graded approach, it is intended that the depth of detail required and the magnitude of resources expended for a particular maintenance function be commensurate with the functions important to safe and reliable operation, environmental compliance, safeguards and security, programmatic mission, facility preservation, and/or other facility specific requirements.

In general, all maintenance on the buildings, facilities, equipment shall be performed using "contact handling or contact maintenance" techniques. This involves direct personnel contact with the equipment vs. the use of remote manipulators or robots.

Maintenance efforts on the Underground Ventilation System will be in the following order of preference:

1. Clean, adjust, repair equipment in place.

2. Remove and replace with available spare; repair original; requalify original and retain as spare.

3. Remove, repair, requalify, and return to service.

7.2 Corrective Maintenance

Corrective maintenance on all subsystems in the Underground Ventilation System will generally follow the above stated preference of in-place, replace, or remove and repair maintenance. For some of the major above ground exhaust equipment such as selective butterfly isolation valves, the time of loss of active mine exhausting will have to be a major consideration. The loss of active mine exhausting will require suspension of underground operations. Most above ground ventilation components can be isolated from the mine air exhaust stream and maintained in place.

The Underground Ventilation System requires very little maintenance. A generic corrective maintenance procedure would basically be as follows:

A. Obtain the proper work permits per procedures.

- WO - Work Order
- RWP - Radiation Work Permit (for HEPA filters, etc.)
- SWP - Safety Work Permit (confined space inside duct work)

B. Consider the consequences of removing from service (mine ventilation, etc).

C. Shutdown per Operating Procedures and/or component manuals.

D. De-energize electrically and/or pneumatically. Tag-lock out.

E. For work inside of air flow ducts, ensure no sudden change in air flow by total fan tag out or by adjacent isolation valve tag out.

F. Perform corrective maintenance as necessary using manufacturer's literature and expertise.

G. Use portable ventilation blower for work inside of duct work.

H. After completion of corrective maintenance, perform acceptance tests and alignments as necessary to ensure that component and system will perform their intended function. This includes the information and control signals transmitted to and from the CMR.

7.3 Preventive Maintenance and Predictive Maintenance

The preventive and predictive maintenance program discussion in this section follow general mining experience for underground equipment; NFPA-70B, *Electrical Equipment Maintenance*, 1990 edition for surface electrical equipment; and ANSI/ASME N510-1989, *Testing of Nuclear Air Treatment Systems*, for HEPA filter testing. The atmosphere or environment in which this equipment operates effects its operating capabilities and the degree of maintenance required. Temperature, moisture, dirt, and salt are the main factors which contribute to this equipment deterioration. The recommended preventive and predictive maintenance frequency discussed in this section should be followed for at least four maintenance cycles, unless undue failures dictate a shorter cycle. Specific manufacturer's recommendations on the type of maintenance and the periodicity of preventive maintenance must be considered. Neither the vendors' manuals for the equipment nor national standards factor into the graded approach used in this system.

Preventive and predictive maintenance will be performed more frequently on critical items and less frequently on the same equipment used in less critical applications. As equipment history is accumulated, preventive and predictive maintenance items and frequency should be altered, to result in the maximum benefit to the overall goal.

Tables VU G-9 provides a summary for preventive and predictive maintenance of the different types of major equipment employed in this system.

Table VU G - 9 – Preventive Maintenance

Item
Main Exhaust Fan Motor
Main Exhaust Fan
Variable Pitch (Vortex) Inlet Vanes-Main
Filtration Fan Motor
Variable Pitch (Vortex) Inlet Vanes-Filtration
Filtration Exhaust Fan
Control/Balance (Louver) Damper-Manual
Filter Isolation Dampers-Half Doors
Filter Fan Isolation (Louver) Damper-Pneumatic
Isolation (Butterfly) Damper
HEPA Filter
U/G Auxiliary Fans-Small
U/G Auxiliary Fans-Large
U/G Air Ducts
Ruskin Tornado (pressure relief) Damper
Local Temporary Ventilation
Air Intake and Exhaust
Instrument Calibration

7.4 In-Service Inspection

The in-service inspection for the Underground Ventilation System is generally performed without disturbing the mechanical system or components; however, the instrumentation system periodic alignment check are included here. A comprehensive inspection program can reduce the corrective and preventive maintenance down time by anticipating performance problems from systematic observation and recorded instruments. The following inspections are recommended. See table VU G-10.

Table VU G - 10 – In-Service Inspection

Item
Exhaust and Filtration Fan Flow Control
Fans and CMS Interface
Damper Pressure Control
Damper and CMS Interface
Major Air Flow Ducts and Dampers
U/G Ducts
Doors, Regulators, and CMS Interface
Bulkheads and Doors
Ruskin Tornado (pressure relief) Dampers
Probe and Instrument Cleaning/Dusting
Local Temporary Ventilation
Air Intake and Exhaust

7.3 - 7.4 Technical Cross Reference

Refer to section 7.3 and section 7.4 of the subsystem chapters (see footnote G-1) for subsystem-specific preventative maintenance and in-service inspection requirements.

The Underground Ventilation System is instrumented to provide operating inspection. All continuously required information is provided to the CMR.

For the above ground exhaust fans, filters, and dampers, the CMR is provided with the following:

- Fan run status
- Fan air flow and low flow alarms
- Fan operating mode selected
- Exhaust fan protective relay status, vibration, and vibration alarms
- HEPA filter stage differential pressure and alarms
- All damper positions (open/closed)

For the underground bulkheads, air regulators, and instrumentation, the CMR is provided with the following information for inspection:

- Door NOT CLOSED signals
- Air regulator shaft position signals
- Air regulator control local/remote status
- Differential pressure signals underground and in the waste hoist tower
- Air quantity flow velocity signals
- Mine weather station signals

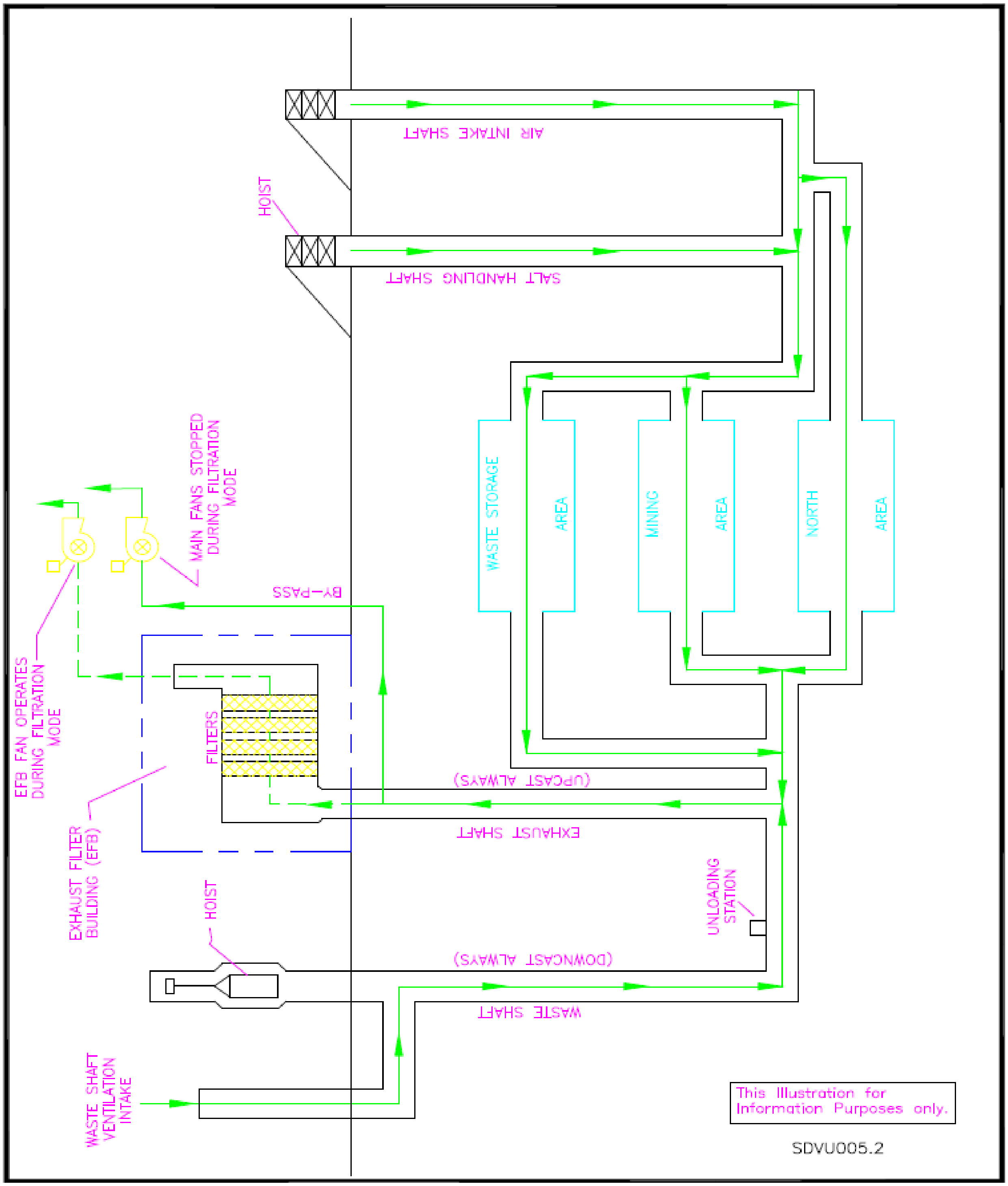

Figure VU-G - 1 – Underground Air Flow Paths – Pictorial

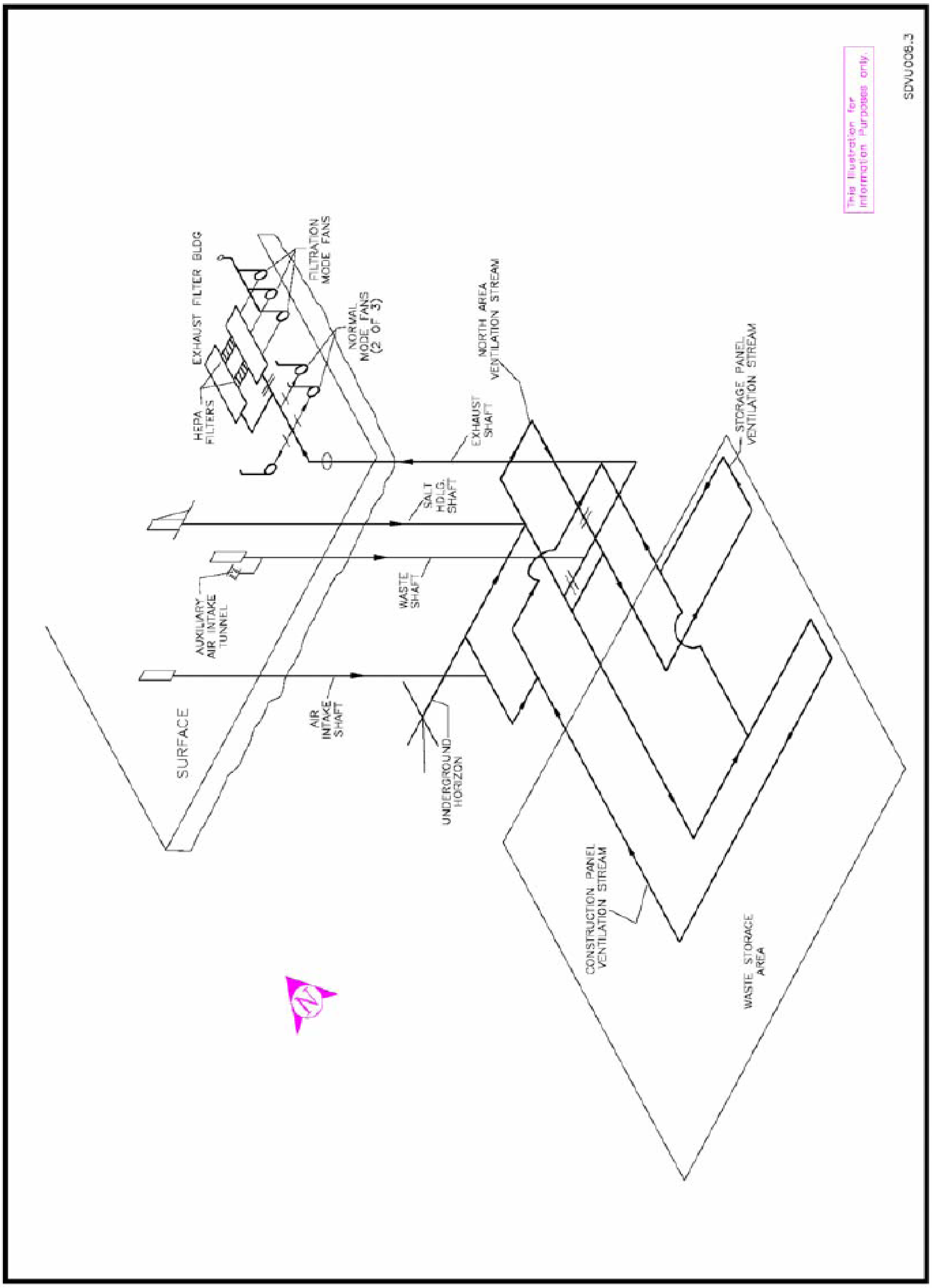

Figure VU-G - 2 – Underground Air Flow Isometric

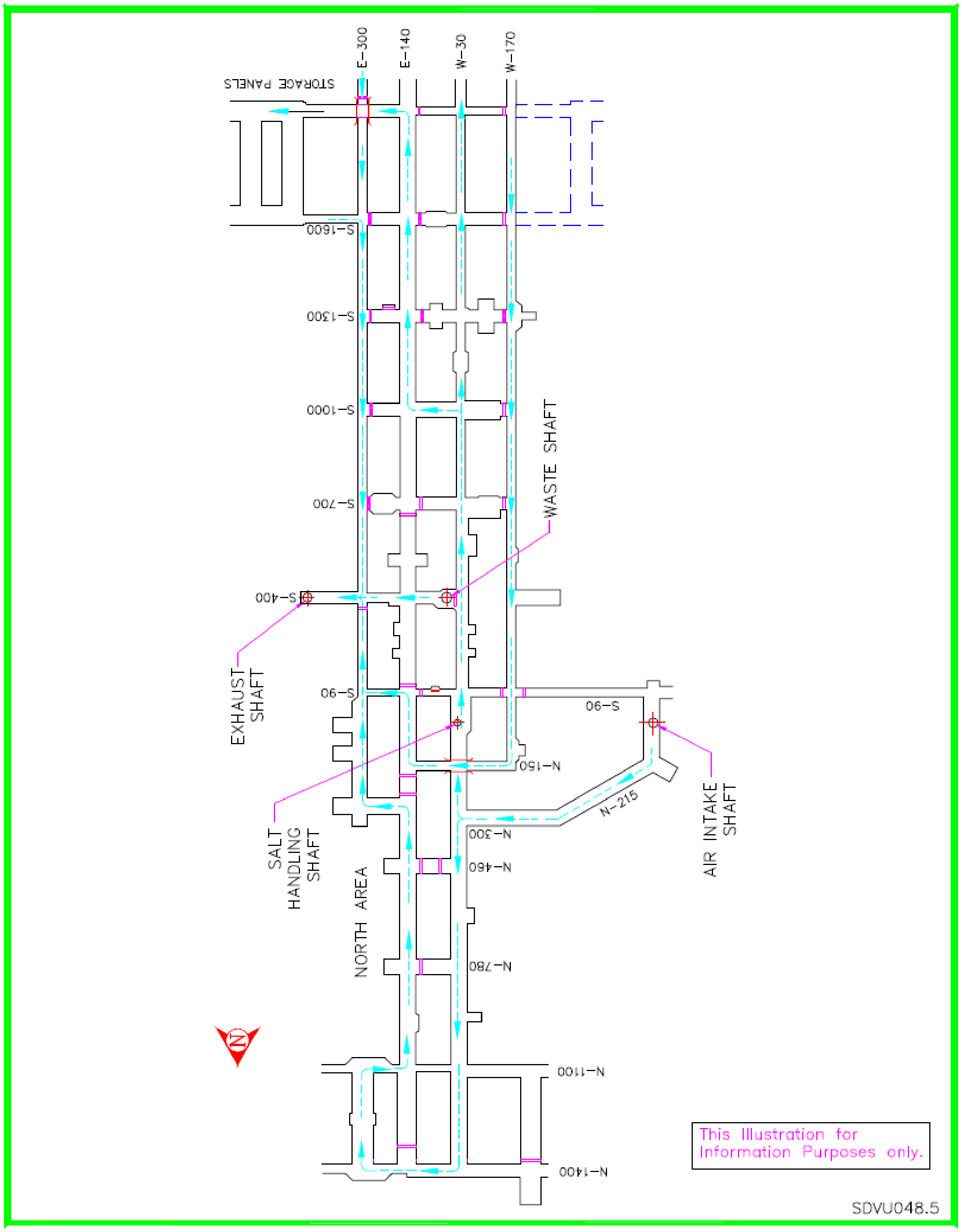

Figure VU-G - 3 – Normal Ventilation Main Flow Distribution

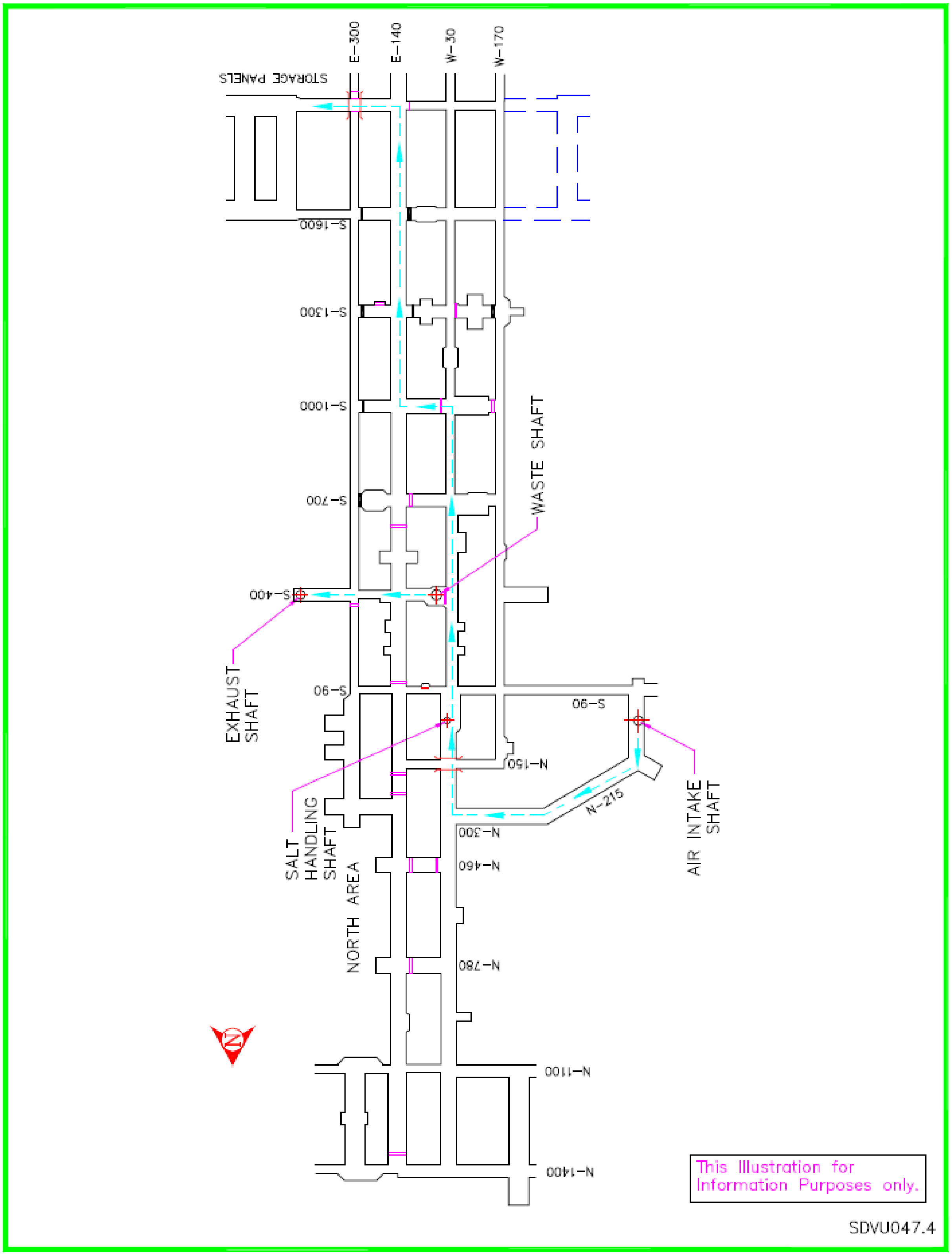

Figure VU-G - 4 – Minimum Ventilation Main Flow Distribution

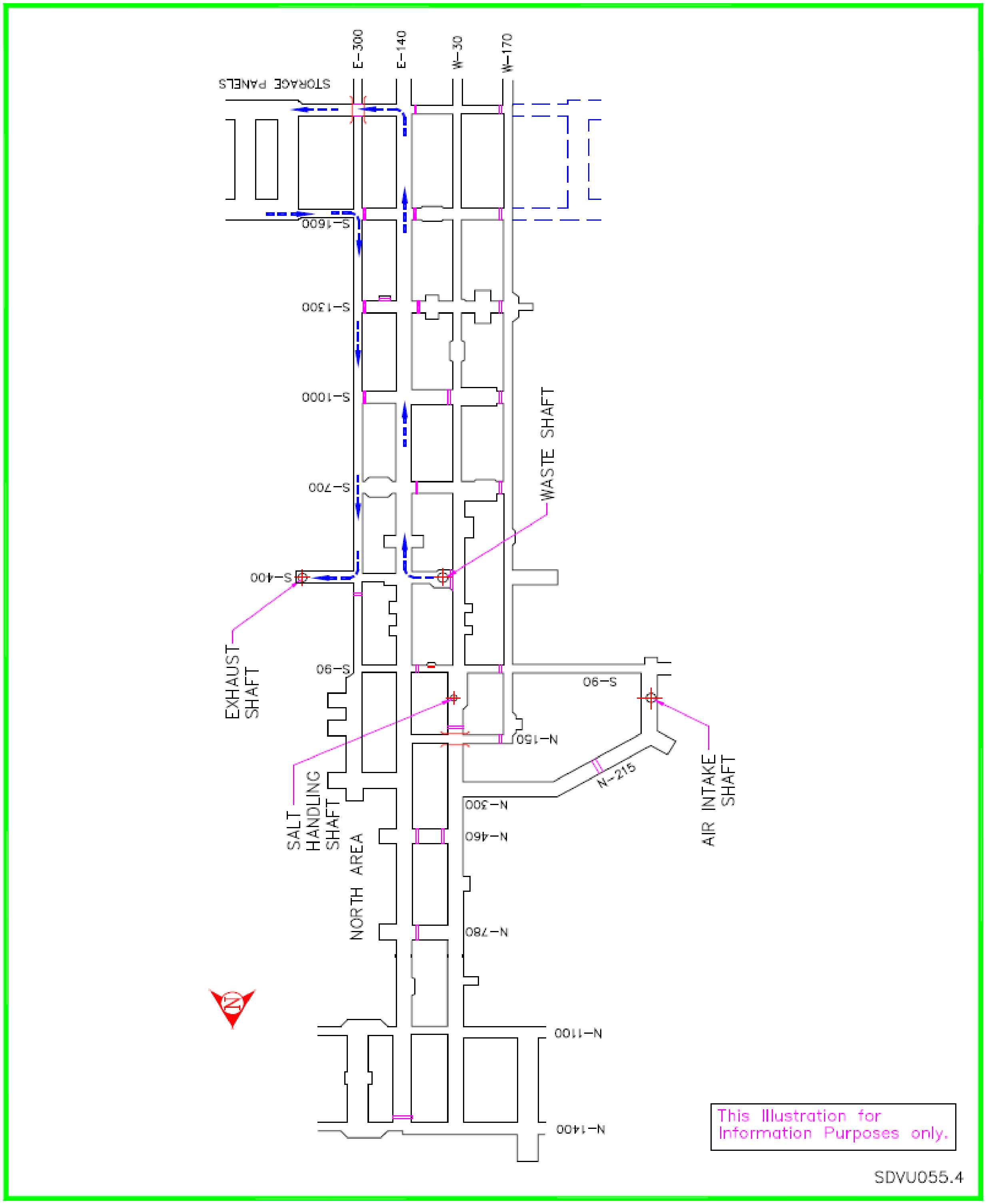

Figure VU-G - 5 – Filtration Ventilation with Diversion Main Flow Distribution

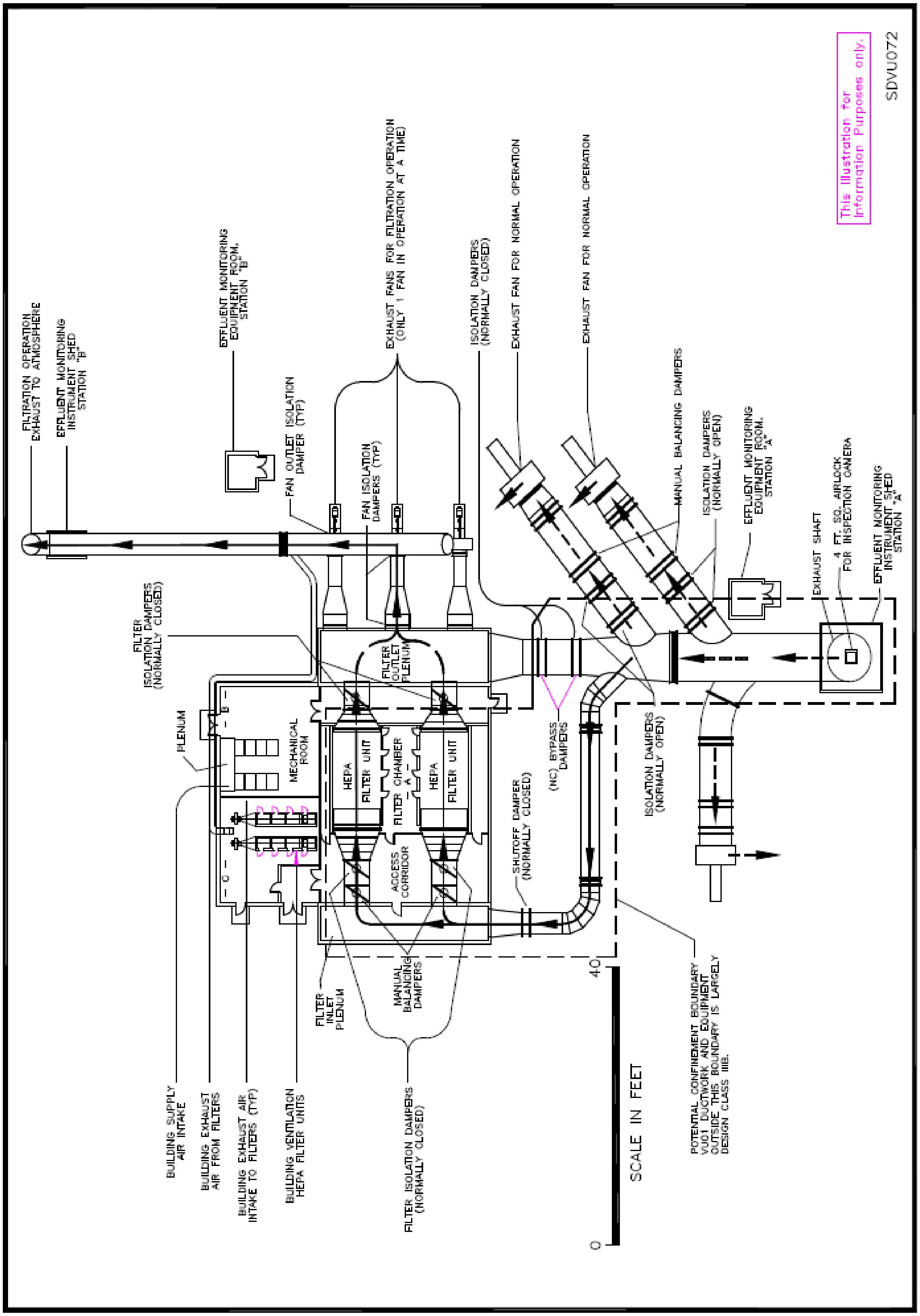

Figure VU-G - 6 – Confinement Boundary

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Subsystem VU01 - Exhaust Fans and Filters

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Chapter I

Subsystem VU01 - Exhaust Fans and Filters

1.0 PRIMARY FUNCTIONS

The primary functions for the exhaust fans and filters are presented in section 1.0 of chapter G.

2.0 DESIGN REQUIREMENTS

2.1 General

The general design requirements for the exhaust fans and filters are presented in section 2.1 of chapter G.

2.2 Subsystem Requirements

2.2.1 Exhaust Fans shall be located outdoors on the surface. For the normal ventilation mode maximum air quantity requirements, three 212 ks cfm exhaust fans shall be located outdoors on the surface in a parallel arrangement.

Three 100% capacity (60 ks cfm) filtration fans shall be provided in a parallel arrangement.

Fans shall be suitable to operate in salt dust laden air.

2.2.2 Two HEPA filter units, each of fifty percent capacity, shall be provided for post accident mitigation. Each filter unit shall consist of one moderate efficiency pre-filter bank, one high efficiency pre-filter bank and two HEPA filter banks. The filter banks shall be made up of filter cells each rated at 1,500 cfm and arranged with a maximum of three filter cells high. The HEPA filter units are located in the Exhaust Filter Building (EFB) which provides a common inlet and common outlet plenum for the filter units.

2.2.3 Isolation and block valves and flow control dampers shall be provided on all surface fans to facilitate automatic transfer from the normal to the filter mode of ventilation. Isolation valves shall be provided at the inlet and outlet of the HEPA filter units. A shut off damper shall be provided at the inlet to the HEPA filter inlet plenum.

2.2.4 Those areas of the Exhaust Filter Building (EFB) which have the potential to become contaminated, shall operate at a negative pressure to atmosphere, and the associated building exhaust air shall be monitored for radioactivity.

2.3 - 2.12 Technical Cross Reference

Refer to section 2.3 to section 2.12 of chapter G for general requirements applicable to each of the following topics:

- 2.3 Operational Requirements
- 2.4 Structural Requirements
- 2.5 General Arrangement & Essential Requirements
- 2.6 Maintenance Requirements
- 2.7 In-Service Inspection Requirements
- 2.8 Instrumentation and Control Requirements
- 2.9 Interface System Requirements
- 2.10 Quality Assurance Requirements
- 2.11 Codes and Standards Requirements
- 2.12 Reliability Requirements

3.0 DESIGN DESCRIPTION

3.1 Summary

Refer to section 3.1 of chapter G for the Underground Ventilation System summary design description.

Subsystem VU01 provides the fans, ductwork, dampers and, when needed, filters, required to pull air through the underground facility. All VU01 equipment is located on the surface.

3.2 Detailed System Description

The location of the VU01 equipment is on the east side of the facility. See figure VU V-1. The subsystem starts at the collar of the Exhaust Shaft (ES), Facility #351, and extends north through the Exhaust Filter Building (EFB), Building #413, and includes the duct work, air flow regulators, isolation dampers, and exhaust fans. The equipment is shown in greater detail in figure VU I-1.

There are six fans connected by ducting to the underground exhaust shaft so that they can draw air through the Exhaust Shaft in accordance with the operating modes.

Any two of three main exhaust fans, 41-B-700A, 41-B-700B, and 41 B-700C working together, provide the normal air flow of 425,000 SCFM through the underground. Any of the three filtration exhaust fans, 41-B-860A, 41-B-860B or 41-B-860C, can provide 60,000 CFM air flow directly or through the HEPA Filters in the Exhaust Filter Building.

OPERATING MODES

Normal	2 Main Fans
Alternate	1 Main Fan
Reduced	2 Filtration Fans
Minimum	1 Filtration Fan
Filtration	1 Filtration Fan and Flow through HEPA Filters
Maintenance	1 Main Fan and 1 or 2 Filtration Fans

The main exhaust air duct runs from the Exhaust Shaft (ES) to the HEPA filter outlet plenum. Three branches from the main duct connect with the main fans. A fourth branch connects to the HEPA filter inlet plenum. Three separate ducts connect the HEPA filter outlet plenum to the filtration exhaust fans. The filtration fan outputs are combined into a single exhaust duct. Air flow regulators and shutoff dampers are provided so that the exhaust air flow path can be fully controlled, from the ES through to the release to the atmosphere.

Descriptions and nomenclature for the various air flow operating modes are provided in section 3.3. In normal operation two of the three main exhaust fans are running and all of the filter exhaust fans are shut down and isolated. This provides unrestricted underground operation to the design level in all three areas simultaneously.

In the event that only one main exhaust fan (of three) is available, the other fans are isolated and ventilation is provided by the remaining main fan. Underground operations may proceed with further limitations on the use of diesel driven equipment.

If all three main exhaust fans are unavailable, they are isolated, and ventilation is supplied by operating one or two of the filtration exhaust fans. To accomplish this the bypass dampers are opened which permit air to flow from the main exhaust duct direct to the filter outlet plenum.

The isolation dampers for the filtration exhaust fan(s) to be operated are opened and the selected fan(s) turned on. Underground operations are substantially limited in this mode of operation.

Underground CAMs at the exhaust side of the active room, will signal if allowable radiation levels are exceeded. Subsystem VU01 will then switch to the filtration mode.

To accomplish this, the main exhaust fans are stopped and isolated, the isolation dampers are opened which allow air flow to pass through the HEPA filter banks, the isolation dampers for the selected filtration exhaust fan are opened and the fan turned on. This transfer to the filtration mode is initiated by both the automatic system and by CMS.

3.3 Performance Characteristics

3.4 System Arrangement

3.3 -- 3.4 Technical Cross Reference

Refer to section 3.3 to section 3.4 of chapter G for general requirements applicable to each of the following topics:

3.5 Component Design Description

The VU01 subsystem controls and channels the exhaust air flow from the collar of the Exhaust Shaft (ES) until it is released to the atmosphere. See figure VU I-2 for the airflow schematic diagram of VU01.

3.5.1 Exhaust Duct

3.5.1.1 Main Exhaust Duct

The exhaust duct begins with a 14 ft diameter elbow bolted to the collar of the ES. The exhaust duct is a rib-reinforced round steel structure that channels the exhaust air from the ES to the Exhaust Filter Building (EFB). There are three branch ducts that lead to the main fans. There is a filter inlet branch duct from the main exhaust duct to the inlet plenum of the EFB. There is a separate exhaust duct that carries the air from the outlet plenum of the EFB to the discharge elbow at monitoring Station B. See figure VU I-3 for the VU01 air flow paths. The length of the duct from ES centerline to the EFB is 117 feet.

The main exhaust duct and shaft head elbow is 14 feet in diameter up to the expansion bellows.

The exhaust duct system centerline is elevated approximately 14 feet above ground level, with a slight downward slope toward the EFB. See figure VU I-4 for the exterior vertical profile of VU01.

The exhaust duct system is supported on structural steel supports with saddles that are welded to the duct, and that have sliding contact pads at the support interfaces. The design allows limited movement, see figure VU I-5 to account for thermal expansion/contraction.

Metal bellows and fabric expansion joints are used to accommodate the thermal expansions imposed on the ducts due to changes in temperature. One end of each duct section and branch are anchored to the ground. Expansion and contraction of the main duct is accommodated by a metallic bellows located between the main fan branch connections.

3.5.1.2 Main Duct to EFB

The main exhaust duct is extended downstream of the main fan ducts and the filter inlet duct to connect to the filter exhaust plenum. This provides the ability to bypass the filters and use the filtration fans for underground ventilation when the filters are not required.

The main exhaust duct diameter reduces from 14 feet diameter at the bellows joint to 10 feet diameter at the section containing the two isolation dampers. These two Bypass Dampers are 10-foot diameter butterfly valves operated remotely by pneumatic cylinders. The dampers are closed by springs. The bypass dampers fail closed on loss of air pressure. A second means is provided to manually open the dampers should the pneumatic system be unavailable. Position indicators are provided. The isolation dampers are normally closed. Access points are provided to allow removal of salt buildup in the ducts.

A 14 foot square transition piece is provided between the main duct and the EFB outlet plenum.

3.5.1.3 Main Fan Ducts

The eastern two main fan ducts are about 68 feet long, 10 feet in diameter, and intersect the main duct at a 50 degree angle in plan, and a minus 8 degree angle in elevation. The slope of these ducts is necessary to accommodate the bend radius of the shaft head elbow without having to elevate the main fans. The western main fan duct is approximately 70 ft long, 10 ft in diameter, and intersects the main duct at approximately 45 degrees. The duct includes an elbow to direct the duct westward.

There are two isolation dampers, and a manual balancing damper in series in each of the branch ducts upstream of the main fans. See figures VU I-2 and VU I-3. The isolation dampers are normally open, and close automatically when the main fans are shut down. The manual balancing dampers are manually set and remain in a fixed position.

The manual balancing dampers in the main fan branch ducts are 10 foot square housings with louver type vanes on horizontal shafts. All vanes are ganged together and positioned by a manual hand wheel.

The six isolation dampers associated with the main (non-filtered) air ducts are 10 foot diameter butterfly valves with horizontal pivots. All are operated automatically by a pneumatic cylinder; however, they also have a manual hand wheel and engaging clutch. The clutch is normally disengaged. Position indicators are provided to physically show the status of the dampers (open or closed). The status is also indicated at the local control panel in the EFB and at the CMR.

3.5.1.4 Filter Inlet Duct

The filter inlet duct is 6 feet in diameter, and intersects the main exhaust duct at a 45 degree angle. See figure VU I-3. It is fully automatic and will only open under the conditions specified in Section 5.4, Interlocks, of the general section. The centerline of this duct is horizontal. There is a 45 degree elbow just downstream of the duct intersection, and a 90 degree elbow to turn the flow toward the EFB. The transition section from the duct to the EFB inlet plenum goes from the 6 foot diameter to an 8-foot square.

The high efficiency (low leakage) shut off damper in the filter inlet duct is a 6 foot diameter butterfly valve with a horizontal pivot and a pneumatic operator. It is located immediately upstream of the transition section. It is fully automatic and will only open with a negative pressure in the filter inlet plenum on filtration fan energized, Bypass Dampers closed and main fans off. It is normally closed, but will fail open.

There are two metallic bellows in the filter building inlet supply duct. These will accommodate both axial changes in the duct, and differential expansions between the filter mode inlet duct and the filter bypass main duct.

3.5.1.5 Outlet Plenum Exhaust Duct

The duct work from the EFB to the filtration fans are square, measuring 8 feet on a side, and terminating in a 56 3/4 inch diameter inlet to the fan.

There are isolation dampers upstream of each filtration fan at the exits of the filter outlet plenum. There are also isolation dampers immediately downstream of each filtration fan. All of these fan isolation dampers are louver type with horizontal pivots, pneumatic operator, manual hand wheel and clutch. The isolation dampers are normally closed, and the upstream and downstream dampers of any one fan are opened before the fan is placed in service. The clutch is normally disengaged. Position indicators are provided to physically show the status of the dampers (open or closed).

The status and operation of the dampers are monitored and controlled at the local control panel in the EFB and at the CMR.

The fan isolation dampers will fail closed on loss of offsite power; however, at least one fan can be operated on backup power.

The filtered exhaust duct is 6 feet in diameter and about 115 feet long. The transition sections from the filtration fans to the duct are rectangular in cross section with approximate internal dimensions of 42 inches by 59 inches. The transitions intersect the bottom of the duct at a 45 degree angle (in elevation).

There is a metal bellows located in the filtered air exhaust duct immediately downstream of the last filtration fan discharge duct connection. This accommodates axial expansions and contractions that occur between the fan connections and monitoring Station B.

The filtered air exhaust duct has a special inlet just upstream of the expansion bellows to accept air being discharged from the EFB ventilation system. This assures that the building ventilation air is being monitored at Station B before being discharged to the atmosphere.

3.5.1.6 Inspection and Access

An inspection hatch is provided on the main exhaust elbow, centered above the Exhaust Shaft. This inspection hatch provides passage for the borehole camera used for inspection of the exhaust shaft.

Two inspection and access ports are provided in each of the eastern two main fan ducts. One port is on the north side near the junction with the main exhaust duct and the other port is on the opposite side between the dampers and the fan. Two ports are also provided on the western main fan duct, both on the south side of the duct. One port is immediately downstream of the first isolation dampers, while the other is immediately downstream of the balance damper.

One inspection and access port is provided in the filtered exhaust duct between the last in-flow and the exit. An inspection and access port is provided in each of the three ducts from the filter outlet plenum to the filter fans.

3.5.2 Exhaust Fans

3.5.2.1 Main Exhaust Fans

The three main exhaust fans are of the centrifugal type, each having a rated capacity of 300,000 scfm with 4.16 kV, 3 phase, 60 hz, 600 HP motors, variable pitch inlet vanes and exhaust mufflers. The field performance curves are shown on figure VU I-6.

A sketch of a typical main fan is shown in figure VU I-8. Each main fan is bolted onto a concrete pad foundation. The support pedestal is metal and backfilled with concrete at the site. The backfill provides stability and sound dampening. The motor, with its air cooling shroud, is mounted on the lower deck of the pedestal.

The fan housing is supported by I beams from the base and from the high end of the pedestal. Each fan has a bearing mounted on each face of the housing to support the shaft. The shaft extends through the rotor and housing to connect to the motor shaft by a mechanical coupling. A bolted removable sector of the fan housing is provided to allow removal and replacement of the fan rotor. An inspection access opening is provided in the removable segment for rotor and shaft inspection.

The 125 KVAR power factor correction capacitor is mounted on the foundation pad just outboard of the motor. Vibration sensors are located on the inboard and outboard bearings of the fan motor of both main fans.

3.5.2.2 Filtration Exhaust Fans

The three filtration exhaust fans are of the centrifugal type, each having rated capacity of 70,000 scfm with 460 v, 3 phase, 60 hz, 235 HP motors, and variable pitch inlet vanes. The shop performance curves are shown on figure VU I-7.

A sketch of a typical filtration fan is shown in figure VU I-9. Each main fan is bolted onto a concrete pad foundation. The support pedestal is metal and backfilled with concrete at the site. The backfill provides stability and sound dampening. The motor is mounted on the lower deck of the pedestal.

The fan housing is supported by angle iron from the base and from the high end of the pedestal. Each fan has a bearing mounted on each face of the housing to support the shaft. The shaft extends through the rotor and housing to connect to the motor shaft by a mechanical coupling. An access door is provided into the fan housing for inspection as well as removal and replacement of the rotor. The 35 KVAR power factor correction capacitor is mounted on I beams, clear of the foundation pad, just outboard of the motor.

3.5.2.3 Duct to Fan Joints

There are fabric flexible joints at the inlets of all main and filtration fans. There are flexible joints at the outlets of the three filtration fans. The fabric joints accommodate expansion and prevent the fan vibrations from being transmitted to the duct work. The joints at the main fan inlets accommodate an approximate 8 degree downward slope of the branch ducts where they connect to the level mounted fans.

3.5.3 Exhaust Filtration

3.5.3.1 Exhaust Filter Building (EFB)

The exhaust filter building (413), houses the HEPA filters, filter inlet and outlet plena, the building ventilation equipment, the backup compressed air system for pneumatic operation of the various dampers and the equipment control panels.

Selected areas of the EFB building operate at a negative pressure, and the building air is passed through separate HEPA filters (Heating and Ventilation System) before being discharged to the atmosphere in the unlikely event that an air release from the main exhaust HEPA filters might occur. The air exhaust is through the filtered exhaust duct and is thus sampled at Station B.

3.5.3.2 Filtration

The two parallel HEPA filter units are walk-in type units. Each unit has one series bank of moderate efficiency prefilters (roughing filters), one series bank high efficiency prefilters and two series banks of HEPA filters. Each filter unit has a rated air flow capacity of 30,000 SCFM, providing a total capacity of 60,000 SCFM. The filters are mounted in parallel between a common inlet plenum and common outlet plenum.

The overall layout of the filter units, ductwork and dampers can be seen on figure VU I-1.

Figure VU I-10 illustrates one of the two filter units. Each filter unit is approximately 17 feet wide by 27 feet long and 8 feet tall. Each filter bank contains 21 filters, clamped into frames, seven filters wide and three filters high.

An individual prefilter element is a Varicel or equivalent filter 24 inches wide, 24 inches high and 12 inches deep. An individual HEPA filter element is an Astrocel or equivalent filter 24 inches wide, 24 inches high and 12 inches deep. These filters all use a pleated fiberglass media, folded and separated by metal spacers in a metal frame.

The first prefilter bank of filters contains 60% efficient filter units. The second prefilter bank of filters contains 90% efficient filter units. The HEPA filter banks contain filters with a 99.97% (0.3µ) efficiency. The efficiency of the prefilters is determined by tests prescribed by ASHRAE while the efficiency of the HEPA filters is determined by aerosol tests.

The filter banks are designed so that the individual filters can be bagged out to minimize spread of contamination. Aerosol distribution sampling manifolds are provided ahead of each HEPA filter bank so that these filters can be routinely tested.

The rectangular duct work from the inlet plenum to the filter units contain a balancing damper followed by an isolation damper assembly. The rectangular ductwork from the filter units to the outlet plenum contain an isolation damper assembly. The filter isolation damper assemblies are configured to be normally closed and fail open. The filter isolation damper assemblies are normally operated by pneumatic cylinders and can also be operated using manually engaged clutches and handwheels. A ladder is required for access to the manual controls.

Each of the HEPA filter inlet ducts from the inlet plenum is 8 ft wide and 6 ft high. Each has a flow balancing damper (from the South and North Filters) which is manually set and fixed in position.

Immediately downstream of the flow balancing dampers are filter inlet isolation dampers. Each damper unit is 4 ft by 6 ft in size, filling half the duct. Two units are used side by side to close off each inlet duct.

Isolation dampers similar to those in the filter inlets are used at the filter outlets. All filter isolation dampers are pneumatically operated and will fail open on loss of offsite power. All dampers have hand wheels operators and clutches for manual operation.

The HEPA filters discharge into an outlet plenum that has three outlet ducts leading to the three filtration fans. These outlets are 8 foot square.

3.6 Instrumentation and Control

This subsystem consists of the six exhaust fans, the exhaust filters and the associated exhaust dampers and exhaust duct work located at the east side of the site. See figure VU I-1.

The controls for the VU01 equipment are located on four panels, all located in the mechanical equipment room at the north end of the Exhaust Filter Building (EFB). See figure VU I-1.

The system design is based on control actions utilizing these four control panels. Some of the control functions can also be actuated from the CMR via the Local Processing Unit (LPU) of the CMS.

Drawings are identified in the Appendices which provide the details of the logic diagrams, schematics, wiring diagrams, instrument loop diagrams, process and instrument diagrams, panel layouts and electrical supply.

This section describes the control capabilities of the instrumentation and control circuits. The outline of the control procedures is contained in section 4 of this SDD.

3.6.1 Main Exhaust Fans

The three main exhaust fans, are controlled from a panel located in the EFB. These fans can be stopped but not started from the CMR.

3.6.1.1 Main Fan Electrical Supply (see also SDD ED00)

The 4.16 KV Fan motor power supply is provided by a dedicated transformer located in Substation 7. The transformer feeds three motor starters also located in Substation 7. See SDD ED00 for details.

The starters utilize vacuum contactors operated by a magnetic relay. The starter relays are energized by a circuit described in the next section. System and equipment protection includes current limiting fuses and a solid state relay system which trips on ground, phase sequence, over current and thermal faults. The fan housing and motor case are grounded.

Each main fan motor has a power factor correction shunt capacitor of 125 KVAR.

The main fan motors can only be started from the local position at the Panel. The logic diagram for the three main exhaust fans controlled from this panel is shown on figure VU I-11.

The fans can be started in either manual or automatic mode from the local panel.

In the manual mode the main fan isolation dampers must be opened manually by setting the OPEN/CLOSE/AUTO switch to OPEN and by selecting MANUAL on the MAN/AUTO fan control mode selector. Then selecting START on the START/STOP selector energizes the fan motor start-up circuit. The logic for the isolation dampers is shown on figure VU I-12.

In the automatic mode the dampers are opened automatically when the fan is energized. The automatic mode is initiated by selecting AUTO on the OPEN/CLOSE/AUTO mode selector switch for the dampers and selecting AUTO on the MAN/AUTO fan control mode selector. Then selecting START on the START/STOP selector energizes both the damper opening and fan motor start-up circuits.

A red pilot light for each isolation damper indicates that the damper is open. A green pilot light indicates that the damper is closed. The pilot lights are located on the panel above the OPEN/CLOSE/AUTO switches.

A red pilot light for each fan indicates that the fan is running. A green pilot light indicates that the fan is not energized. The pilot lights are located on the panel above the START/STOP switches.

The fans can be shut down by selecting STOP on the START/STOP fan switch, selecting STOP on the graphic display in the CMR or by pushing the red emergency pull-ON/push-OFF button located at the north side of the fan motors.

A filtration mode ON signal will always automatically deactivate both main exhaust fans whether the control mode selector is in the AUTO or MANUAL control position.

There is a differential pressure transmitter located in the WS hoist tower which measures the differential pressure between the inside and outside of the WS hoist tower. The output goes to the CMS which will take the following actions at the set levels:

Delta Pressure Level	Action Taken
25 in. wg	CMS Alarm (refer to VU05 for further action)
-2.5 in. wg	STOP a fan if two are running. (Go to Alternate Mode if in Normal Mode)
-2.75 in. wg	Stop all Fans

Other actions are described in section V.

3.6.1.2 Main Fan Flow Control

Dynamic flow control for each of the fans is accomplished by adjusting the inlet control dampers (vortex vanes).

There is a manually adjustable flow regulating damper in each main fan duct. These are used for long term trim. These dampers are only adjustable by means of a handwheel.

3.6.1.3 Main Fan CMS Interface

The following main exhaust fan measurement and status signals are transmitted to the CMS from the local LPU in the exhaust filter building.

Parameters

Fan Flow Rate
Fan Motor Axial Shaft Vibration
Fan Motor Outboard Bearing Vibration
Fan Motor Inboard Bearing Vibration
Fan Outboard Bearing Vibration
Fan Inboard Bearing Vibration

Electrical Supply

Transformer 25P-TR15/7 Malfunction
Breaker 25P-SWG05/7-1 Trip Status
Fan 41-BM-700A MPR Relay Alarm
Fan 41-BM-700A MPR Protection Trip
Fan 41-BM-700B MPR Relay Alarm
Fan 41-BM-700B MPR Protection Trip
Fan 41-BM-700C MPR Relay Alarm
Fan 41-BM-700C MPR Protection Trip

Fan Status

Fan 41-B-700A Low Flow
Fan 41-B-700A Status (Run/Stop)
Fan 41-B-700B Status (Run/Stop)
Fan 41-B-700C Status (Run/Stop)

The following functionally active output signals are transmitted from the CMR to the exhaust filter building by way of the local LPU.

Stop Fan 41-B-700A from CMS
Stop Fan 41-B-700B from CMS
Stop Fan 41-B-700C from CMS

3.6.2 Filtration Exhaust Fan Motors

The three filtration exhaust fan motors, 860 A, B, and C can be controlled from a panel located in the exhaust filter building. See figure VU I-13. These fan motors can also be controlled from the CMR graphics display. See SDD CM00.

3.6.2.1 Filtration Fan Electrical Supply (See also SDD-ED00)

The 480v fan motor power supply for fan 860-A is provided from BUS A of Substation 3. This bus is supplied by a transformer in Substation 3 or from a Diesel Generator 503. The 480V fan motor power supply for fans 860-B and 860-C is provided from BUS B of Substation 3. This bus is supplied by a transformer in Substation 3 or from Diesel Generator 504. BUS A and BUS B are normally isolated by a NO breaker. Closing of this breaker can be used to feed a filtration fan from the alternate sources. This configuration is shown on figure VU I-14.

The 480v fan motors are started directly on-line through 480V circuit breakers located in Substation 3. The circuit breaker operating coils are energized as described in the next section. Protection is provided by a solid state relay system which trips on over current and ground faults. The fan housing and motor case are grounded.

Each filtration fan motor has a power factor correction shunt capacitor of 35 KVAR.

3.6.2.2 Filtration Fan Start-up and Shutdown Controls

Control of the filtration fan motors can be exercised either from the local panel, in the exhaust filter building or remotely from the CMS graphics display. Figure VU I-15 is a logic diagram for the filtration fan and damper controls. Control from the CMR must be enabled at the local panel.

A key operated LOCAL/REMOTE selector switch allows the operator to select between local control and CMR (REMOTE) control. This one switch controls the operating mode for all three fans.

Each fan has its own key operated three way MANUAL/OFF/AUTO control mode selector switch. When any of these switches is placed in the AUTO position, the corresponding fan will stop if the filtration signal is energized. This is needed when a filtration fan is running with the filtration bypass dampers open. In the MANUAL position of the switch, the filtration signal is ignored.

To start and stop the filtration fans refer to WIPP Controlled Operating Procedures.

3.6.2.3 Filtration Fan Flow Control

Dynamic flow control for each of the fans is accomplished by adjusting the inlet control dampers (vortex vanes). This adjustment is manual, at the fan. Refer to NWP Controlled Drawings for the 860 fan and damper assignments and alignment.

3.6.2.4 Filtration Fan CMS Interface

The following filtration exhaust fan measurement and status signals are transmitted to the CMS from the local LPU in the exhaust filter building.

Local Panel BYPASS/FILTRATION Selection

- Initiation of FILTER MODE FROM LP
- Initiation of BYPASS MODE FROM LP

The following functionally active output status signals are transmitted from the CMR to the exhaust filter building by way of the local LPU.

- Initiation of FILTRATION from CMR
- Initiation of BYPASS MODE from CMR
- START/STOP of each Filtration Fan

3.6.2.5 Filtration Mode Controls

The filtration exhaust fans are not energized during normal operation. Their function is to provide filtration mode operation when the shaft exhaust is diverted through the HEPA filters and the main exhaust fans are shutdown. The circuitry which initiates filtration ON is described in section 3.6.10.2.

Manual initiation of filtration can be carried out locally or at the CMR based on the position of the LOCAL/REMOTE selector switch on the filtration fan control Panel. To accommodate filtration mode operation, one of the filtration fans must be left with the AUTOMATIC mode selected on its control mode selector switch. A filtration mode initiation signal from whatever source will close contacts in the control circuits of the fan with the AUTOMATIC mode selected. This will open the isolation dampers on that fan and start-up the fan as previously described.

3.6.2.6 Ventilation Mode Controls

It is possible to use the filtration fans as ventilation fans when the main exhaust fans are shutdown. See the control logic, figure VU I-15.

In this mode the HEPA filter shutoff and isolation valves remain closed but the bypass dampers are opened. The FILTRATION/BYPASS selector switch is used to select BYPASS and the START/STOP switch of one or two of the two filtration fans on normal mode can be switched to START. The fan(s) selected would then start up as previously described. Note that one filtration fan MUST remain in the AUTO mode to retain the capability for a FILTRATION mode.

If the FILTRATION mode is initiated when one or two of the filtration fans are being used as ventilation fans, the fans will shut down, the bypass dampers will close, the HEPA shutoff and isolation dampers will open and the filtration fan placed in AUTO will start after the 15 to 30 second time delay to allow damper positioning.

3.6.3 Flow Measurements and Controls

Flow control in each of the six exhaust fans (three main exhaust and three filtration exhaust fans) is manual.

Flow measurement is accomplished for the main fans (41-B-700A, B, C) by the use of ultrasonic flow sensors with local indications in panels adjacent to the respective duct. These indications are in both Actual Cubic Feet per Minute (ACFM) and Standard Cubic Feet per Minute (SCFM). In addition, the flow signal is sent to the CRM for remote indication for each fan.

Flow measurement is accomplished for the filtration fans (41-B-860A, B, C) by the use of hot-wire type sensors at Station B with local indications in a panel in Building 413B. The flow signals are sent to the CMR for remote indication.

3.6.4 Main Fan Isolation Dampers

Each main exhaust fan has two isolation dampers located in the inlet duct upstream of the fans. These dampers are pneumatically opened and spring closed when the solenoid operated actuator valves are de-energized.

3.6.4.1 Main Fan Damper Control System

The logic diagram for the operation of these dampers is shown on figure VU I-12. The dampers for each main fan are controlled by two three position, OPEN/CLOSE/AUTO, selector switches, on a panel B in the exhaust filter building. Each switch controls both dampers for one fan. The status of each damper is indicated by red (open) and green (closed) lamps on the panel.

Refer to NWP Controlled Operating Procedure for Main Fan isolation damper control sequences.

3.6.4.2 Main Fan Damper CMS Interface

The following main fan isolation damper status signals are transmitted to the CMS from the local LPU.

Fan No.	Damper Number	Status
41-B-700A	413-HD-307-003A	CLOSED/OPEN
41-B-700A	413-HD-307-003B	CLOSED/OPEN
41-B-700B	413-HD-307-002A	CLOSED/OPEN
41-B-700B	413-HD-307-002B	CLOSED/OPEN
41-B-700C	413-HD-307-004A	CLOSED/OPEN
41-B-700C	413-HD-307-004B	CLOSED/OPEN

3.6.5 Filtration Fan Isolation Dampers

Each filtration fan has an inlet and an outlet isolation damper. These dampers are pneumatically operated and are slaved to the status of the fan with which they are associated. These damper units are designated as follows:

Fan	Damper Inlet	Damper Outlet	Status
413-BM-860A	413-HD-056-OlOA	413-HD-056-OlOB	Closed/Open
413-BM-860B	413-HD-056-OllA	413-HD-056-OllB	Closed/Open
413-BM-860C	413-HD-056-012A	413-HD-056-012B	Closed/Open

Each filtration fan inlet isolation damper is located just outside the EFB in the large square duct section leading to the fan. Each filtration fan outlet isolation damper is located in the segment of exhaust duct attached to the fan outlet.

3.6.5.1 Filtration Fan Damper Control System

When a filtration fan receives an initiation signal, the inlet and outlet isolation dampers receive a signal to open. When the isolation dampers are fully open, they close contacts which enable the fan control to complete the startup of the fans.

3.6.5.2 Filtration Fan Damper CMS Interface

Filtration fan isolation damper status signals are transmitted to the CMS from LPU 805.

3.6.6 Bypass Dampers

Two bypass dampers are in series to block flow between the main exhaust duct and the outlet plenum for the filter system. See figure VU I-1. When opened, these dampers provide the means for bypassing filtration when the filtration exhaust fans are in use as ventilation fans. Under normal operating and filtration ON conditions these dampers are closed.

3.6.6.1 Bypass Dampers Control

These dampers are pneumatically open and spring closed when de-energized. A single manual three position CLOSE/OPEN/AUTO selector switch is used to control both dampers in conjunction with the REMOTE/LOCAL selector switch on the same panel. See figure VU I-13. The logic diagram for these dampers is shown on figure VU I-17.

Refer to WIPP Controlled Operating Procedures for bypass isolation dampers operations.

The top six indicator lights on the control panel indicate the status of the bypass dampers. See figure VU I-13. The red lamp of each pair indicates open and the green lamp closed.

3.6.6.2 Bypass Dampers CMS Interface

The bypass dampers status (open/closed) are transmitted to the CMS by way of the local LPU.

3.6.7 HEPA Filter Instrumentation

Pressure drops are measured across each of the four series filter banks in each of the two HEPA filter units, by a differential pressure (DP) transmitter located on the walls adjacent to each HEPA filter unit.

From each of these transmitters a signal is transmitted to a control panel where the signals are displayed on vertical indicators.

The pressure differential output signals are also supplied to circuit boards which generate an alarm signal when the differential exceeds preset limits, indicating a fully loaded (clogged) filter.

These clogged filter alarms are brought up on the second row of annunciator lights on a panel as shown in figure VU I-13, marked as an Engraving. An audible horn signal is also activated on the front of the panel. The alarm is acknowledged by pressing the acknowledge button on the panel. This action de-energizes the horn and switches the window illumination to a flashing mode. A reset button is used to deactivate the alarm window.

3.6.7.1 HEPA Filter Pressure Differential CMS Interface

Pressure Differential measurement and status signals are transmitted to the CMS from the local LPU in the exhaust filter building for each filter bank.

3.6.8 HEPA Filter Isolation Dampers

Each of the two filter systems, has one pair of isolation dampers. One damper for each filter is located at the inlet, in the duct between the common inlet and the filter chamber inlet. The other damper is located at the outlet of the filter, in the duct between the filter chamber outlet and the common outlet plenum. See figure VU I-1.

3.6.8.1 Control System

The HEPA filter isolation dampers are pneumatically closed. They are designed to revert to the open position when de-energized. Refer to WIPP Controlled Operating Procedures for HEPA filter isolation dampers.

3.6.8.2 CMS Interface

The open/closed status signals related to the operation of the HEPA Filter dampers are transmitted to the CMS by way of the local LPU.

3.6.9 Inlet Plenum Isolation Damper

The inlet plenum isolation damper is located in the branch exhaust duct from the main exhaust duct to the inlet plenum in the EFB. See figure VU I-1. The purpose of the inlet plenum isolation damper is to isolate the inlet plenum of the HEPA filters from the main exhaust duct under normal operating conditions.

This is a pneumatically closed, spring opened damper. It is designed to revert to the fully open position when de-energized. Refer to WIPP Controlled Operating Procedures for the inlet plenum isolation damper.

3.6.9.1 For this damper to open, the following must occur:

1. A filtration fan must be running.

2. The bypass dampers must be closed.

3. One isolation damper in each Main Fan string must be closed.

4. There must be negative pressure on the filter building side of the damper.

When all of the above occurs, the solenoid is de-energized and the damper opens.

There is a latch in the circuit to seal in the pressure switch (item 4 above) when the damper is open.

There are three maintenance bypass switches to allow work on the 700 fan control circuits without affecting the shift to filtration. These switches bypass their respective fan damper indication contacts in the shift to filtration logic.

3.6.10 Filtration/Bypass Control Circuitry

The exhaust fan system can be switched from the normal or bypass mode of operation to the Filtration Mode in which the underground exhaust air is passed through an arrangement of HEPA filters as described in section 3.3.7, chapter G.

3.6.10.1 Control Equipment

The logic used for filtration and bypass is illustrated in figure VU I-19. Alarm indications are shown on figure VU I-13.

The system can be placed in the Filtration Mode in any of the ways in the WIPP Controlled Operating Procedures for filtration mode operational sequences.

3.6.10.2 Filtration ON Test

A test circuit is provided in the local panel which allows the local operator to carry out a partial test of the filtration ON circuitry.

The operator switches the key operated test switch TS-l on the front of the panel to the TEST position and then selects the LOCAL position on the REMOTE/LOCAL switch on the panel and the FILTRATION position on the BYPASS/FILTRATION switch on the panel. This will energize the FILTRATION latching relay and an auxiliary relay. The auxiliary relay closes if the main latching relay contacts are closed and the test switch blocks the circuit beyond to prevent the completion of the transfer to FILTRATION. There is a blue light above the test switch which indicates that these relays have closed. When the test is in process, a yellow indicator light on the panel will indicate that the auto filtration system has been disabled due to the disconnection of relay R2.

3.7 System Interfaces

Primary Interfaces

System Providing Service	Service to be Provided
CA00	Provide instrument air and operator air for valves, variable pitch vanes and adjustable louvers.
	Provide Exhaust Filter Building and ductwork confinement.
CM00	Provide monitoring of the UVS.
	Provide backup signals to change the configuration of the UVS when needed by an emergency, or a change in mode of ventilation.

Primary Interfaces

System Providing Service	Service to be Provided
ED00	Provide electric power to 4.16 kV, 60 Hz, 3-phase power to the main exhaust fans. Provide electric power to 480v, 60 Hz, 3-phase and backup power to the Filtration fans.
FP00	Provide automatic fire protection to the Exhaust Filter Building and the HEPA filters.
GC00	Provide the Exhaust Filter Building and supports for the exhaust ducts.
RM00	Upon detection of radio nuclides above the setpoint in the underground air streams, provide an alarm to System CM00 which in turn provides a signal to VU00 to reduce the airflow and divert the airflow through the HEPA filters automatically (filtration mode). Continuously sample the effluent air downstream from the HEPA filters for radio nuclides.

Secondary Interfaces

No Secondary Interfaces to VU01.

4.0 OPERATIONS

Refer to section 4.0 of chapter G for VU00 system integrated operations information.

5.0 SYSTEM LIMITATIONS, SETPOINTS, AND PRECAUTIONS

Refer to section 5.0 of chapter G for system-subsystem performance limitations, setpoints, and precautions.

6.0 OFF NORMAL EVENTS AND RECOVERY

Refer to section 6.0 of chapter G for system-level off normal events and recovery.

7.0 MAINTENANCE

Refer to section 7.0 of chapter G for information relating to the Underground Ventilation System maintenance approach, corrective maintenance, preventative maintenance and inspection program requirements.

Presented are VU01 specific maintenance items which shall be considered and included in the VUS controlled maintenance procedures.

For the above ground portion of the underground mine ventilation system the equipment is:

- Main Exhaust Fan Motor
- Main Exhaust Fan
- Variable Pitch (Vortex) Inlet Vanes - Main
- Filtration Exhaust Fan Motor
- Filtration Exhaust Fan
- Variable Pitch (Vortex) Inlet Vanes - Filtration
- Flow Control/Balance (louver) Dampers (Manual)
- Filter Isolation Dampers - Half Door
- Filter Fan Isolation (Louver) Damper - Pneumatic
- Isolation (Butterfly) Damper
- HEPA Filters

7.1 In-Service Inspection

In-service inspection program shall address the following inspection requirements:

- Exhaust and Filtration Fans
- Dampers
- HEPA Filters
- Major Air Flow Ducts and Dampers

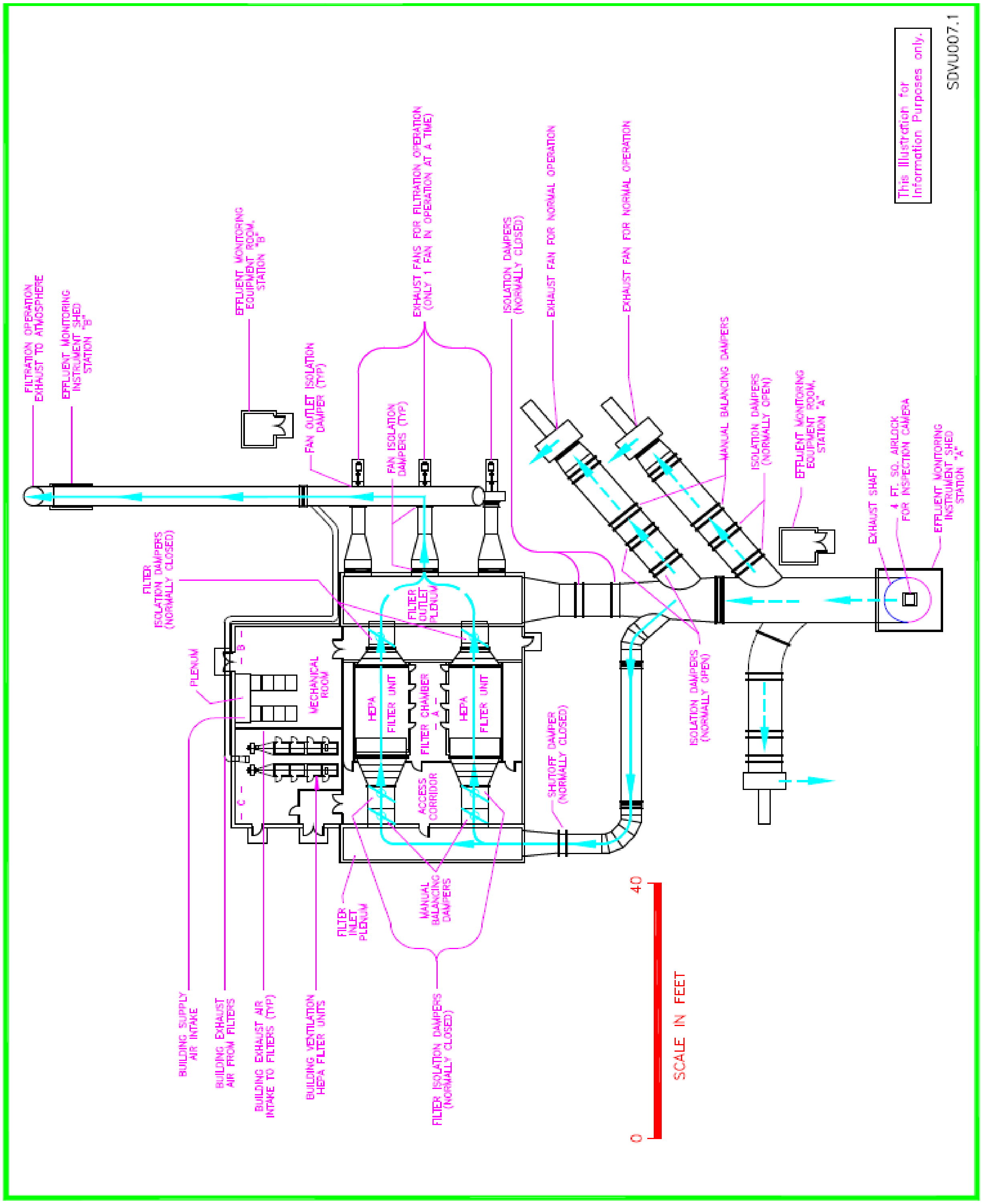

Figure VU I - 1 – Exhaust Flow Diagram – Surface Equipment

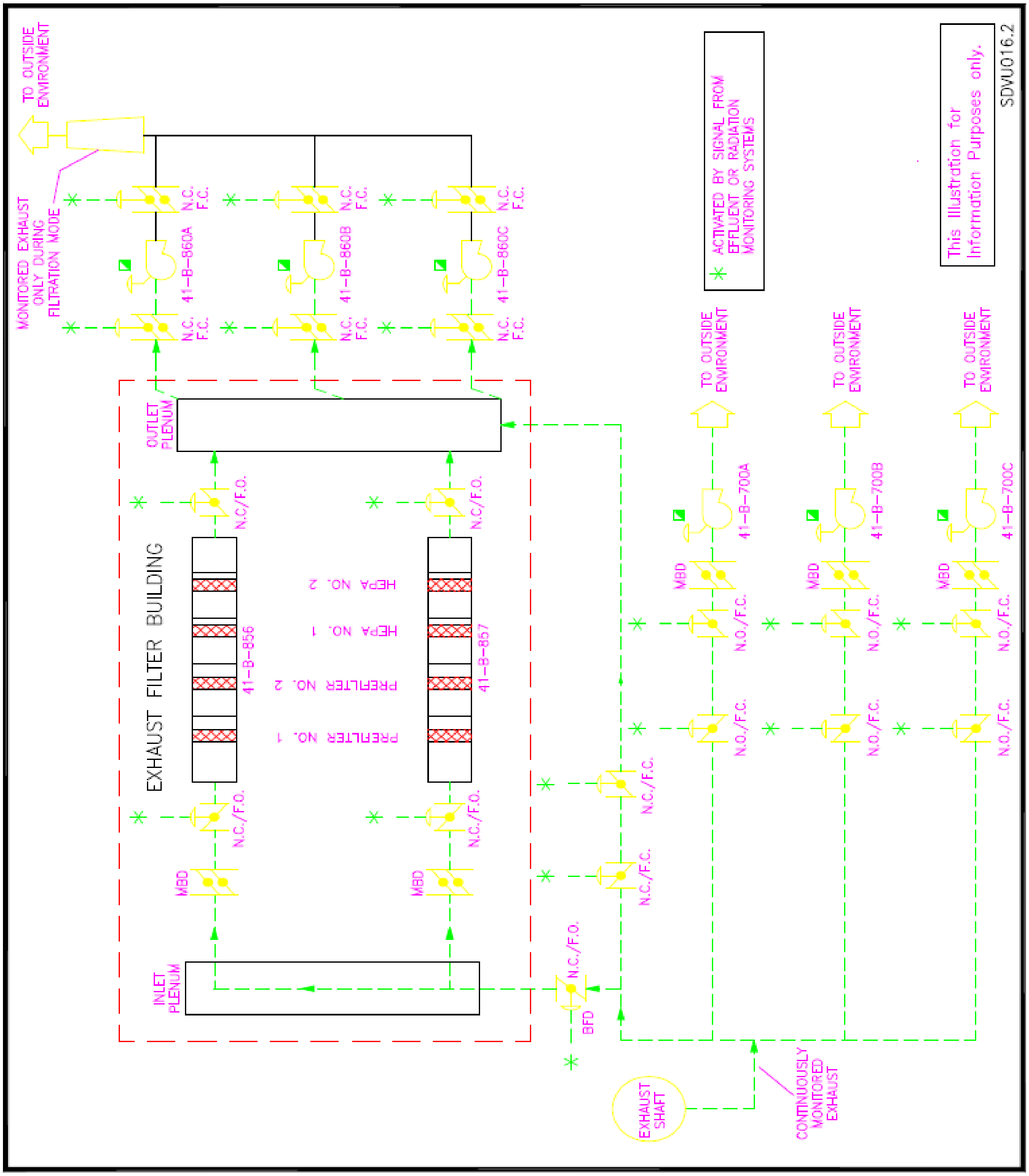

Figure VU I - 2 – VU01 Air Flow Schematic

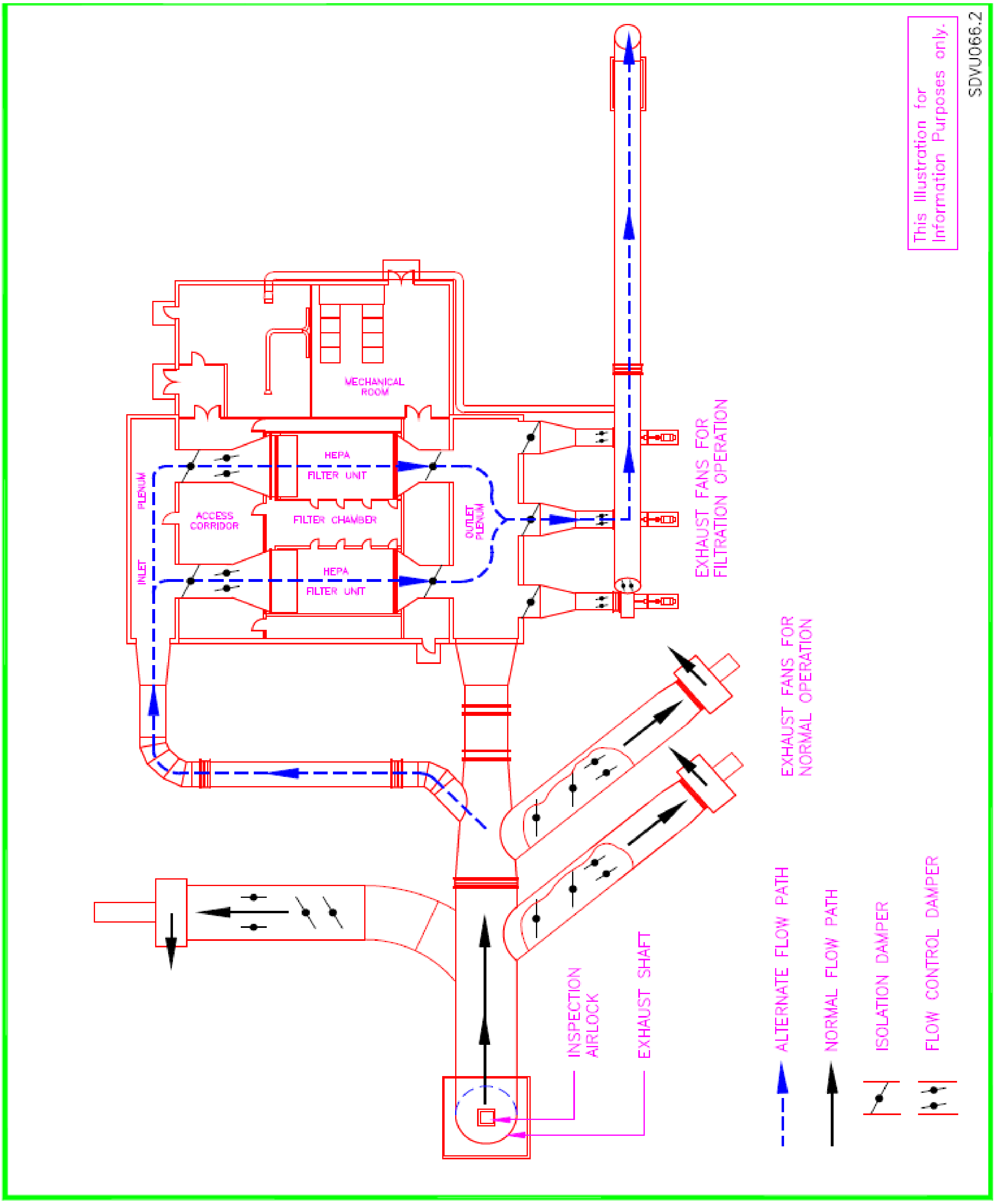

Figure VU I - 3 – VU01 Air Flow Paths

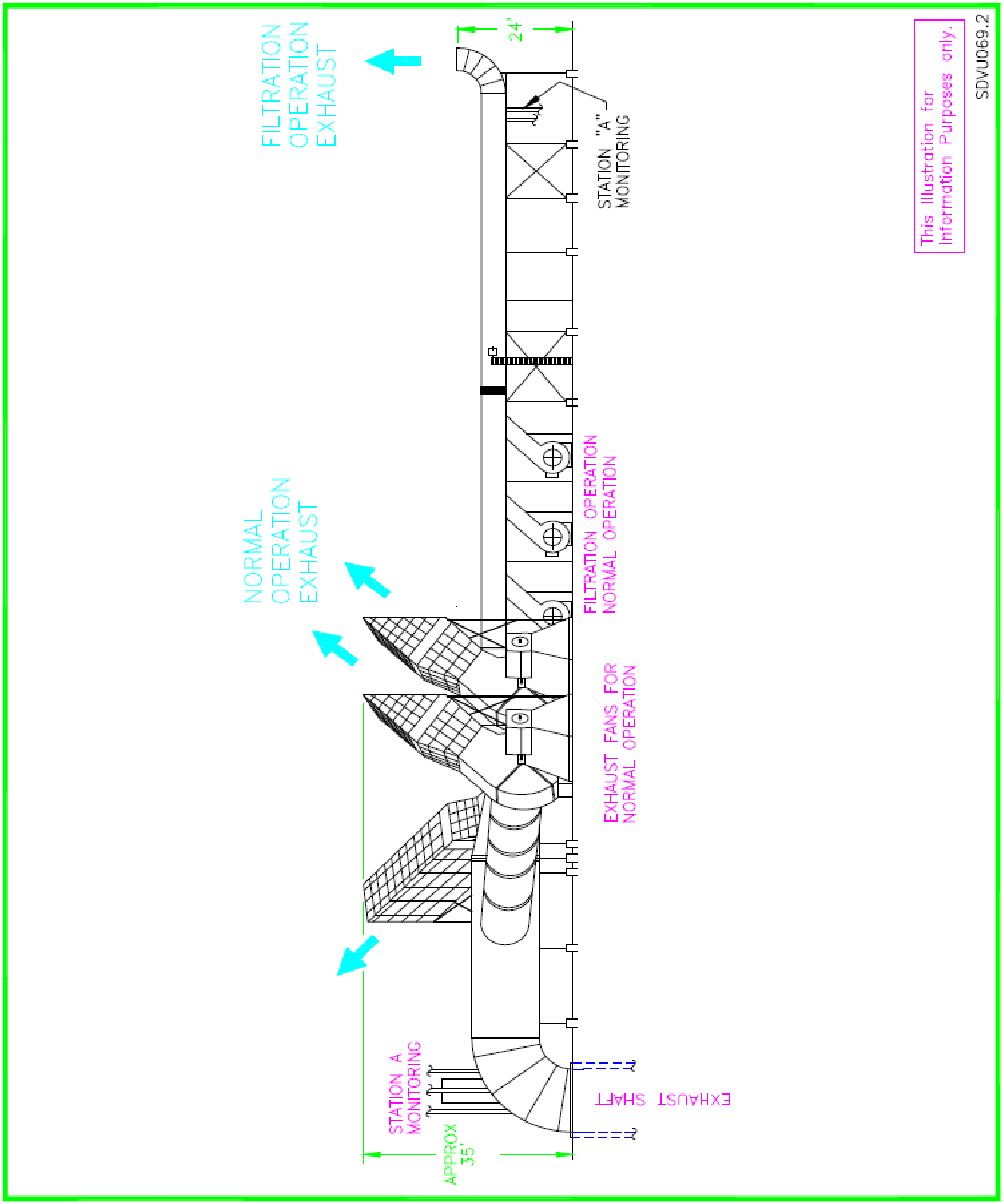

Figure VU I - 4 – VU01 External Vertical Profile

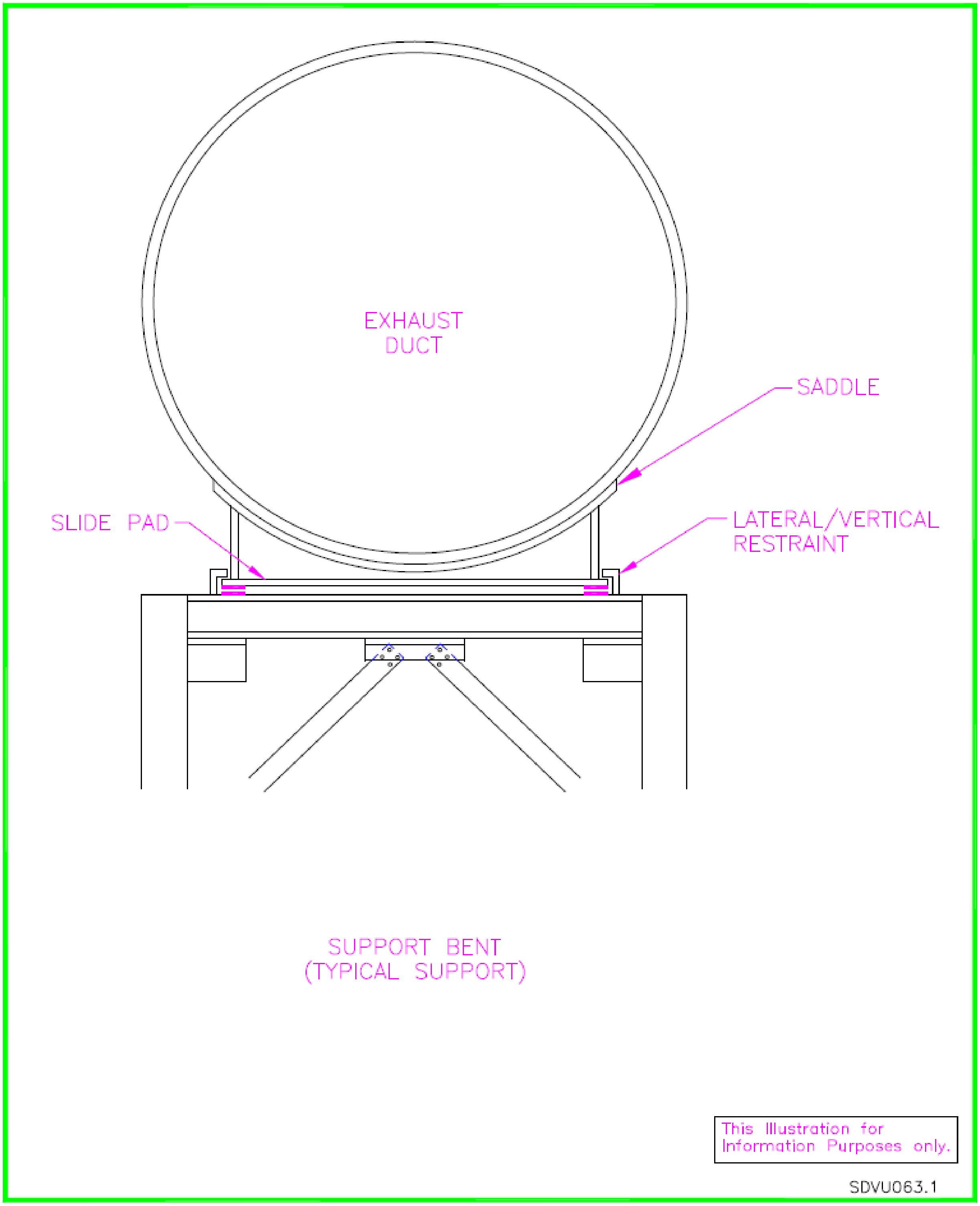

Figure VU I - 5 – Exhaust Duct Support System

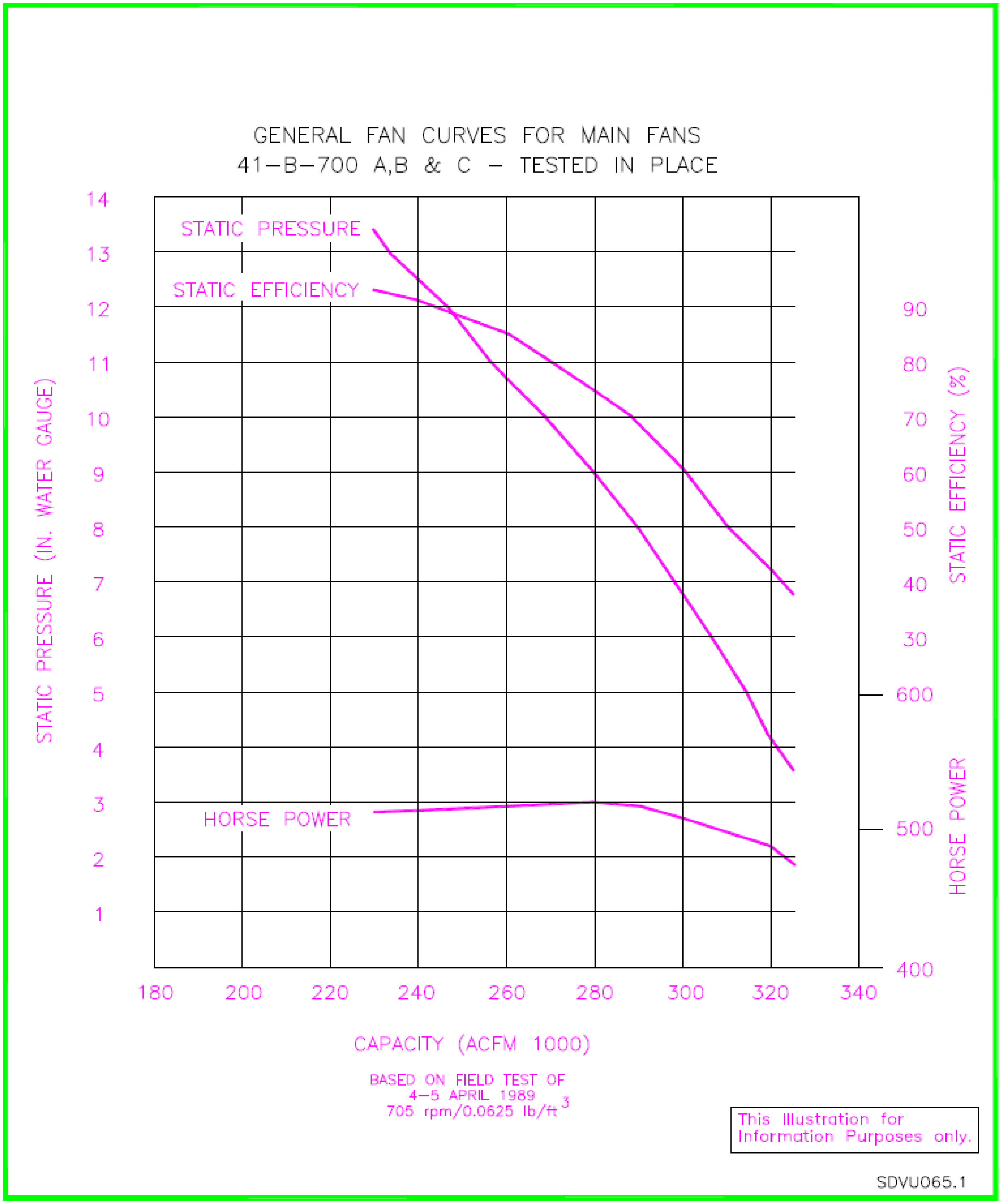

Figure VU I - 6 – Performance Curves, Exhaust 41-B-700 AB

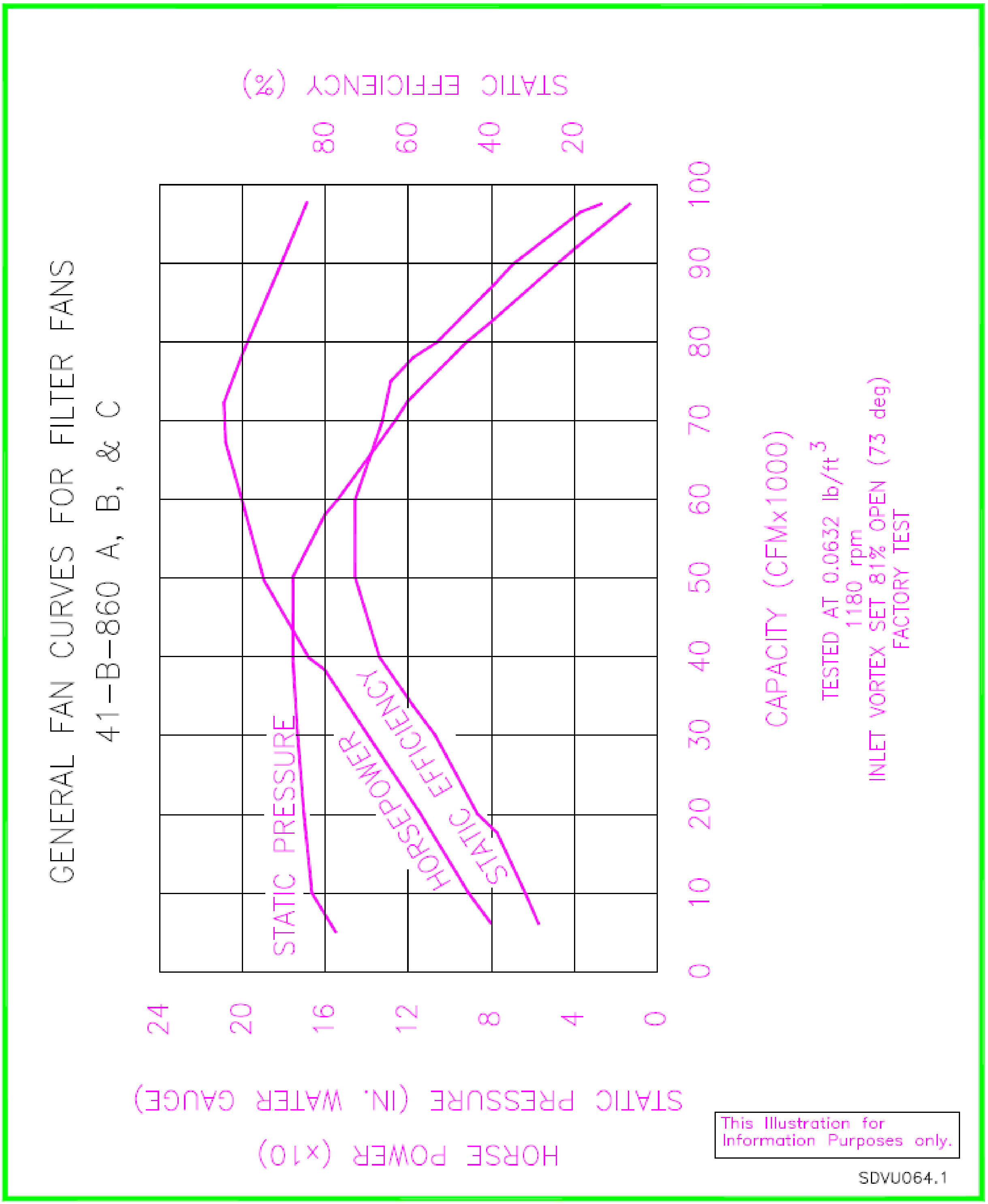

Figure VU I - 7 – Performance Curves, Exhaust 41-B-860 ABC

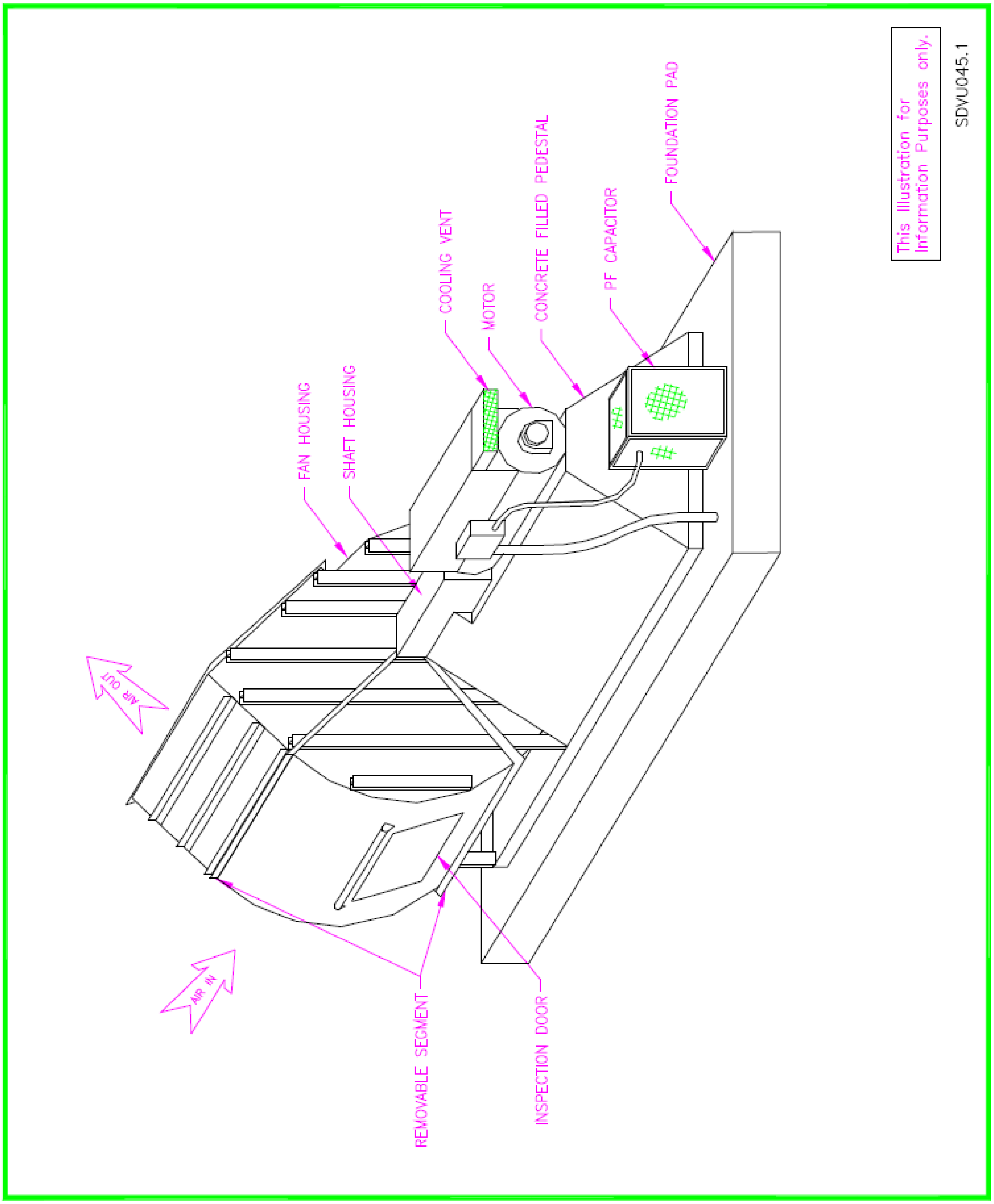

Figure VU I - 8 – Main Exhaust Fan

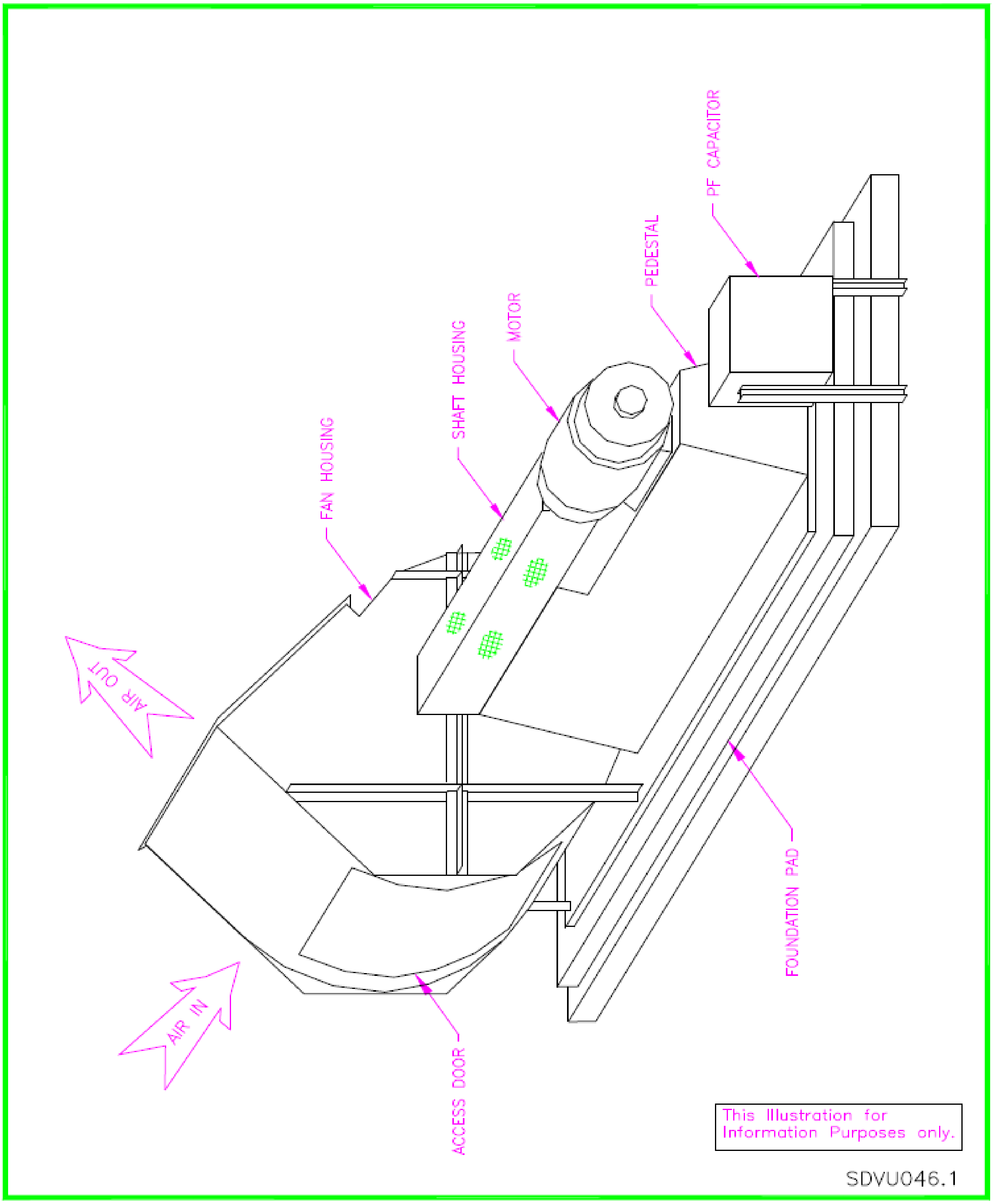

Figure VU I - 9 – Filtration Exhaust Fan

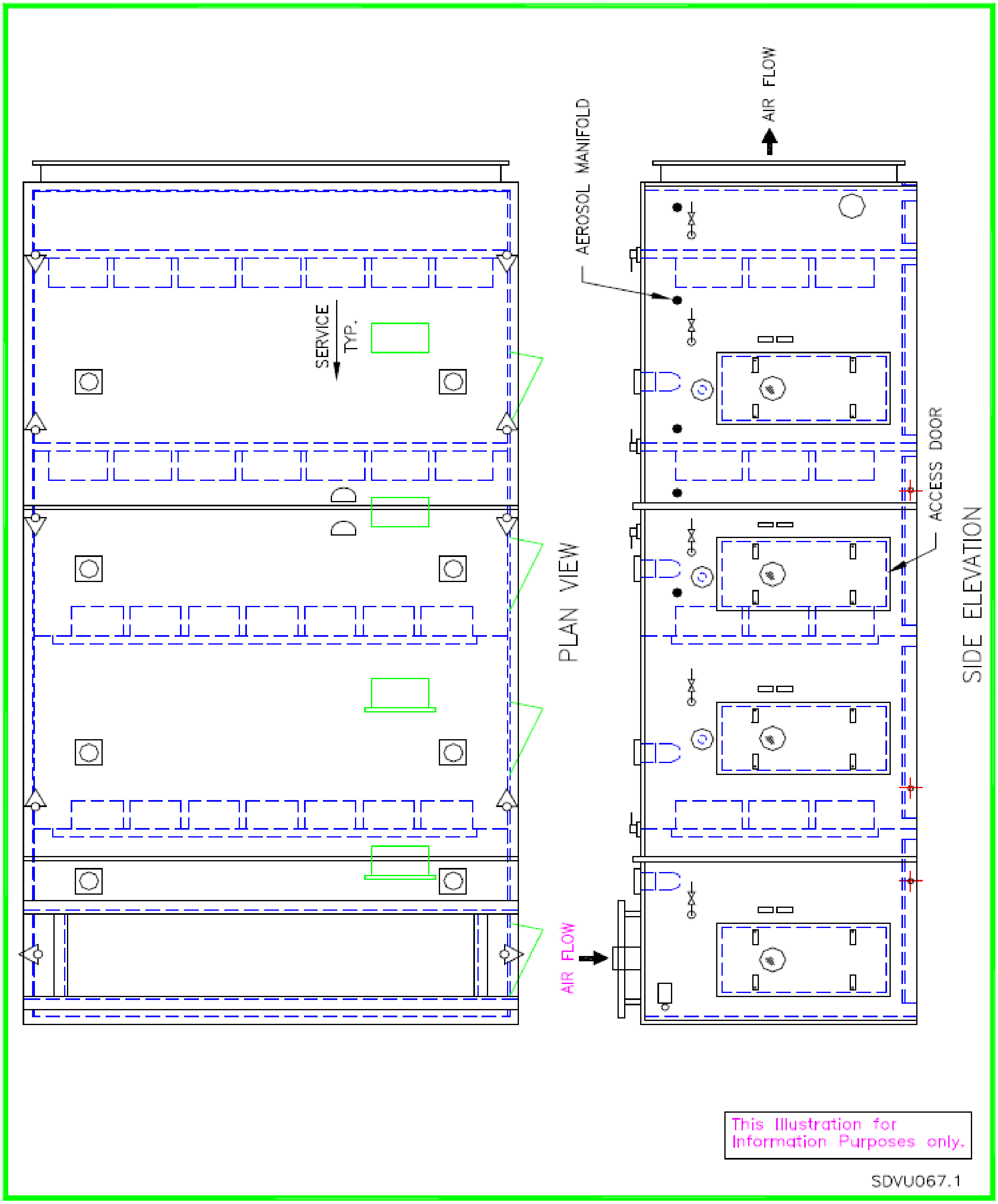

Figure VU I - 10 – Main Filter Units in Exhaust Filter Building

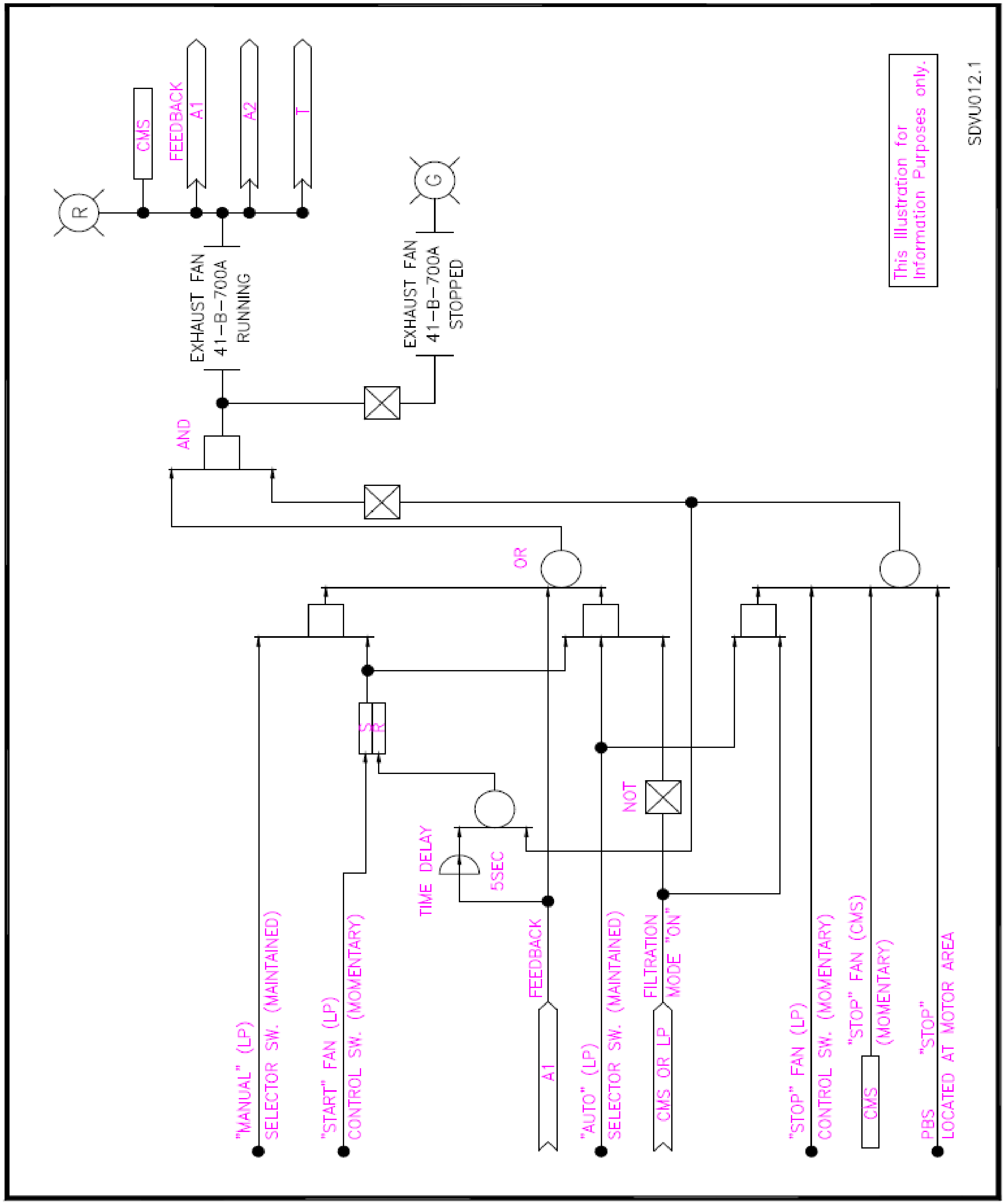

Figure VU I - 11 – Exhaust Fan 41-B-700A Logic (41-B-700B and 41-B-700C similar)

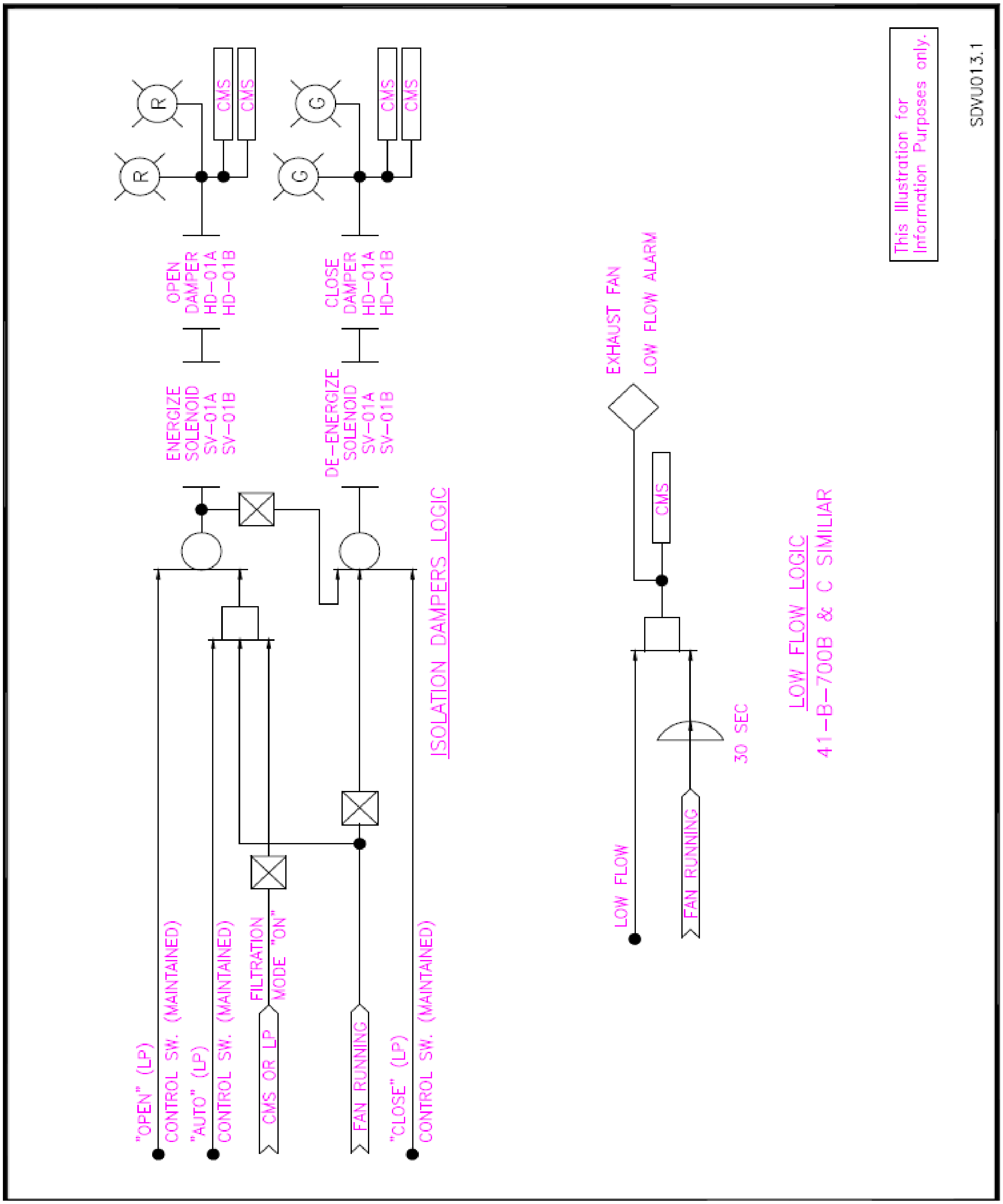

Figure VU I - 12 – Main Exhaust Fan Isolation Damper and Low Flow Logic

ANNUNCIATOR ENGRAVING FOR 413–CP–056–01

WINDOW NO.	LINE 1	LINE 2	LINE 3	LINE 4
1–1	FAL–056–010	AIR FLOW LOW	EXH. FAN 41–B–860A	
1–2	FAL–056–011	AIR FLOW LOW	EXH. FAN 41–B–860B	
1–3	FAL–056–012	AIR FLOW LOW	EXH. FAN 41–B–860C	
1–4	SPARE	AIR FLOW LOW	EXH. FAN 41–B–860C	
1–5	SPARE			
1–6	SPARE			
2–1	PDAH–056–002	MOD. EFF. FILTER	HEPA UNIT 41–B–856	CLOGGED
2–2	PDAH–056–003	HIGH EFF. FILTER	HEPA UNIT 41–B–856	CLOGGED
2–3	PDAH–056–004	1ST HEPA FILTER	HEPA UNIT 41–B–856	CLOGGED
2–4	PDAH–056–005	2ND HEPA FILTER	HEPA UNIT 41–B–856	CLOGGED
2–5	PDAH–056–006	MOD. EFF. FILTER	HEPA UNIT 41–B–857	CLOGGED
2–6	PDAH–056–007	HIGH EFF. FILTER	HEPA UNIT 41–B–857	CLOGGED
2–7	PDAH–056–008	1ST HEPA FILTER	HEPA UNIT 41–B–857	CLOGGED
2–8	PDAH–056–009	2ND HEPA FILTER	HEPA UNIT 41–B–857	CLOGGED

This Illustration for Information Purposes only.

SDVU035.1

Figure VU I - 13 – Annuciator Engraving for Fan Control Panel

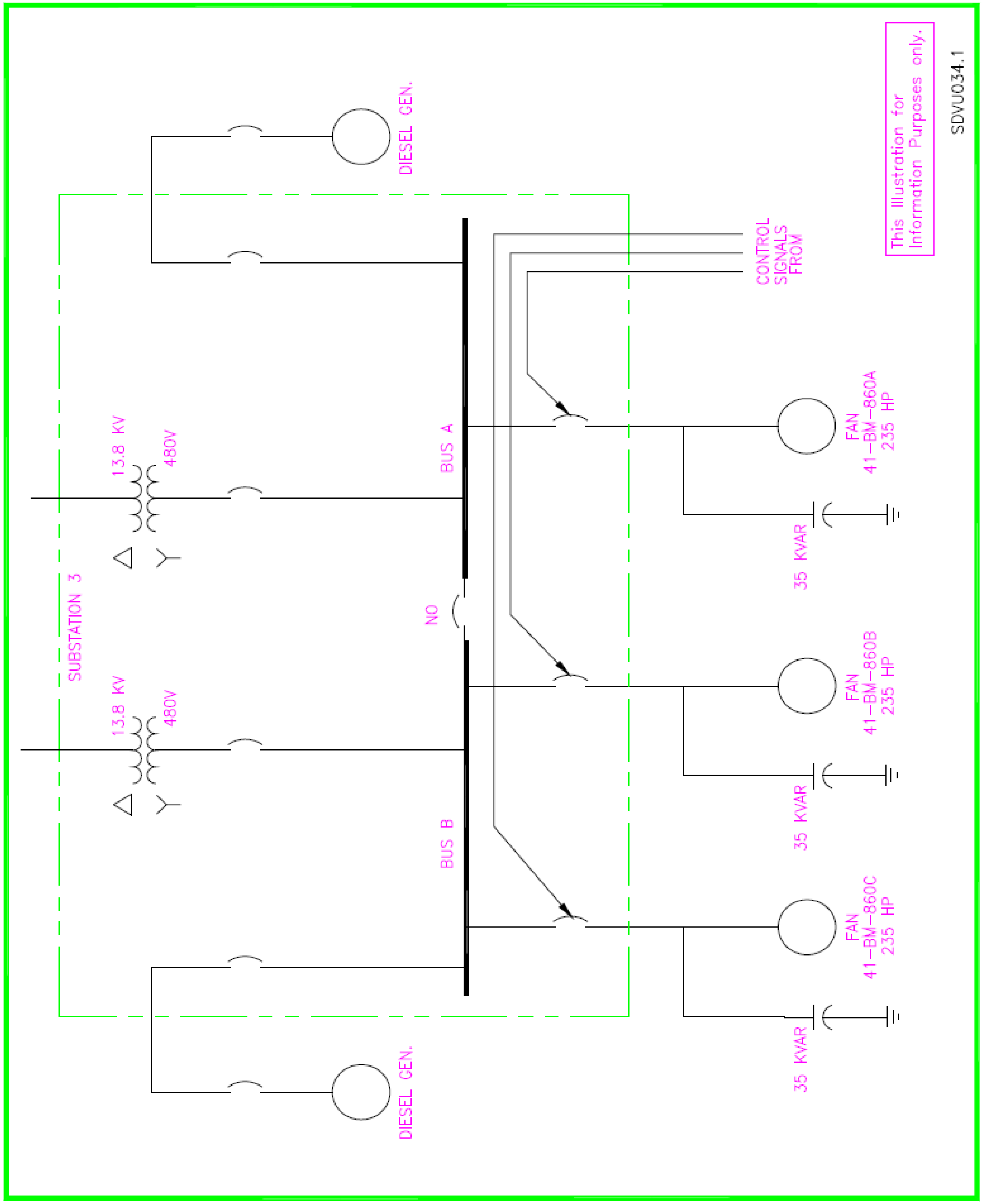

Figure VU I - 14 – Electrical Supply for Filtration Fans

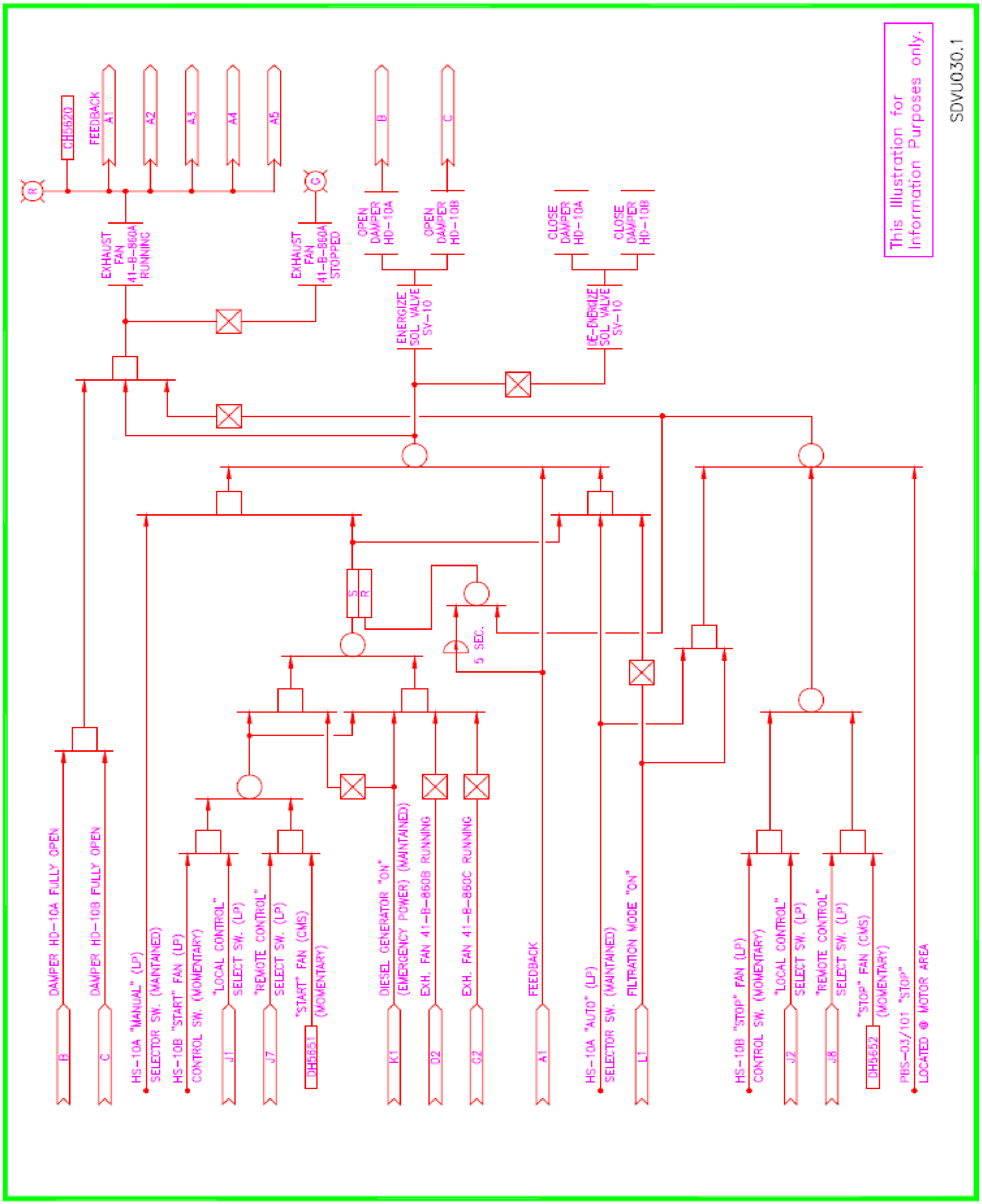

Figure VU I - 15 – Filtration Fan and Damper Control Logic

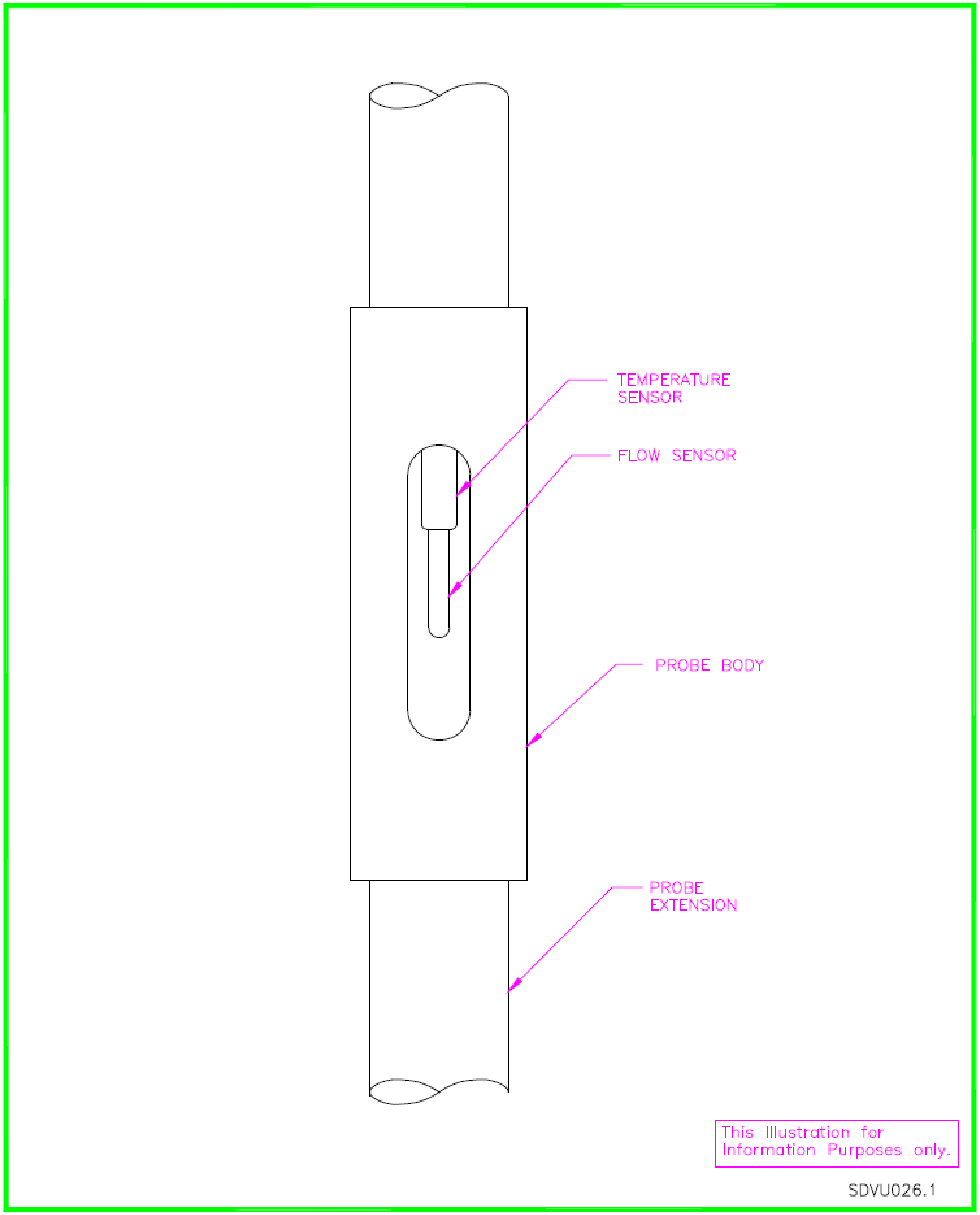

Figure VU I - 16 – KURZ Flow Sensor

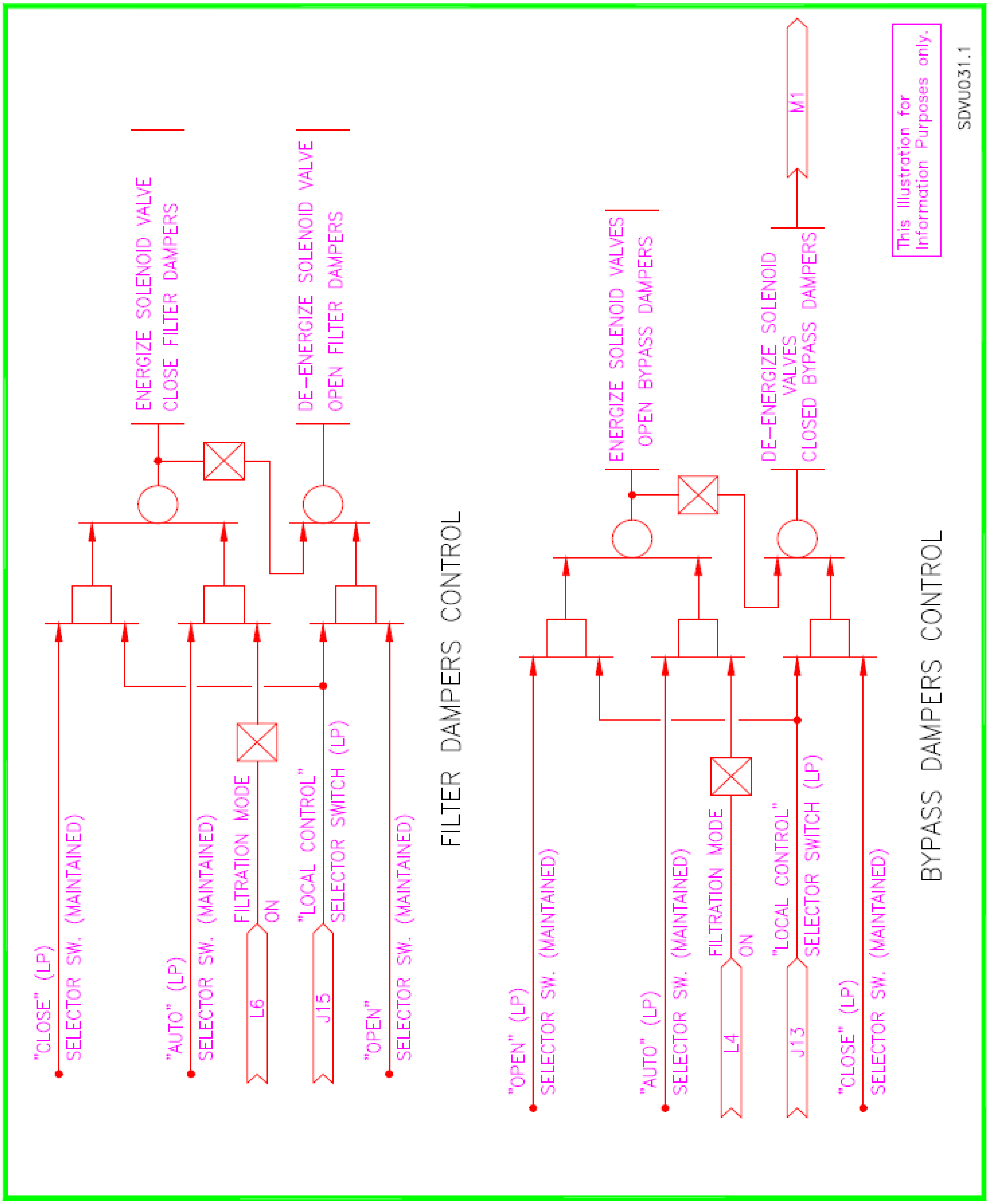

Figure VU I - 17 – Filter and Bypass Damper Logic

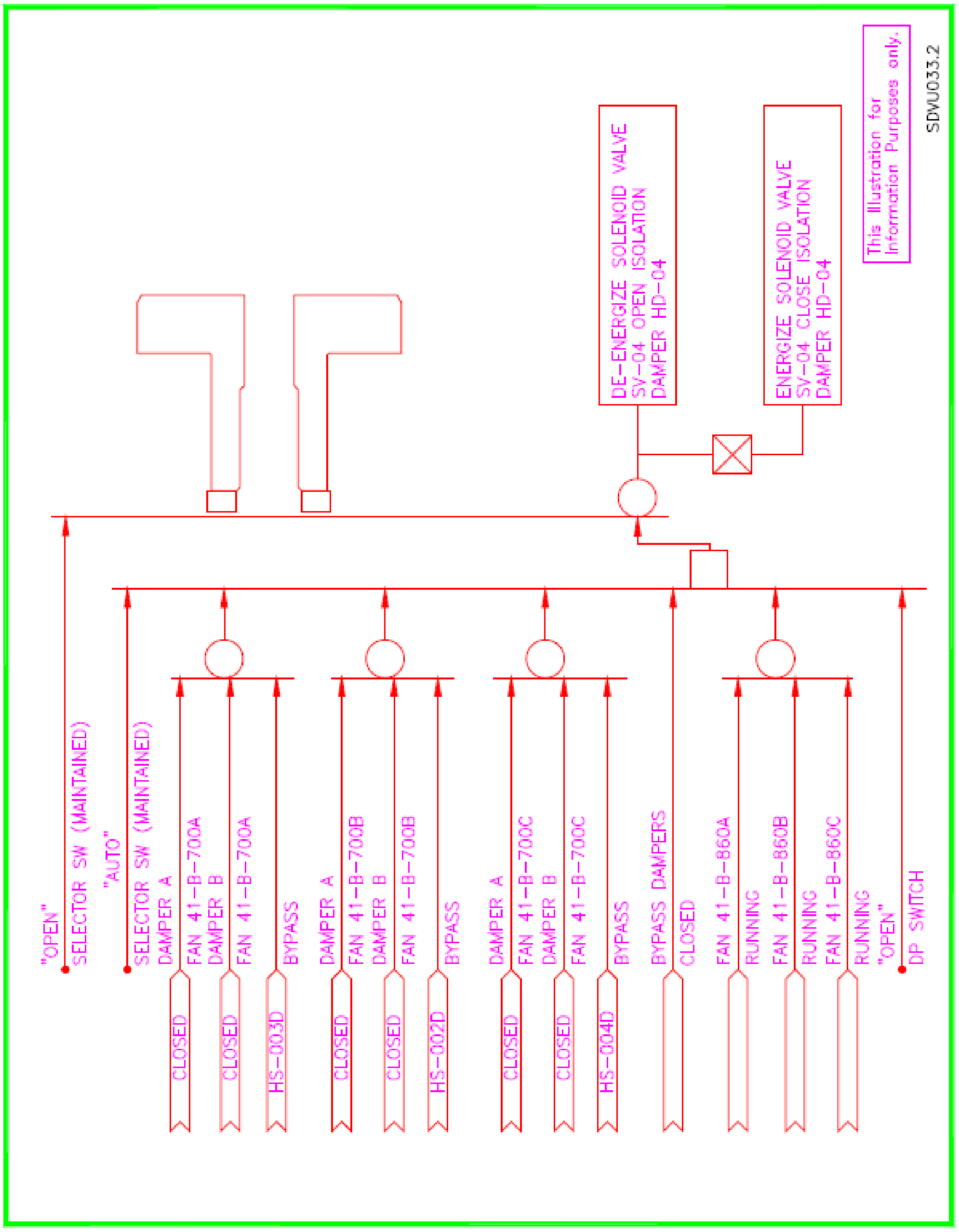

Figure VU I - 18 – Inlet Plenum Isolation Damper Control

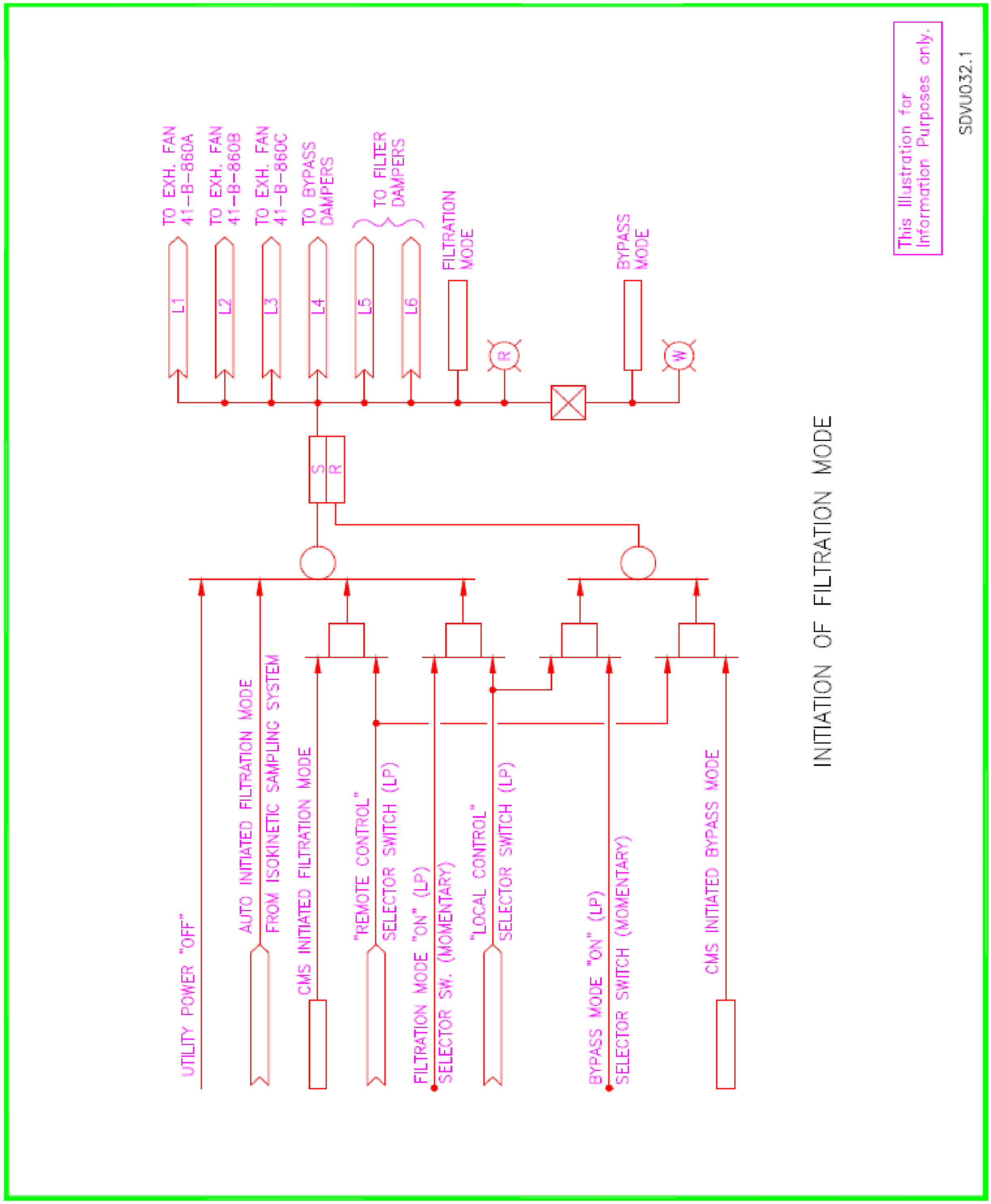

Figure VU I - 19 – Filtration Initiation Logic

Chapter II
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Subsystem VU02 - Installed Auxiliary Fans & Ducts

Chapter II

Subsystem VU02 - Installed Auxiliary Fans & Ducts

1.0 PRIMARY FUNCTIONS

The primary functions for the installed auxiliary fans, and the related auxiliary ducts are presented in section 1.0 of chapter G.

2.0 DESIGN REQUIREMENTS

2.1 General

The general design requirements for installed auxiliary fans, and the related auxiliary ducts are presented in section 2.1 of chapter G.

2.2 Subsystem Requirements

2.2.1 Dead end rooms or drifts shall have local ductwork and fans or regulators to provide the required ventilation.

2.2.2 Air used for ventilating the fuel stations shall not be recirculated but shall be directly exhausted to an exhaust drift.

2.3 - 2.12 Technical Cross Reference

Refer to section 2.3 to section 2.12 of chapter G for general requirements applicable to each of the following topics:

- 2.3 Operational Requirements
- 2.4 Structural Requirements
- 2.5 General Arrangement & Essential Requirements
- 2.6 Maintenance Requirements
- 2.7 In-Service Inspection Requirements
- 2.8 Instrumentation and Control Requirements
- 2.9 Interface System Requirements
- 2.10 Quality Assurance Requirements
- 2.11 Codes and Standards Requirements

- 2.12 Reliability Requirements

3.0 DESIGN DESCRIPTION

3.1 Summary

Refer to section 3.1 of chapter G for the Underground Ventilation System summary design description.

In order to meet the operational requirements of the facility, supplemental air circulation is provided in dead ended areas when personnel are in the spaces. Subsystem VU02 provides the ducts and the manually controlled fans which are required to provide or modify local air flow in those spaces.

3.2 Detailed System Description

In order to meet the operational requirements of the facility there are many rooms, alcoves and blocked drifts in the underground facilities which require supplemental air circulation when personnel are in the spaces. Subsystem VU02 provides those fans and ducts which are required to provide or modify local air flow in those spaces.

The remaining fans and ducts of subsystem VU02 are distributed in the underground works as necessary to satisfy the requirements for safe mining activity. This equipment has local manual controls so that it can be operated as needed when the space is occupied. The fans and ducts are described in the Component Design Description section 3.5.

3.3 - 3.4 Technical Cross Reference

Refer to section 3.3 to section 3.4 of chapter G for general requirements applicable to each of the following topics:

3.3 Performance Characteristics

3.4 System Arrangement

3.5 Component Design Description

3.5.1 Auxiliary Fans and Ducts

Throughout the UVS there are many dead end room and drifts that require auxiliary fans and ductwork to assure adequate air circulation when the area is occupied. All fans are locally controlled.

For the most current information concerning auxiliary ventilation fans (equipment numbers air flow, or Hp) refer to drawing 54-W-001-W and the WIPP Equipment Register on file in the EFR.

Likewise refer to the current Mine Ventilation Plan (DN:00CD-0001) for current as-built fan and duct configurations.

3.6 Instrumentation and Control

3.6.1 General Fan Controls

Each fan of this subsystem simply has a hand switch to turn the fan on and off. There is no instrumentation for these fans.

3.7 System Interfaces

Primary Interfaces

System Providing Service	Service to be Provided
ED00	Provide electric power to local and auxiliary fans.

Secondary Interfaces

No Secondary Interfaces to VU02.

4.0 OPERATIONS

Refer to section 4.0 of chapter G for VU00 system integrated operations information.

5.0 SYSTEM LIMITATIONS, SETPOINTS, AND PRECAUTIONS

Refer to section 5.0 of chapter G for system-subsystem performance limitations, setpoints, and precautions.

6.0 OFF NORMAL EVENTS AND RECOVERY

Refer to section 6.0 of chapter G for system-level off normal events and recovery.

7.0 MAINTENANCE

Refer to section 7.0 of chapter G for information relating to the Underground Ventilation System maintenance approach, corrective maintenance, preventative maintenance and surveillance program requirements. Presented are the VU02 minimum specific maintenance requirements and considerations that must be incorporated in VU02 maintenance procedures.

The following items are removed, replaced, or repaired on an "As Needed" basis:

- Auxiliary Fans - Small
- Auxiliary Fans - Large
- Underground Air Ducts

Chapter III
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Subsystem VU03 - Ventilation Control Bulkheads & Air Regulators

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Chapter III

Subsystem VU03 - Ventilation Control Bulkheads & Air Regulators

1.0 PRIMARY FUNCTIONS

The primary functions for the ventilation control bulkheads and air regulators are presented in section 1.0 of chapter G.

2.0 DESIGN REQUIREMENTS

2.1 General

The general design requirements for the ventilation control bulkheads and air regulators are presented in section 2.1 of chapter G.

2.2 Subsystem Requirements

2.2.1 Ventilation controls include bulkheads, ventilation doors, and air regulators. These controls shall direct or prevent airflow, govern the volume distribution of the flow, maintain required pressure differentials between the storage and construction ventilation air streams, and prevent incorrect airflow direction.

2.2.2 Bulkheads shall be placed in entries and cross-cuts to direct or prevent airflow. The bulkheads shall be equipped with personnel doors or drive-through doors where required. Air flow through bulkheads shall be controlled by air regulators. Select regulators shall be operated by motorized positioners controlled locally and monitored by the Central Monitoring System (CMS) with provision for CMS control.

2.2.3 Bulkheads shall be installed in the cross-cuts between ventilation streams. Airlocks shall be provided where necessary for underground operations.

2.2.4 Ventilation doors shall be normally opened or closed depending on the ventilation flow path desired during normal operation. In the event of a fire, selected doors, shall be capable of being closed or opened from a remote location.

2.2.5 Those bulkheads that enclose underground fuel storage station(s) shall be fire resistant.

2.2.6 A method for personnel escape (personnel and vehicle doors) through all bulkheads shall be provided, except for unpassable bulkheads. Personnel doors shall be placed at every other cross-cut as a minimum for emergency escape. In locations where high differential pressure differentials exist across the bulkheads, appropriate airlocks shall be provided.

2.2.7 The SHS station, AIS station and WS station shall be capable of being isolated from the spread of, smoke or toxic gases by control doors constructed to meet the requirements of 30 CFR Part 57. These control doors shall be capable of being operated remotely from the Central Monitoring Room (CMR). The door operations shall be designed to maintain the doors closed against the largest possible pressure differential that can develop across the doors. The doors shall be capable of being opened from either side by one person, or be provided with a manway door that can be opened from either side.

2.2.8 Any underground shop where maintenance work is done on mobile equipment shall have enclosing bulkheads and control doors which are fire resistant, or the shop air shall be directed to the exhaust stream. Whichever method is used must meet the requirements of 30 CFR Part 57.

2.2.9 All control and ventilation door openings and swing space shall be kept free of obstructions that could prevent remote operation of the door.

2.3 - 2.12 Technical Cross Reference

Refer to section 2.3 to section 2.12 of chapter G for general requirements applicable to each of the following topics:

- 2.3 Operational Requirements
- 2.4 Structural Requirements
- 2.5 General Arrangement & Essential Requirements
- 2.6 Maintenance Requirements
- 2.7 In-Service Inspection Requirements
- 2.8 Instrumentation and Control Requirements
- 2.9 Interface System Requirements
- 2.10 Quality Assurance Requirements
- 2.11 Codes and Standards Requirements
- 2.12 Reliability Requirements

3.0 DESIGN DESCRIPTION

3.1 Summary

Refer to section 3.1 of chapter G for the Underground Ventilation System summary design description.

The underground horizon plan is shown in figure VU III-1, including the planned storage panels. In order to separate, direct, and regulate the air flow in each stream, bulkheads are provided. Bulkheads are basically walls constructed to block flow of air through a drift. Bulkheads can be used to fully block air flow or to regulate air flow through them by means of adjustable air flow regulators. A bulkhead is also referred to as a stopping.

Normal and/or emergency passage is provided through all bulkheads which are located in escape paths. Refer to the current WIPP MINE Ventilation Plan which identifies the as-built conditions for bulkheads and air regulators.

3.2 Detailed System Description

The underground horizon plan is shown in figure VU III-01, including the planned storage panels. In order to separate the different air streams and to direct and regulate the air flow in each stream, barriers have to be provided.

The barriers provided are bulkheads which are walls constructed to block flow of air through a drift. Bulkheads are provided to fully block air flow or to restrict air flow by means of adjustable air flow regulators. The regulating capability is utilized to control the airflow volume and the differential pressure between waste handling and none waste handling areas.

The typical bulkhead is assembled of welded steel tubing covered by sheet metal. Sealing to the salt is accomplished by attaching rubber flashing to the bulkhead frame and to the salt. In a few areas where a higher fire resistance is required the bulkhead may be double sided with a fire resistant material (rockwool insulation) enclosed between the two sides.

Normal and/or emergency passage is provided through all bulkheads which are located in escape paths. This is accomplished by means of vehicle access doors and human scale personnel access doors or emergency hatches. Most vehicle access doors are power actuated by compressed air cylinders designed to stop and hold in place on loss of power. Some strategic vehicle doors are equipped with battery back-up power which enables the doors to be operated during the loss of primary power to these doors. Batteries and charger/inverter units are located near the power distribution panels that provide the 120 volt power to these bulkhead control panels.

The personnel doors are hung to be self closing with the prevailing air flow. Bulkhead doors are equipped with sensors for closure indication.

Airlocks are provided where doors must be kept closed to achieve normal underground air flow and differential pressure. Vehicle airlocks are created by placing two bulkheads containing vehicle doors near each other in the same drift. Critical airlock doors have interlocks to prevent simultaneous open condition on both bulkheads. Interlocks may be overridden manually if necessary under administrative control. Personnel airlocks are constructed as part of a single bulkhead.

To ensure compliance with the ventilation control measures provisions of 30 CFR, bulkheads with control doors are provided in the drifts near the shaft stations for all three of the intake shafts. In the event of fire or other off-normal occurrence, each shaft can be isolated to limit the spread of smoke or other hazard. The bulkheads are constructed in accordance with 30 CFR Part 57. Certain shops and fuel storage spaces are isolated by fire resistant bulkheads.

There is a unique pair of bulkheads in the S400 drift to ensure that air leakage from the Waste Shaft station area at the base of the WS cannot mix with the fresh air stream in drift W30. During waste handling operations in the waste shaft and/or waste shaft station area, the space between the two bulkheads is pressurized (if necessary) with air to a level which ensures that air leakage is into the waste handling station area. This mitigates the problem of the differential pressure between drift W30 and the waste handling station falling to an unacceptable value or possibly air reversal.

3.3 -- 3.4 Technical Cross Reference

Refer to section 3.3 to section 3.4 of chapter G for general requirements applicable to each of the following topics:

3.3 Performance Characteristics

3.4 System Arrangement

3.5 Component Design Description

Subsystem VU03 incorporates those features of the underground which serve to:

A. Regulate, channel and isolate the main underground air streams

B. Provide the capability to isolate each shaft

The main features are bulkheads, airlocks, the pressure chamber and the overcasts. Auxiliary features include vehicle access doors, personnel access doors, emergency personnel hatches (doors), air flow regulators, and slide gates.

3.5.1 Underground Bulkheads

A bulkhead is a wall installed to fill the cross-section of a drift to minimize air passage. Throughout the underground horizon there are numerous bulkheads. The bulkheads provide the isolation and channeling functions and are combined to form airlocks and the pressure chamber. The bulkheads combined with auxiliary features provide the airflow regulation and ventilation. Bulkheads with regulators installed in non-active disposal rooms in active panels regulate air flow through the active disposal room to provide desired air flow.

The location and function of each bulkhead is different. Consequently the design of each bulkhead is unique in its details. The location of each bulkhead is recorded on a drawing, and the construction of each bulkhead is recorded on a separate drawing.

The addition and removal of individual bulkheads will routinely be required as the operating plans, construction and storage change and as salt creep exceeds the allowances built into bulkheads. New and replacement bulkhead designs will vary from the previous designs as improved materials and techniques are developed.

3.5.1.1 Bulkhead Structure

Framing for the majority of the bulkheads is fabricated by welding of rectangular steel tubing. Tubing size and thickness and the number of framing members varies to suit the location, size, functions and loads. Sheathing is galvanized sheet steel screwed to the frame. Figure VU III-2 illustrates a typical bulkhead frame arrangement where provision has been made to mount a pair of vehicle access doors. Anchoring and sealing to the salt ribs, floor and back is discussed under Accommodation of Salt Movement. Bulkheads are constructed of noncombustible materials, except for flexible flashing used to accommodate salt movement, in accordance with 30 CFR 57, "Safety and Health Standards - Underground Metal and Nonmetal Mines" [**DSA sections 2.4.4.2.1]**.

> The bulkheads are designed of noncombustible material except for flexible flashing.

Flyash Brick bulkheads are used in several areas in the underground to create an unpassable barricade. These barricades isolate non ventilated areas from ventilated areas of the mine. See figure VU III-6.

3.5.1.2 Accommodation of Salt Movement

The salt surrounding a bulkhead in a drift will slowly move inward in response to the compressive load from the overburden. In order to accommodate the changing dimensions, the fixed bulkhead framing is fabricated shorter and narrower than the drift when installed. The allowance for salt creep is adjusted with the size of the drift, with 1.5 foot at top and 1 foot each side being typical.

To accommodate the salt creep and still anchor a framed bulkhead in place, a telescoping extension to the main framing is used. The extension is then fastened to the salt by anchored studs or bolts.

Since the function of a bulkhead is to control or block air flow, the bulkheads are sealed to the walls, floor and back (top) of the drift in which they are installed. To accommodate the salt creep while sealing off air flow, the majority of bulkheads use rubber belting as flashing which is gasketed to the frame on one side and to the salt on the other.

3.5.1.3 Provisions for Access

It is necessary to make provision for personnel and/or equipment to pass through many of the bulkheads. In order to limit air leakage, all access openings seal to the bulkhead when closed. Where access openings expose the floor of the drift, a flexible sweep is provided at the bottom to provide a seal when closed. Doors are placed to swing toward the side which normally has the higher pressure. Where space limitations or other interferences require the reverse, latches and/or pneumatic cylinders are used maintain the seal.

Personnel passage is provided by man doors. In a few cases, where the differential pressure across a bulkhead is high or the air flow through the open door is unacceptable, personnel airlocks are provided. Personnel airlocks consist of a closed chamber attached to a bulkhead with man doors at entrance and exit.

In locations where regular personnel passage is not required but an escape route is needed, emergency hatches are installed.

Passage through bulkheads by forklifts and other machinery is provided by large, drive through doors. Most of the drive through doors are operated by means of pneumatic cylinders designed to hold their position. The door control is local. As with personnel openings, where the air flow through the open door is unacceptable, airlocks are installed.

3.5.1.4 Provisions for Air Flow Control

Bulkheads may be equipped with slide gates or volume regulators to control the flow of air through a bulkhead.

A slide gate is an opening in a bulkhead, with a horizontally sliding cover. Figure VU III-3 illustrates a typical bulkhead slide gate. The slide gate provides ventilation into a local area.

3.5.1.5 Air Flow Regulators

The air flow regulators are used to balance the flow streams in the underground, assure the differential pressure requirements are met and adjust air flow in local areas.

The regulators are commercial louver type air flow controllers, some are electrically adjusted. The units are typically rectangular in shape with multiple blades mounted on a horizontal axis. Figure VU III-3 illustrates a typical bulkhead air flow regulator.

The louver blades are positioned by gear motors that lock in the current position upon power failure. The louver drive units provide position information to and can be controlled by the CMS, but have provision for local electric control and position readout. In the event of a total power failure, the louvers can be adjusted by means of a handwheel on the gear train.

Monitoring of air regulator status is accomplished with continuous shaft position sensors that report the output shaft position angle through the CMS and locally, where applicable. The regulators are located in bulkheads as shown on Mine Map drawing 54-W-001-W.

3.5.1.6 Provisions for Cable and Pipe Penetrations

It is necessary to make provision for pipe and cable to pass through many of the bulkheads. Penetrations for cable and pipe are typically provided in the bulkhead framing. The pipe and cable are sealed to the bulkhead to minimize air leakage. Many of the new and replacement penetrations utilize prefabricated gland seals which can be opened from the side to accommodate cable and pipe already in place.

3.5.2 Underground Airlocks

There are drifts in which air flow must be blocked continuously but which simultaneously require personnel or vehicle passage. Airlocks are provided to permit access through a stopping without altering the airflow. Airlocks are constructed of noncombustible materials, except for flexible flashing used to accommodate salt movement, in accordance with 30 CFR 57, "Safety and Health Standards - Underground Metal and Nonmetal Mines **[DSA sections 2.4.4.2.1]**.

> Airlocks are non-combustible construction (except for flexible flashing).

3.5.2.1 Vehicle Airlocks

To provide vehicle access while blocking air flow, bulkheads with vehicle doors are installed in pairs to create an airlock. Figure VU III-4 illustrates an airlock with vehicle access doors installed in a drift. Airlock doors are normally closed and are operated locally by color coded pull cords. Operation of most of the airlock doors is locally interlocked such that only the doors in one bulkhead at a time can be open. Airlock door open/close are monitored in the CMR.

Specific doors can be opened and closed from the CMR. Personnel access doors, man doors or emergency hatches, may also be placed in these bulkheads.

3.5.2.2 Personnel Airlocks

To provide personnel access while blocking air flow, a personnel airlock is attached to a single bulkhead. A personnel airlock is simply a small room attached to the bulkhead. The airlock has two doors, which open to provide access to opposite sides of the bulkhead.

3.5.3 Pressure Chamber

Drift S400 runs from W30, through the waste handling station, to the exhaust shaft. Drift W30 is the main fresh air source for both the mining area and the disposal area. Drift S400 is blocked by bulkheads to prevent shunting flow directly from W30 to the exhaust shaft.

There is no isolation between the west end of S400 and the exhaust shaft. The entire length of S400 could potentially become contaminated. In order to ensure that air flow leakage is never from the potentially contaminated exhaust stream to the fresh air stream in W30, the differential pressure must always be toward the exhaust shaft during waste handling operations in the waste shaft and/or waste shaft station area.

There are two standard bulkheads located between the waste shaft station and the W30 drift. Each bulkhead is sealed to the floor, back, and ribs of drift S400. High pressure fans in the west bulkhead draw suction (when activated) from the W30 Drift and exhaust into the space between the bulkheads, forming a pressure chamber.

The pressure chamber was tested to withstand as much as 3 inch wg. As a secondary backup system, pressure will be supplied by an actuated valve on a plant air pressurized line.

The valve will be controlled by a Foxboro controller to regulate the flow of air into the chamber and maintain pressure differentials.

In normal operation there will always be higher pressure in W30 than S400. In off normal operation there are conditions in which the pressure in W30 could be slightly lower than that in S400. During this off-normal condition, when waste handling operations in the waste shaft and/or waste shaft station area the pressure chamber will be activated to mitigate this condition.

Figure VU III-5 provides a plan view of the pressure chamber.

3.5.4 Overcasts

An overcast is a structure used at the intersection where two air streams must cross but remain separate. Overcasts are constructed of noncombustible materials, except for flexible flashing used to accommodate salt movement, in accordance with 30 CFR 57, "Safety and Health Standards - Underground Metal and Nonmetal Mines" **[DSA sections 2.4.4.2.1].**

> Overcasts are non-combustible construction (except for flexible flashing).

Overcasts will be installed, as required, as construction in the underground facility proceeds.

Emergency access through and/or over the overcast is provided as necessary in the escape route map.

3.5.5 Chain Link and Brattice Cloth

Brattice cloth barricades are used to control air flow. The brattice cloth is a flame-resistant brattice cloth accepted by the MSHA Approval and Certification Center.

Once a disposal room is filled and is no longer needed for emplacement activities, it will be barricaded against entry and isolated from the mine ventilation system by removing the air regulator bulkhead and constructing chain link/brattice cloth barricades at each end. The chain link impeded physical entry into the closed disposal room, and the brattice cloth isolates the room from underground ventilation.

3.6 Instrumentation and Control

This subsystem incorporates all the underground bulkheads with the associated doors and regulators. The doors may be normally opened or closed to create specific air flow modes.

3.6.1 Bulkheads With No Doors Or Regulators

Those bulkheads which have no access doors or air flow regulators have no instrumentation or control. These bulkheads may have emergency escape hatches. The hatches have no instrumentation or active control.

3.6.2 Personnel Doors

The normal personnel access doors, have no active controls. Some of these doors are instrumented to detect the open/closed condition.

3.6.3 Door Operation

Typical local control of Vehicle Door controls consists of pairs of ropes attached to momentary switches which are hung from the back.

Ropes are located far enough from doors so as not to interfere with door operation.

A bell sounds or a strobe light flashes on initiation of door open/close.

Some doors can be remotely controlled by the CMRO. A bell sounds or a strobe light flashes on CMRO signal initiation.

3.6.4 Locally and CMR Operated Regulators

A signal from either the local panel or from the CMS through the local LPU will cause the regulator to move to the commanded position. Controls are provided near the regulator for local actuation.

On loss of power, the regulators fail as is.

3.6.5 Airlock Doors

Vehicle airlock doors are controlled in the same manner as other vehicle doors except that there is a interlock circuit added. The permissive circuit allows the doors to open if the doors at the other end of the airlock are closed.

3.6.6 Pressure Chamber Control

The underground ventilation system is designed to maintain pressure in the active Waste Handling and Disposal areas negative with respect to all other areas. This ensures that any airborne radiological leakage will be limited to these areas.

Two bulkheads are installed in parallel between the WS station and the W30 drift to create a chamber which can be pressurized. With the pressure chamber at a minimum of .05 inches wg above the WS station, no air flow should occur from the WS station back to the W30 drift.

The control panel for this system is located in W30. It provides control and power for the high pressure fan system that is installed at the pressure chamber. The control panel has a primary and alternate power supply that provides redundant power to the system. There are three process meters installed in the control panel to monitor the differential pressure locally and remotely via CMS.

3.6.7 Interface to CMS

The following bulkhead door, damper, air velocity, and differential pressure measurement and status signals are transmitted to the CMS from the LPUs underground:

Door Status	Open/ Closed
Damper Position	Value (0 to 100%)
Damper Command Status	Local/Remote (CMS)

3.7 System Interfaces

Primary Interfaces

System Providing Service	Service to be Provided
CA00	Provide air to the operating cylinders for bulkhead and airlock cylinders.
CM00	Provide backup signals to change the configuration of the UVS when needed by an emergency, or a change in mode of ventilation. Provide monitoring of the UVS.

Primary Interfaces

System Providing Service	Service to be Provided
ED00	Provide electric power to the underground door operators, local control panels, and door monitors.

Secondary Interfaces

CF00	Limit the differential pressure on the Waste Shaft Tower.
CM00	Provide wiring from UVS equipment to the CMS. Provide status of selected bulkhead doors. Provide air regulators, differential pressure measurements, airflow velocities and psychrometric conditions throughout the facility.
FP00	Provide emergency control of ventilation for underground fires.
GC00	Provide ventilation for underground construction operations.

4.0 OPERATIONS

Refer to section 4.0 of chapter G for VU00 system integrated operations information.

5.0 SYSTEM LIMITATIONS, SETPOINTS, AND PRECAUTIONS

Refer to section 5.0 of chapter G for system-subsystem performance limitations, setpoints, and precautions.

6.0 OFF NORMAL EVENTS AND RECOVERY

Refer to section 6.0 of chapter G for system-level off normal events and recovery.

7.0 MAINTENANCE

Refer to section 7.0 of chapter G for information relating to the Underground Ventilation System maintenance approach, corrective maintenance, preventative maintenance and inspection program requirements.

Presented is a list of VU03 equipment and related devices that shall be maintained in the WIPP Maintenance Procedures.

- Bulkheads
- Air Regulators
- Tornado Dampers

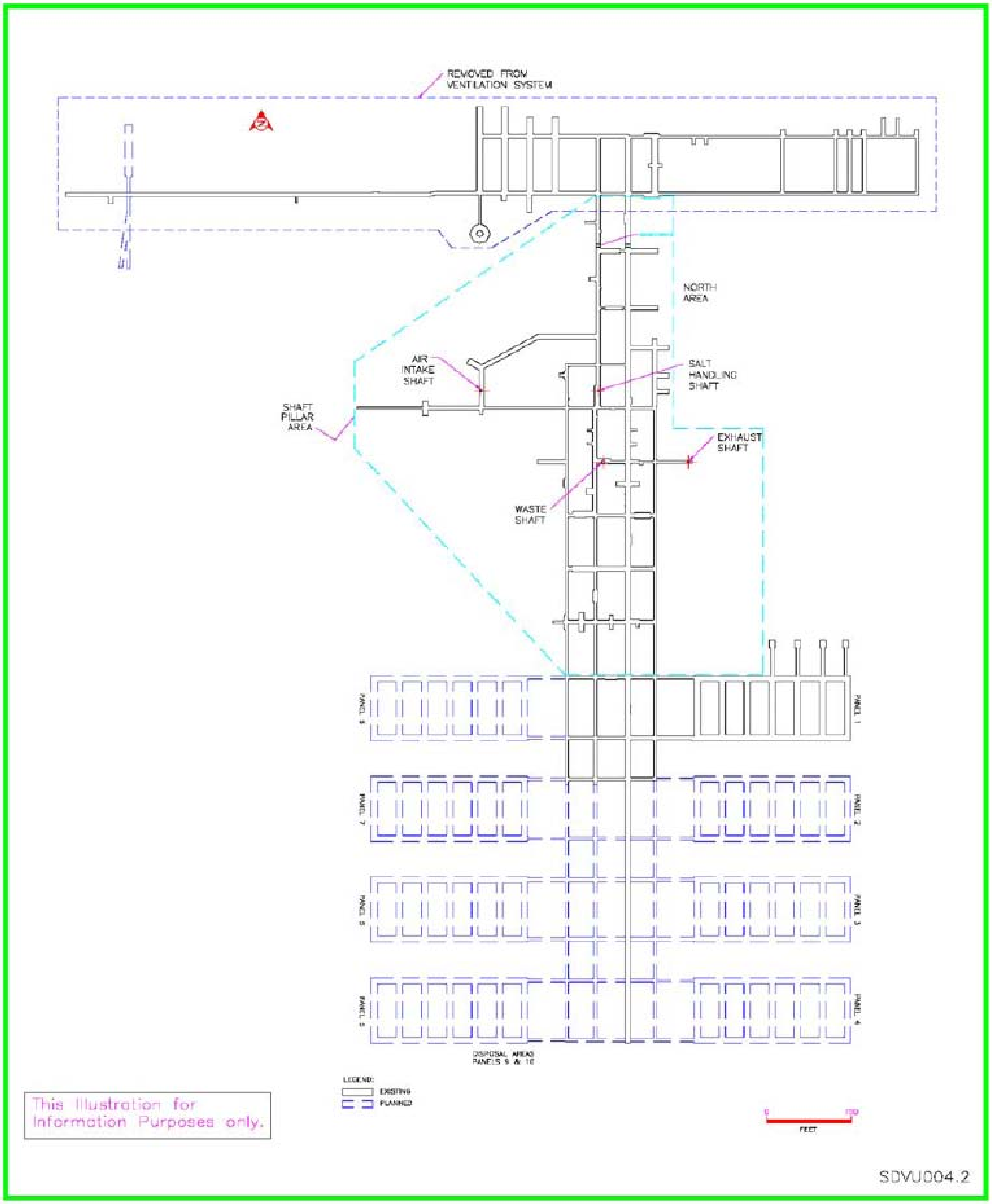

Figure VU III - 1 – Underground Horizon Plan View

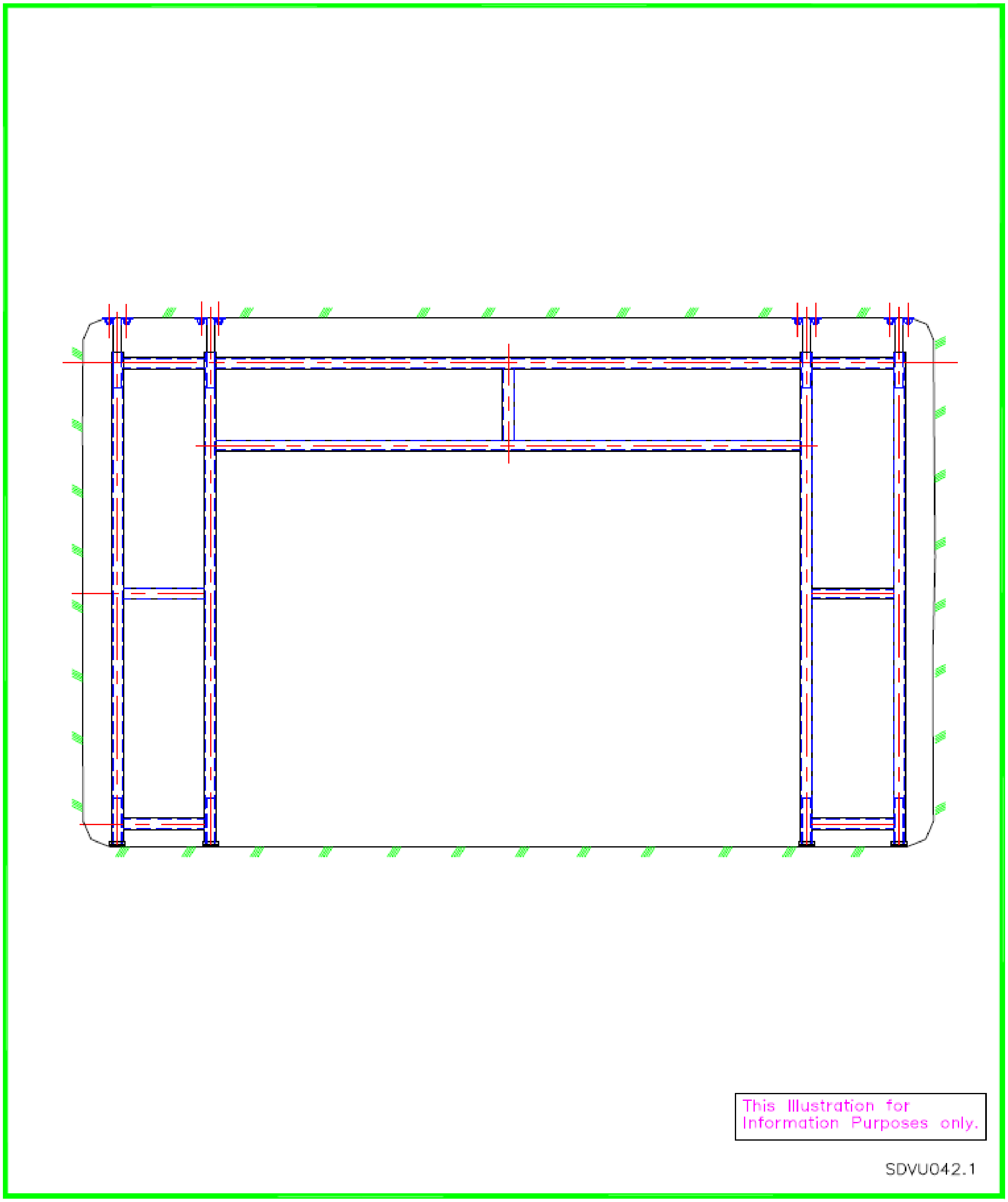

Figure VU III - 2 – Typical Bulkhead Framing

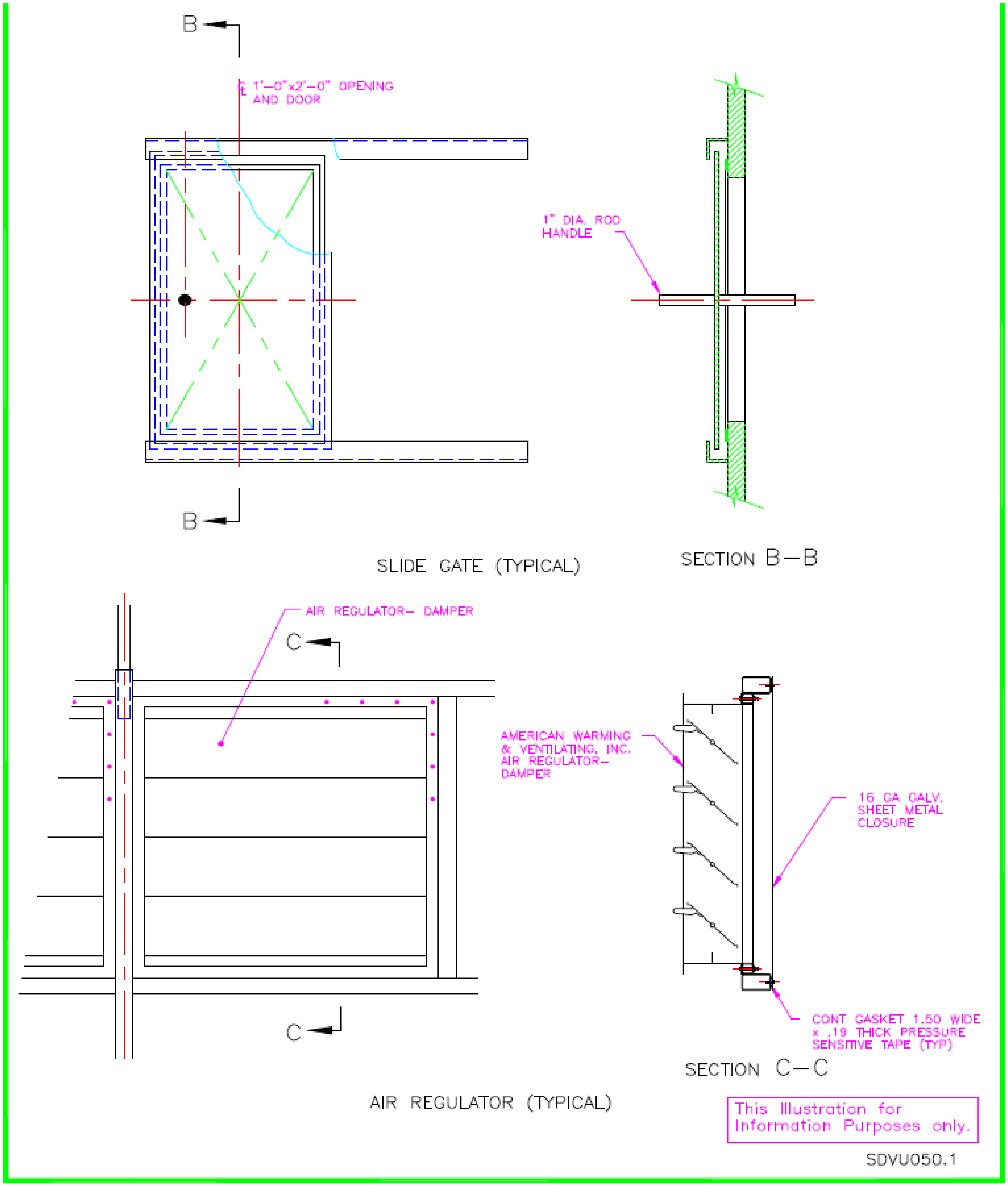

Figure VU III - 3 – Slide Gates and Air Regulators

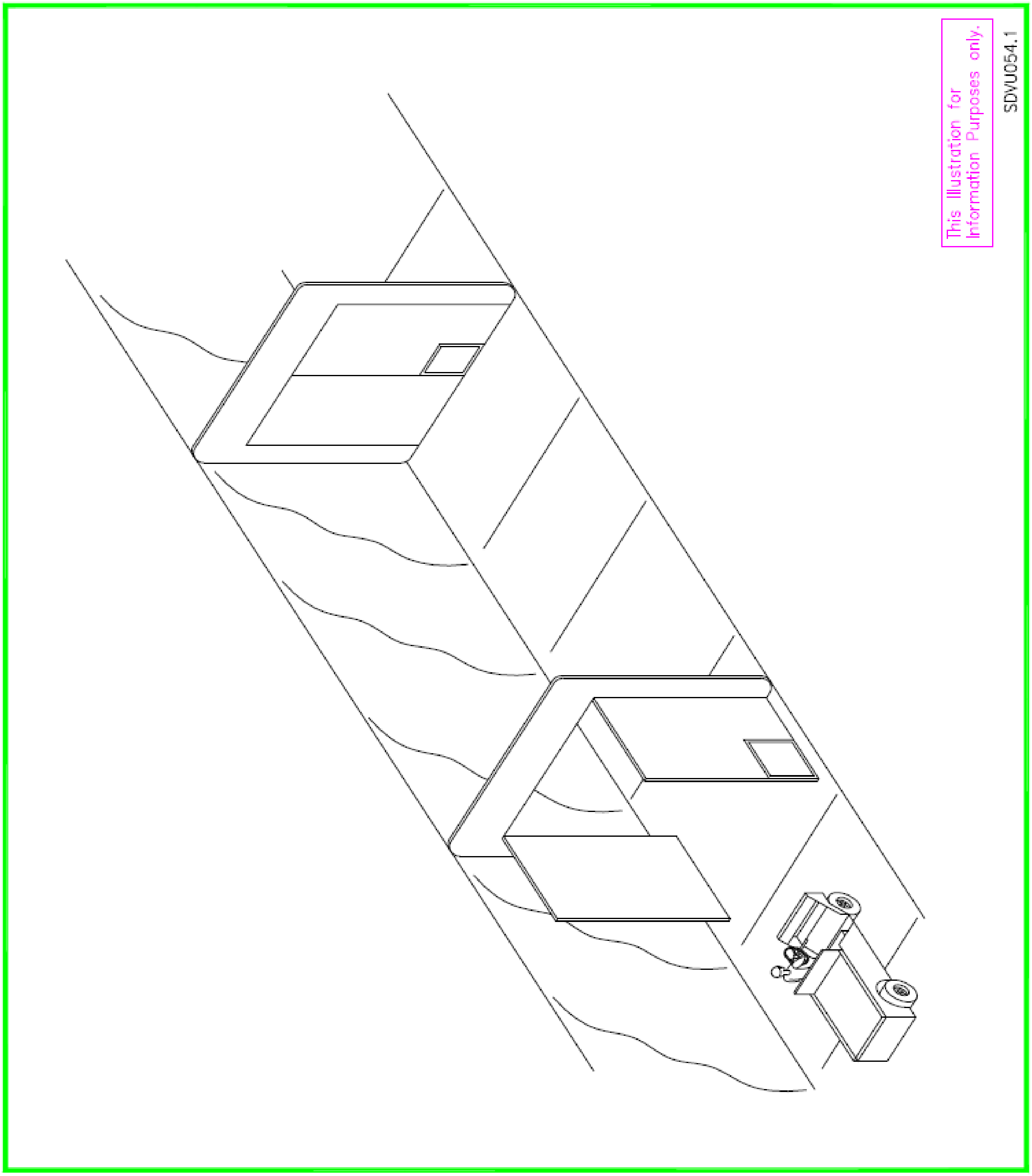

Figure VU III - 4 – Underground Vehicle Airlock

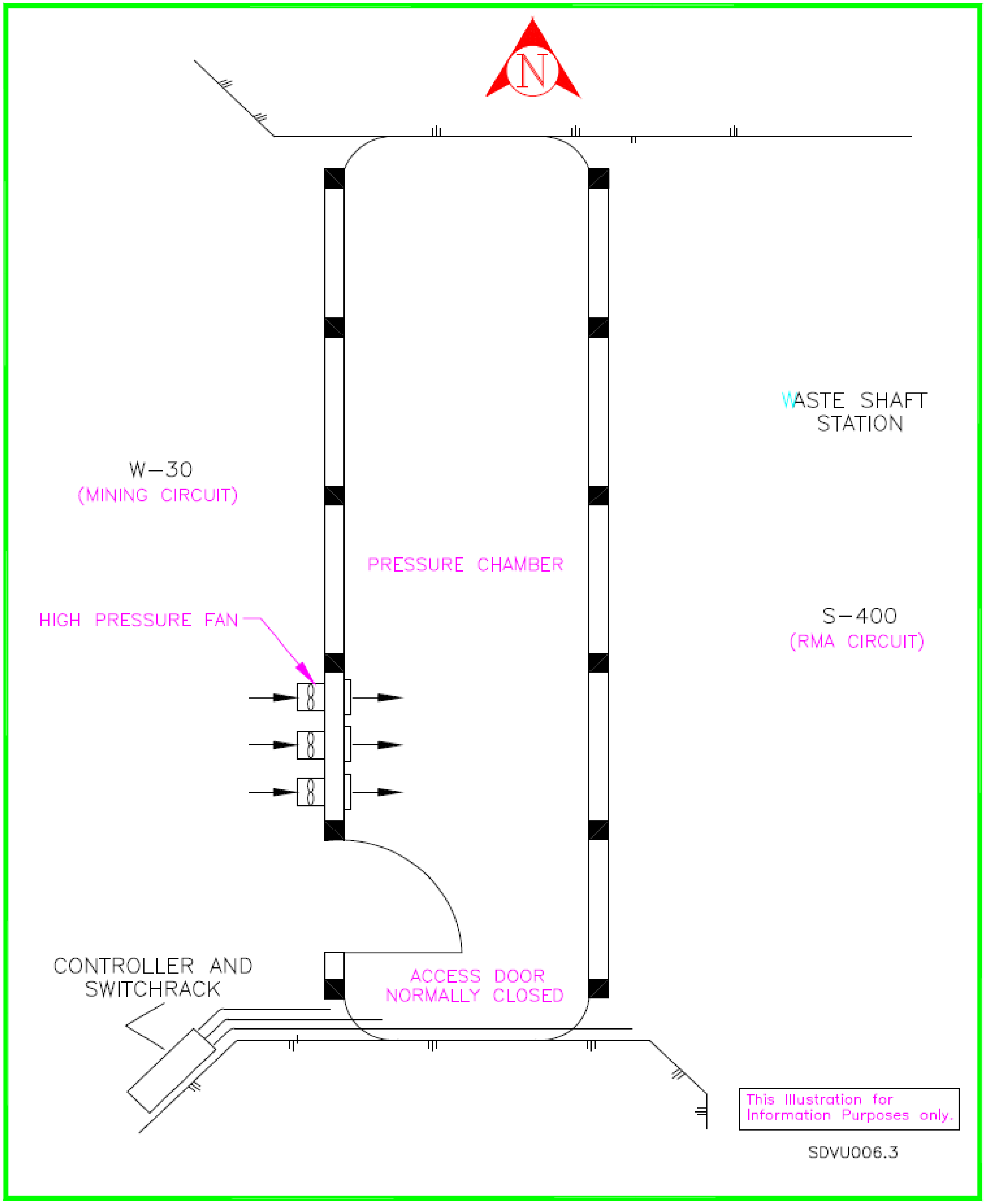

Figure VU III - 5 – Pressure Chamber

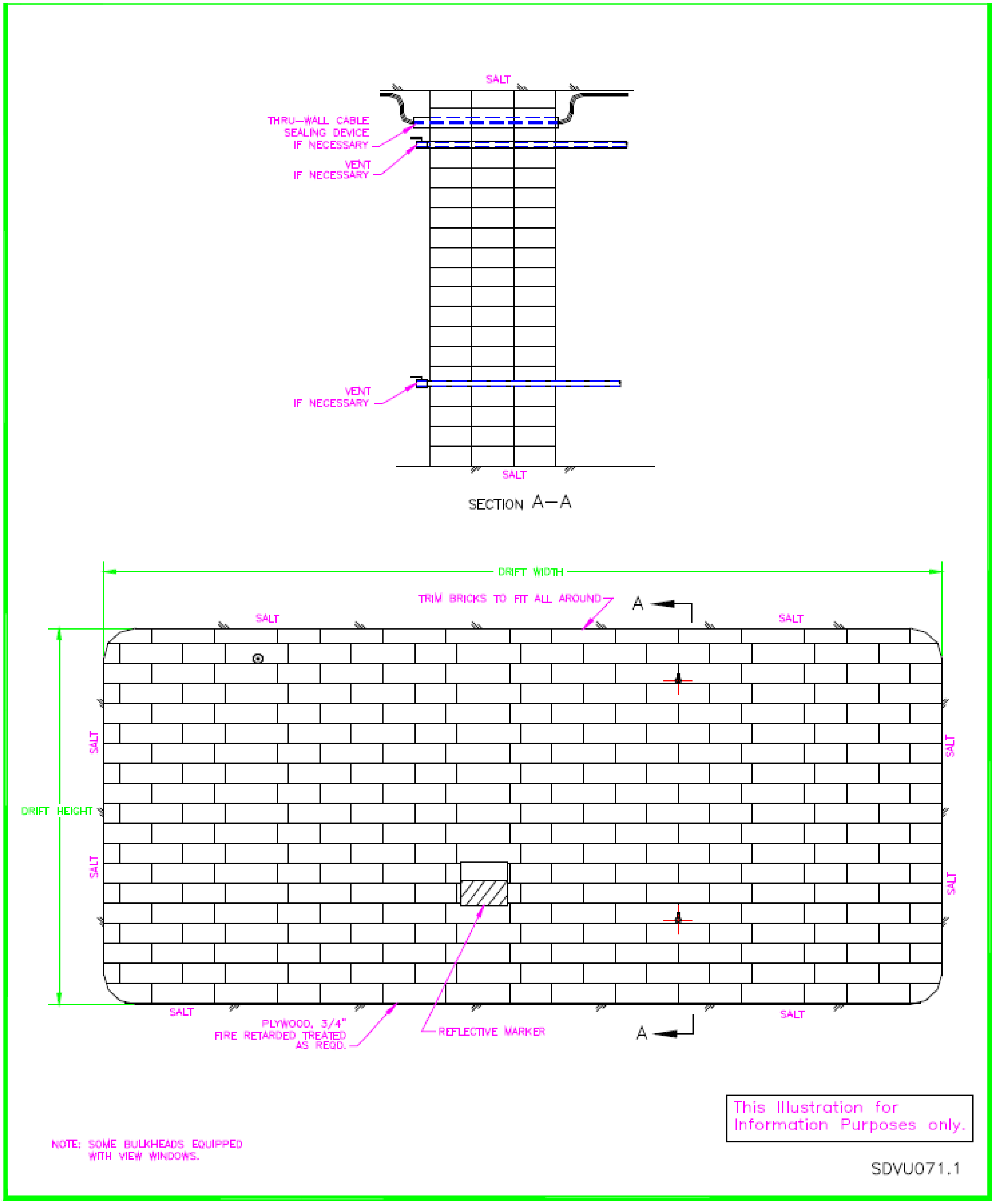

Figure VU III - 6 – Flyash Brick Bulkhead

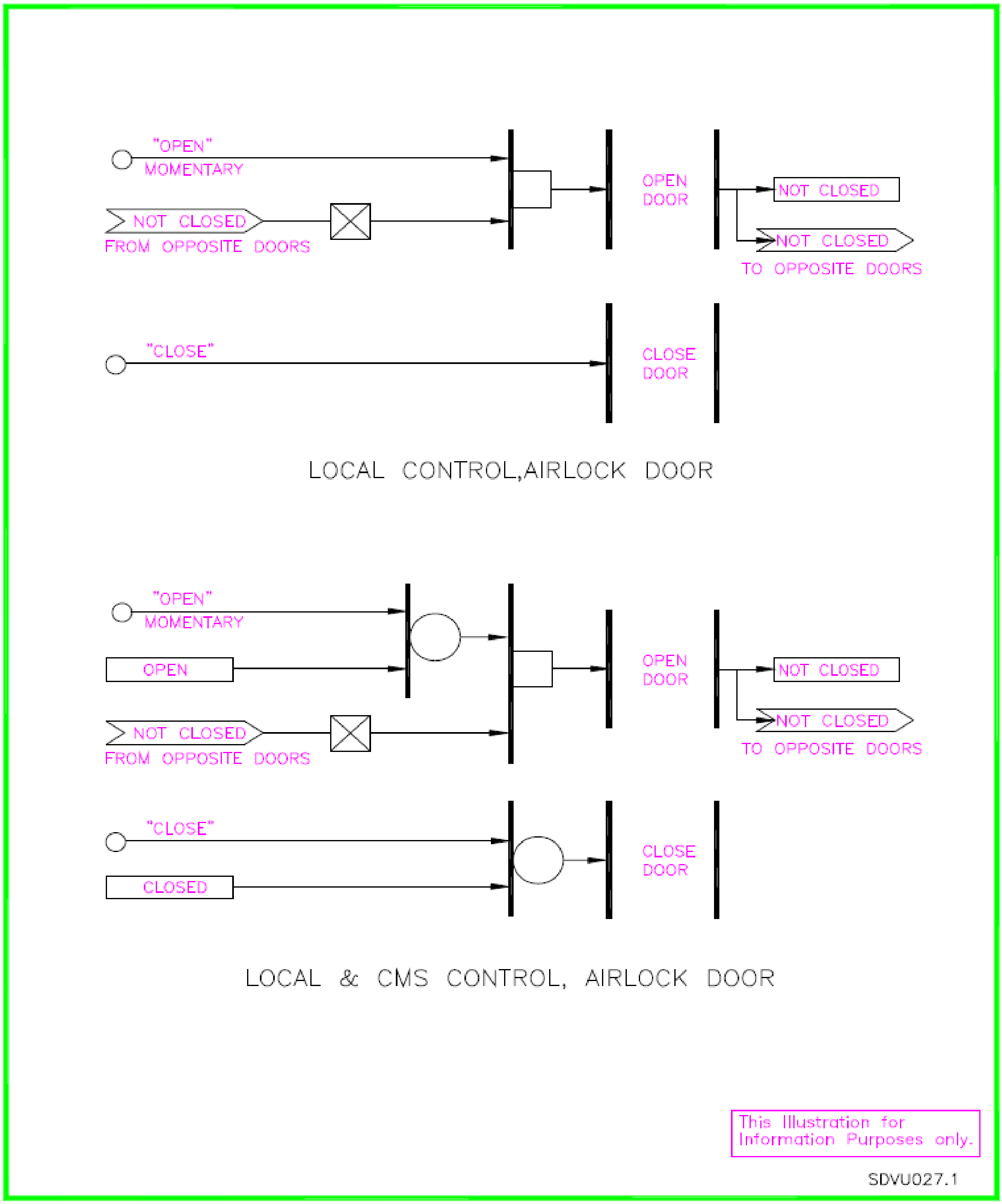

Figure VU III - 7 – Airlock Door Logic

Chapter IV
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Subsystem VU04 - Local Temporary Ventilation

Chapter IV

Subsystem VU04 - Local Temporary Ventilation

1.0 PRIMARY FUNCTIONS

The primary functions for local temporary ventilation are presented in section 1.0 of chapter G.

2.0 DESIGN REQUIREMENTS

2.1 General

The general design requirements for local temporary ventilation are presented in section 2.1 of chapter G.

2.2 Subsystem Requirements

2.2.1 Any local area which requires temporary ventilation for personnel comfort and safety shall be ventilated with auxiliary fans sized to the specific needs of the area in accordance with 30 CFR 57.

2.2.2 The face ventilation in the mining area shall be under the direction of the VU04 mining cognizant engineer or their designated representative.

2.2.3 Face ventilation shall be conducted as described in the approved WIPP Mine Ventilation Plan as required by 30 CFR 57.

2.3 - 2.12 Technical Cross Reference

Refer to section 2.3 to section 2.12 of chapter G for general requirements applicable to each of the following topics:

- 2.3 Operational Requirements
- 2.4 Structural Requirements
- 2.5 General Arrangement & Essential Requirements
- 2.6 Maintenance Requirements
- 2.7 In-Service Inspection Requirements
- 2.8 Instrumentation and Control Requirements
- 2.9 Interface System Requirements

- 2.10 Quality Assurance Requirements
- 2.11 Codes and Standards Requirements
- 2.12 Reliability Requirements

Refer to Ventilation Plan for typical pre-configuration approved plan.

3.0 DESIGN DESCRIPTION

3.1 Summary

Refer to section 3.1 of chapter G for the Underground Ventilation System summary design description.

The equipment of VU04, fans, is used to provide safe, comfortable working conditions. This equipment is moved about as needed in the underground. This system also includes the fans, ducts, and brattice work which provide air circulation at the working face.

3.2 Detailed System Description

3.3 - 3.4 Technical Cross Reference

Refer to section 3.3 to section 3.4 of chapter G for general requirements applicable to each of the following topics:

3.3 Performance Characteristics

3.4 System Arrangement

3.5 Component Design Description

The equipment in VU04 is used to provide comfortable working conditions for personnel. Fans and air-conditioners are temporarily located as needed to provide a satisfactory working environment.

The equipment utilized in the VU04 subsystem changes to accommodate current working conditions at the underground working face. Fans, ducts and brattice work for the working face are provided as required by the operation in progress.

3.6 Instrumentation and Control

The commercial portable equipment which make up this subsystem have external ON/OFF switches and proprietary controls incorporated within them.

3.7 System Interfaces

Primary Interfaces

System Providing Service	Service to be Provided
ED00	Provide electric power to local working face ventilation fans.

Secondary Interfaces

No Secondary Interfaces to VU04.

4.0 OPERATIONS

Refer to section 4.0 of chapter G for VU00 system integrated operations information.

5.0 SYSTEM LIMITATIONS, SETPOINTS, AND PRECAUTIONS

Refer to section 5.0 of chapter G for system-subsystem performance limitations, setpoints, and precautions.

6.0 OFF NORMAL EVENTS AND RECOVERY

Refer to section 6.0 of chapter G for system-level off-normal events and recovery.

7.0 MAINTENANCE

Refer to section 7.0 of chapter G for information relating to the Underground Ventilation System maintenance approach, corrective maintenance, preventative maintenance and inspection program requirements.

- Local Temporary Ventilation - VU04

The small portable fans require no preventive maintenance; use a graded repair approach as needed.

No in-service inspections should be needed for this small portable equipment unless specifically required by the manufacturer.

Chapter V
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Subsystem VU05 - Air Intake Flow Paths and Exhaust

List of Figures

Chapter V

Subsystem VU05 - Air Intake Flow Paths and Exhaust

1.0 PRIMARY FUNCTIONS

The primary functions for the air intake flow paths and exhaust are presented in section 1.0 of chapter G.

2.0 DESIGN REQUIREMENTS

2.1 General

The general design requirements for the air intake flow paths and exhaust are presented in section 2.1 of chapter G.

2.2 Subsystem Requirements

2.2.1 The UVS shall receive air from the three intake shafts, and discharge the air through a single exhaust shaft.

2.2.2 The duct elbow at the top of the exhaust shaft, shall be designed to withstand the WIPP facility Design Basis Earthquake and Design Basis Tornado (DBE/DBT). Refer to the General Plant Design Basis, GPDD.

2.2.3 An Auxiliary Air Intake Tunnel (AAIT) with appropriate regulators shall be used to control the flow of air down the waste shaft. Refer to figures VU V-1 and VU V-2.

2.3 - 2.12 Technical Cross Reference

Refer to section 2.3 to section 2.12 of chapter G for general requirements applicable to each of the following topics:

- 2.3 Operational Requirements
- 2.4 Structural Requirements
- 2.5 General Arrangement & Essential Requirements
- 2.6 Maintenance Requirements
- 2.7 In-Service Inspection Requirements
- 2.8 Instrumentation and Control Requirements
- 2.9 Interface System Requirements

- 2.10 Quality Assurance Requirements
- 2.11 Codes and Standards Requirements
- 2.12 Reliability Requirements

3.0 DESIGN DESCRIPTION

3.1 Summary

Refer to section 3.1 of chapter G for the Underground Ventilation System summary design description.

The Air Intake Shaft, the Salt Handling Shaft and the Waste Shaft with its Auxiliary Air Intake Building and tunnel are used to convey fresh air to the underground. The Exhaust Shaft is utilized for bringing exhaust air from the underground to the surface level The location of the air shafts relative to other WIPP features on the surface can be seen on figure VU V-1. The location of these facilities relative to other features in the WIPP underground can be seen on figure VU III-1.

3.2 Detailed System Description

The Air Intake Shaft, the Salt Handling Shaft, the Waste Shaft, and the Auxiliary Air Intake Building and tunnel are used to convey fresh air to the underground. The design, physical features, and other uses of the air intake shafts are summarized in the Components Design Description, section 3.5, and covered in detail in SDD-UH00. The design and physical features of the Auxiliary Air Intake Building and tunnel are summarized in the Components Design Description, section 3.5, and covered in detail in SDD-CF00.

The Exhaust Shaft is utilized for bringing exhaust air from the underground to the surface level. The design and physical features of the air Exhaust Shaft are summarized in the Components Design Description, section 3.5, and covered in detail in SDD-UH00.

The driving force for the air flow through the vertical shafts is normally provided by the exhaust fans on the surface, which pull air down through the AIS, SHS and WS, through the underground, then up through the ES into the exhaust ducts and return it to the atmosphere.

3.3 - 3.4 Technical Cross Reference

Refer to section 3.3 to section 3.4 of chapter G for general requirements applicable to each of the following topics:

3.3 Performance Characteristics

3.4 System Arrangement

3.5 Component Design Description

3.5.1 Subsystem VU05 - Air Intake and Exhaust

Normal air intake is provided through three vertical shafts, the Air Intake Shaft (AIS), the Salt Handling Shaft (SHS) and the Waste Handling Shaft (WHS). Air flow into the WS is supplemented by the Auxiliary Air Intake Tunnel (AAIT). Normal air exhaust is provided through a single vertical shaft, the Exhaust Shaft (ES).

The design, physical features and other uses of the vertical air shafts are described in detail in SDD-UH00. The design and physical features of the AAIT are described in detail in SDD-CF00.

- Air Intake Shaft
- Salt Handling Shaft
- Waste Shaft
- Exhaust Shaft
- Auxiliary Air Intake Tunnel

The WS provides a secondary service to supply air for waste shaft and waste shaft areas.

3.5.2 Auxiliary Air Intake Tunnel

An AAIT is provided to supply fresh air as needed to supplement the air flow drawn down the WS from leakage into the tower area. The location of the AAIT is shown on figure VU V-1, running north and slightly east of the WS to the Auxiliary Air Intake Building (building number 465).

The Auxiliary Air Intake Building is a small block building containing air regulators/dampers on three sides. One set of dampers are for balancing and are used to adjust air flow through the AAIT in normal and alternate modes. The Tornado dampers are provided to protect the Waste Shaft Tower structure in the event of a tornado for additional pressure relief. Dampers are provided to limit the negative pressure on the waste hoist tower. These dampers are counter balanced.

Once a damper if fully open, it must be closed manually in order to restore the WS pressure to full normal and to establish normal air flow patterns.

The interface between VU-CF-UH relative to the AAIS and AAIT is as follows:

- The physical building of the AAIT is under CF00.

- The Louvers within the building (balance, pressure, relief and tornado) are under VU03.

- The tunnel which connects the building to the waste shaft (UH00) is under VU05.

3.6 Instrumentation and Control

This subsystem consists of use of the four vertical shafts plus the Auxiliary Air Intake Building and Tunnel. There is no Underground Ventilation control equipment associated with any of the shafts.

3.7 System Interfaces

Primary Interfaces

System Providing Service	Service to be Provided
UH00	Provide resistance to airflow in the Shafts.

Secondary Interfaces

UH00	Provide ventilation to the shafts and underground stations of System UH00.

4.0 OPERATIONS

Refer to section 4.0 of chapter G for VU00 system integrated operations information.

5.0 SYSTEM LIMITATIONS, SETPOINTS, AND PRECAUTIONS

Refer to section 5.0 of chapter G for system-subsystem performance limitations, setpoints, and precautions.

6.0 OFF NORMAL EVENTS AND RECOVERY

Refer to section 6.0 of chapter G for system-level off normal events and recovery.

7.0 MAINTENANCE

Preventive and corrective maintenance and in-service requirements as it relates to tornado dampers, pressure relief dampers and regulators are in accordance with WIPP Site controlled maintenance procedures.

Preventive maintenance on the vertical intake and exhaust shafts is covered in SDD-UH00, Underground Hoisting System.

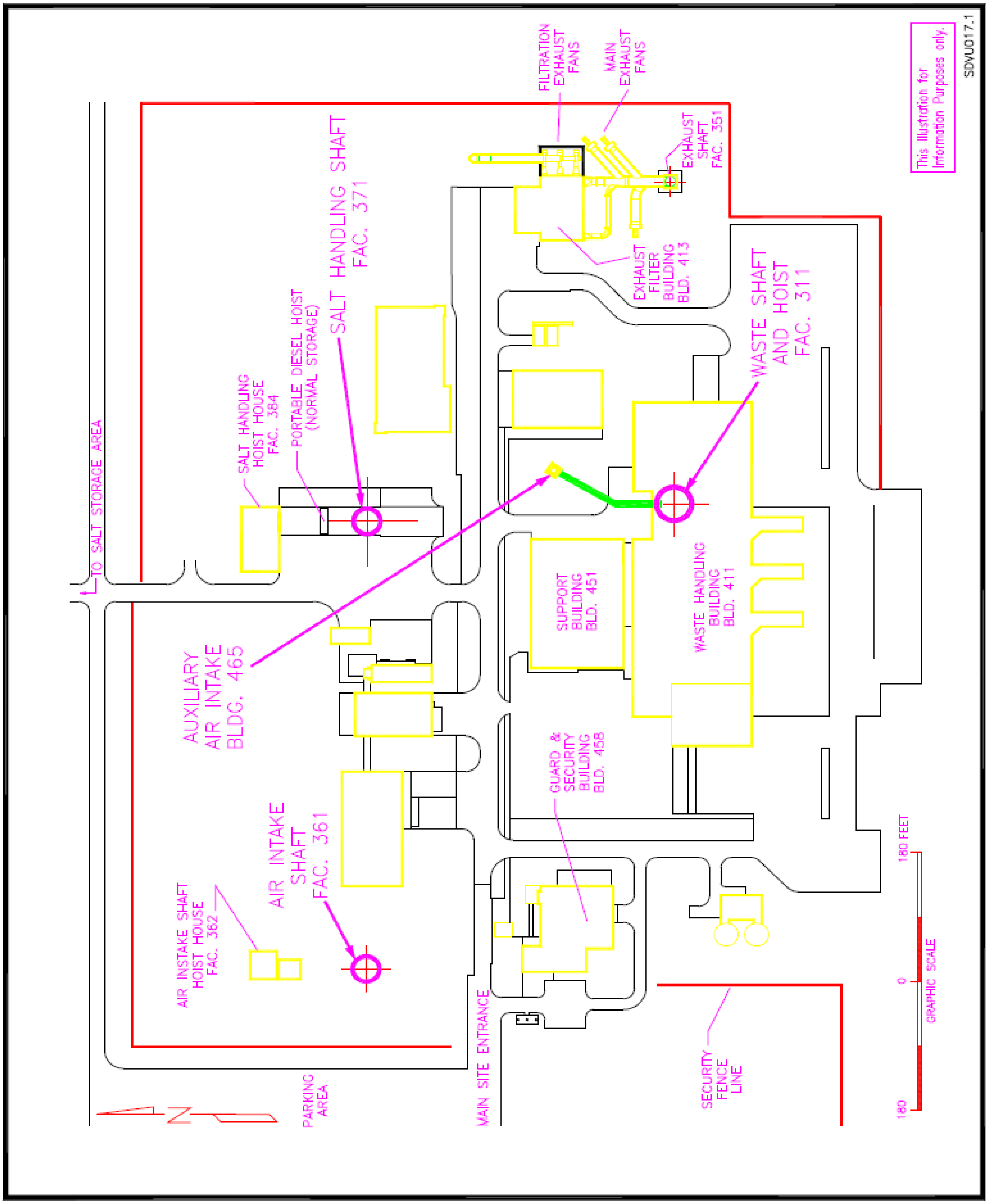

Figure VU V - 1 – WIPP Surface Plot Plan – VU00 Surface Facilities

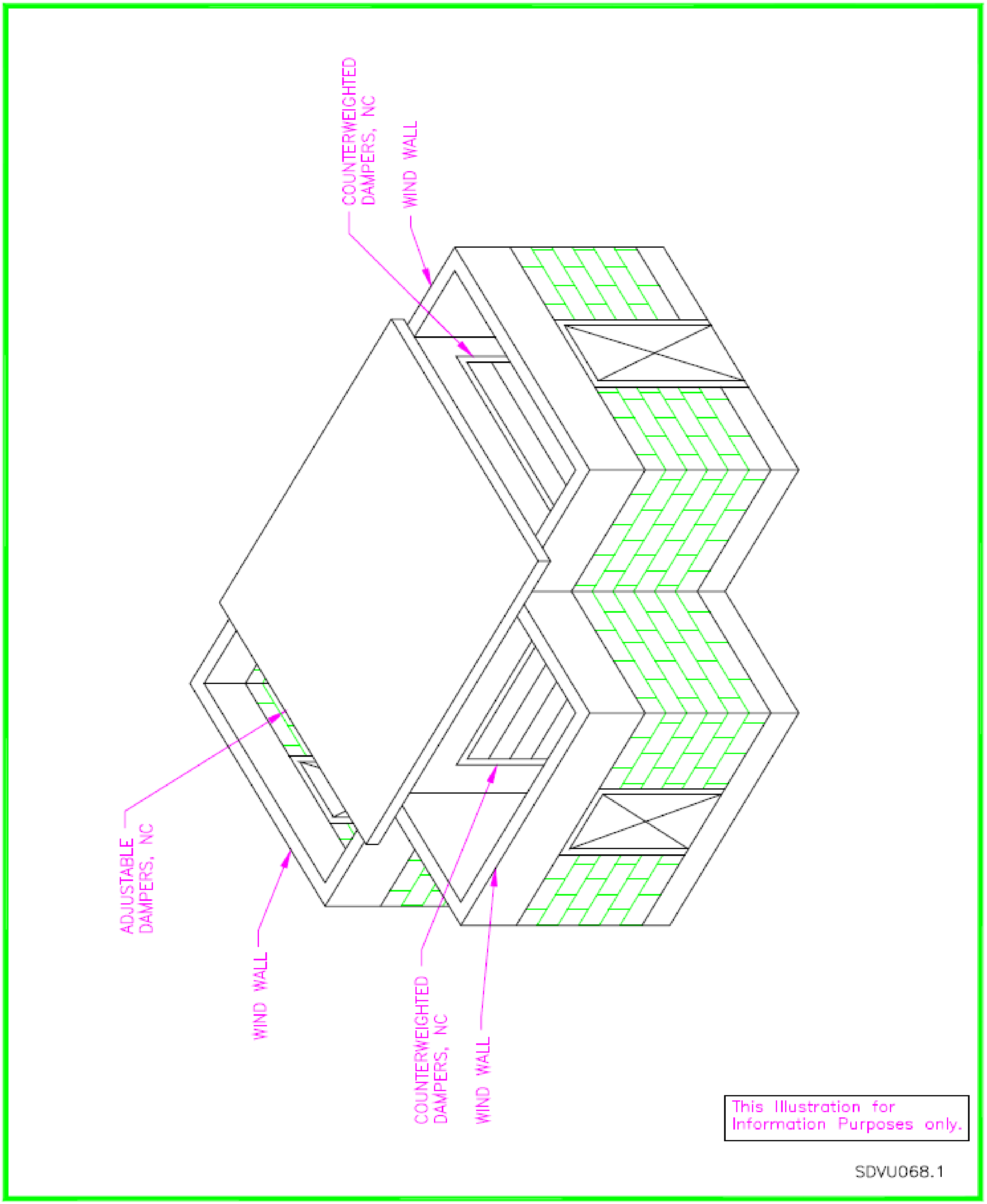

Figure VU V - 2 – Auxiliary Air Intake Building

Chapter VI
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Subsystem VU06 - Remote Monitoring and Control

Chapter VI

Subsystem VU06 - Air Flow Monitor and Control

1.0 PRIMARY FUNCTIONS

The primary functions for the air flow monitor and control features are presented in section 1.0 of chapter G.

2.0 DESIGN REQUIREMENTS

2.1 General

The general design requirements for the air flow monitor and control features are presented in section 2.1 of chapter G.

2.2 Subsystem Requirements

2.2.1 The underground ventilation shall be monitored at strategic locations to obtain adequate data. Differential air pressure is monitored across select bulkheads and air locks. Air velocity (fpm)and/or air quantity (cfm) is measured in key drifts. These measurements shall be monitored through the Central Monitoring Station (CMS) and indicated locally at each station.

2.2.2 Preservation of the monitor stations' data stream during power outages and/or fan failures is desired; therefore, the monitor stations' control power source shall be protected by uninterruptible power capable of operation for 30 minutes after primary power outage.

2.2.3 Psychrometric air conditions shall be monitored at selected stations (termed mine weather stations). Barometric pressure, dry-bulb temperature and relative humidity values shall be measured for air in-taking and exhausting each shaft. These measurements shall be monitored through the CMS. Data from the stations shall be used to evaluate the natural ventilation pressures in the facility.

2.3 - 2.12 Technical Cross-Reference

Refer to section 2.3 to section 2.12 of chapter G for general requirements applicable to each of the following topics:

- 2.3 Operational Requirements
- 2.4 Structural Requirements

- 2.5 General Arrangement & Essential Requirements
- 2.6 Maintenance Requirements
- 2.7 In-Service Inspection Requirements
- 2.8 Instrumentation and Control Requirements
- 2.9 Interface System Requirements
- 2.10 Quality Assurance Requirements
- 2.11 Codes and Standards Requirements
- 2.12 Reliability Requirements

3.0 DESIGN DESCRIPTION

3.1 Summary

Refer to section 3.1 of chapter G for the Underground Ventilation System summary design description.

In order to access current underground ventilation conditions, the CMS monitors the differential air pressure across certain bulkheads and air locks, the position of ventilation regulator dampers in critical bulkheads, and the velocity and/or quantity of the air stream at several key places in the drifts. Each monitor station has a local data display for on-site verification, for maintenance and calibration, and for underground control as necessary. The power sources for the monitor stations are served by uninterruptible power.

The ventilation regulator dampers can be positioned by electric drive motors commanded through the CMS. Each drive also has a local control panel for on-site operation. The drive motors are not connected to backup power sources, but are provided with manual hand wheels for operation during power loss.

The psychrometric conditions of the air entering and exiting the facility are continuously monitored through local mine weather stations. The data are used for base line psychrometic conditions and to calculate the natural ventilation pressure (NVP) of the facility .

3.2 Detailed System Description

The air flow in the underground can be made to vary significantly in various drifts. This airflow is monitored by sensors. In addition, the differential air pressure is monitored across selected air locks, bulkheads and regulators to monitor the performance of the ventilation system. The psychrometric conditions of the air are monitored at selected locations, both on the surface and in the underground.

The flow is regulated by operating various combinations of fans above ground and by varying the position of the louvers in the regulator bulkheads.

FloSonic Ultrasonic Airflow Sensors are used to measure air mass flow.

The placement of the air velocity probes along the drift is important because obstructions between the probes could invalidate the readings. During installation and periodic re-calibrations the air velocity is surveyed across the entire section in the plane between the probes.

Several parameters are entered into the FloSonic's memory. These parameters can be adjusted until the FloSonic is calibrated within ± 5% of the local anemometer readings.

The differential pressure station consists of an electronic sensor, a local electronic readout, a mechanical gauge, a pair of static ports shielded from dust and dynamic air flow, and associated air tubing and valves. The sensor, display, and the passive gauge are mounted in a small equipment cabinet mounted on or in the vicinity of the bulkhead.

The air regulator assemblies in certain bulkheads are driven by reversible gear motors which can be controlled through the CMS and with a local electrical override. The gear motor local control panel accepts a standard analog signal and converts it to a drive command which allows remote control and fine positioning of the regulators to any position from fully closed to fully open.

Only the gear motor drive unit and its shaft position sensors are mounted on the air regulator. The control circuitry, local operating pushbuttons, a local/remote selector switch, and the local electronic display readout of the shaft position for each drive unit are installed in a small electrical cabinet mounted either on the bulkhead or nearby.

The mine weather stations, measuring the psychrometric conditions of the air, consist of a temperature and relative humidity probe, barometric pressure sensor, data logger, analog output module and rechargeable backup battery pack.

3.3 -- 3.4 Technical Cross Reference

Refer to section 3.3 and section 3.4 of chapter G for general requirements applicable to each of the following topics:

3.3 Performance Characteristics

3.4 System Arrangement

3.5 Component Design Description

Subsystem VU06 incorporates those elements necessary to monitor the air flow conditions underground and report those conditions to the CMS. These consist of differential static pressure sensing stations, air mass flow velocity sensing stations, mine weather stations, and both control and monitor capability for air flow regulators located in bulkheads throughout the underground.

These components are referenced in the WIPP Controlled Operating Procedures documents:

- Air Flow Velocity Stations
- Differential Pressures Measurements
- Psychrometric Air Measurements

3.6 Instrumentation and Control

This subsystem consists of CMS analog and discrete output channels monitoring air flow conditions signals controlling the position of air regulators underground. These break down as follows:

- Air Velocity monitors
- Differential pressure monitors
- Mine weather stations
- Damper Position sensors
- Damper Drive commands

3.7 System Interfaces

Primary Interfaces

System Providing Service	Service to be Provided
CM00	Provide monitoring of the UVS.
ED00	Provide electric power to 120-volt ac, 60 Hz, 1 phase and UPS power to air flow monitor and control stations.

Secondary Interfaces

System Providing Service	Service to be Provided
CM00	Provide air regulators, differential pressure measurements, airflow velocities and psychrometric conditions throughout the facility. Provide wiring from UVS equipment to the CMS.
EM00	Provide air flow to the underground VOC monitors.

4.0 OPERATIONS

Refer to section 4.0 of chapter G for VU00 system integrated operations information.

5.0 SYSTEM LIMITATIONS, SETPOINTS, AND PRECAUTIONS

Refer to section 5.0 of chapter G for system-subsystem performance limitations, setpoints, and precautions.

6.0 OFF NORMAL EVENTS AND RECOVERY

Refer to section 6.0 of chapter G for system-level off normal events and recovery.

7.0 MAINTENANCE

Refer to section 7.0 of chapter G for information relating to the Underground Ventilation System maintenance approach, corrective maintenance, and preventative maintenance program requirements.

The following instrumentation should be checked annually as to calibration, and (if applicable) serviceability of the CMS interface.

- Mine Weather
- Differential Pressure
- Select Air Flow Monitors

APPENDICES

Statement of Intent

--- NOTICE ---

The appendices that follow are for information only and thereby are not part of the Controlled Document. Some of the information provided is controlled in various component indices and no attempt to duplicate these is intended here.

Appendices

Table of Contents

Appendix A – References

The references used in writing this document included the codes and standards of section 2.11, the drawings listed in appendix D, and the following references.

1. Title 30 CFR Part 57 - "Safety and Health Standards - Underground Metal and Non-Metal Mines"

2. DOE Order 420.1B, *Facility Safety*

3. DOE Order 430.1B, *Real Property Asset Management*

4. DOE Order 433.1, *Maintenance Management Program for DOE Nuclear Facilities*

5. DOE Order 5480.4, *Environmental Protection, Safety, and Health Protection Standards*

6. ANSI-510, *Standard for Testing Nuclear Air Cleaning System*

7. DN-0440-12, *Final Report of the Phase I and II WIPP Ventilation System Studies*, May 1990.

8. New Mexico Mine Safety Code for All Mines.

9. Most recent version of the Test and Balance of the Underground Ventilation Report.

10. Current versions of the WIPP Mine Ventilation Plan which is developed and issued yearly <u>in accord</u> (or as required) whichever occurs first, with MSHA requirements.

Appendix B – Definitions and Acronyms

The more common definitions, acronyms and abbreviations are included in the overall design description, GPDD. Only definitions, acronyms and abbreviations specific to the Underground Ventilation System are included in this appendix.

Appendix B2 – Acronyms

AAIT	Auxiliary Air Intake Tunnel
ACFM	Actual Cubic Feet per minute
AIS	Air Intake Shaft
ANSI	American National Standards Institute
AUTO	Automatic
CFM	Cubic feet per minute
CFR	Code of Federal Regulations
CMR	Central Monitoring Room
CMS	Central Monitoring System
EFB	Exhaust Filter Building
ES	Exhaust Shaft
ft	Foot or feet
GPDD	General Plant Design Description
HEPA	High efficiency particulate air
Hg	Mercury
hp	Horsepower
in or in.	Inch(es)
IWG	Inches water gauge
KCFM	Thousand cubic feet per minute
LPU	Local Processing Unit
M	Month(s)
mA	milliamperes
MAN	Manual
MSHA	Mine Safety and Health Administration
NVP	Natural ventilation pressure
PSIG or psig	Pounds per square inch gauge
RMA	Radioactive Materials Area
rpm	Revolutions per minute
SHS	Salt Handling Shaft
SKCFM	Standard Thousand Cubic Feet per minute

Appendix B2 – Acronyms

V	Volts
WG or W.G.	Water
WHS or WS	Waste Handling Shaft
Y	Year(s)
°C	Degrees Celsius
°F	Degrees Fahrenheit

Appendix C – Equipment Register

For a list of equipment for this system (VU00, VU01, VU02, VU03, VU04, VU05, and VU06), see the Equipment Register, which is routinely updated with the latest information and controlled by the Engineering File Room.

Appendix D – Drawing Register

For a list of drawings for this system (VU00, VU01, VU02, VU03, VU04, VU05, and VU06), see the Drawing Register, which is routinely updated with the latest information and controlled by the Engineering File Room.

Appendix E – Interfaces

Appendix F-1	Interfaces imposed upon other systems by System VU00
Appendix F-2	Interfaces imposed upon System VU00 by other systems

Interfaces relocated to section 3.7 of their respective subsystem chapters.

Appendix F – Underground Diesel Equipment Ventilation Requirements

For a list of the diesel equipment in operation in the underground and their ventilation requirements refer to the current version of the WIPP ventilation plan available with the Cognizant Engineer of system VU00.

Appendix G – Central Monitoring System Point List

For a list of CMS points representing system status and alarm signals for this system (VU00, VU01, VU02, VU03, VU04, VU05, and VU06), see the WIPP CMR Point List, which is routinely updated with the latest information and controlled by Engineering.

Appendix H – Instrument Register

For a list of instruments for this system (VU00, VU01, VU02, VU03, VU04, VU05, and VU06), see the Instrument Register, which is routinely updated with the latest information and controlled by the Engineering File Room.

Appendix I – Valve Register

For a list of valves for this system (VU00, VU01, VU02, VU03, VU04, VU05, and VU06), see the Valve Register, which is routinely updated with the latest information and controlled by the Engineering File Room.

Appendix J – Pipe Line Index

For a list of pipe lines for this system (VU00, VU01, VU02, VU03, VU04, VU05, and VU06), see the Pipe Line Register, which is routinely updated with the latest information and controlled by the Engineering File Room.

Appendix K – U/G Ventilation System Bulkhead Features

For the most complete data on bulkhead design, refer to drawing 54-W-012-W, and to the WIPP drawing file No. 00CD-0008, Bulkhead Drawing Book series (located in the EFR).

Appendix L – Instrument Requirements

Instrument	Range	Accuracy	Setpoint
Exhaust Fan Flow Controller (1 fan running)	0 - 500 KSCFM	±5%	260 KSCFM
Exhaust Fan Flow Controller (2 fans running)	0 - 500 KSCFM	±5%	212 KSCFM
Filtration Fan Flow Controller	0 - 100 KSCFM	±5%	60 KSCFM
Exhaust Fan A suction (Ind. & Record.)	0 - 20 IWG	(I)	NA
Exhaust Fan B suction (Ind. & Record.)	0 - 20 IWG	(I)	NA
HEPA 856 MOD Filter ΔP	0 - 2 IWG	±10%	NA
HEPA 856 HIGH Filter ΔP	0 - 2 IWG	±10%	NA
HEPA 856 FIRST Filter ΔP	0 - 5 IWG	±10%	NA
HEPA 856 SECOND Filter ΔP	0 - 5 IWG	±10%	NA
HEPA 857 MOD Filter ΔP	0 - 2 IWG	±10%	NA
HEPA 857 HIGH Filter ΔP	0 - 2 IWG	±10%	NA
HEPA 857 FIRST Filter ΔP	0 - 5 IWG	±10%	NA
HEPA 857 SECOND Filter ΔP	0 - 5 IWG	±10%	NA
Pressure Chamber Controller	0.2 to 2.5	.1	NA
Differential Pressure Gauges	±-5" WG	±2%	NA
Differential Pressure Transducers	±-5" WG	±1%	NA
Air Mass Flow Velocity Probes (at S400 near the exhaust shaft)	0-2000 fpm 0-4000 fpm	±5% ±5%	NA NA
Barometric Pressure Sensors Temperature/Relative Humidity Probes Air Regulator Shaft Position	800-1060 mb -33 to 120°F 0 to 100 %RH 0-100%	±0.4 mb ±0.2° F ±1 %RH ±5%	N/A N/A N/A NA
Waste Hoist Tower ΔP Instrument	±5 IWG	±5%	Varied
Main and Exhaust Fan Vibration Instrument	0 - 1 IPS	(I)	NA

Notes :
(I) = Indicator only
IWG = Inches water gage
IPS = Inches per second
KSCFM = Thousand standard cubic feet per minute
NA = Not Applicable

Appendix M – WIPP Damper Register

For a list of the dampers for this system (VU00, VU01, VU02, VU03, VU04, VU05, and VU06), see the WIPP Damper Register which is routinely updated with the latest in information and controlled by in the Engineering File Room.

Appendix N – Conceptual Future Ventilation Configurations

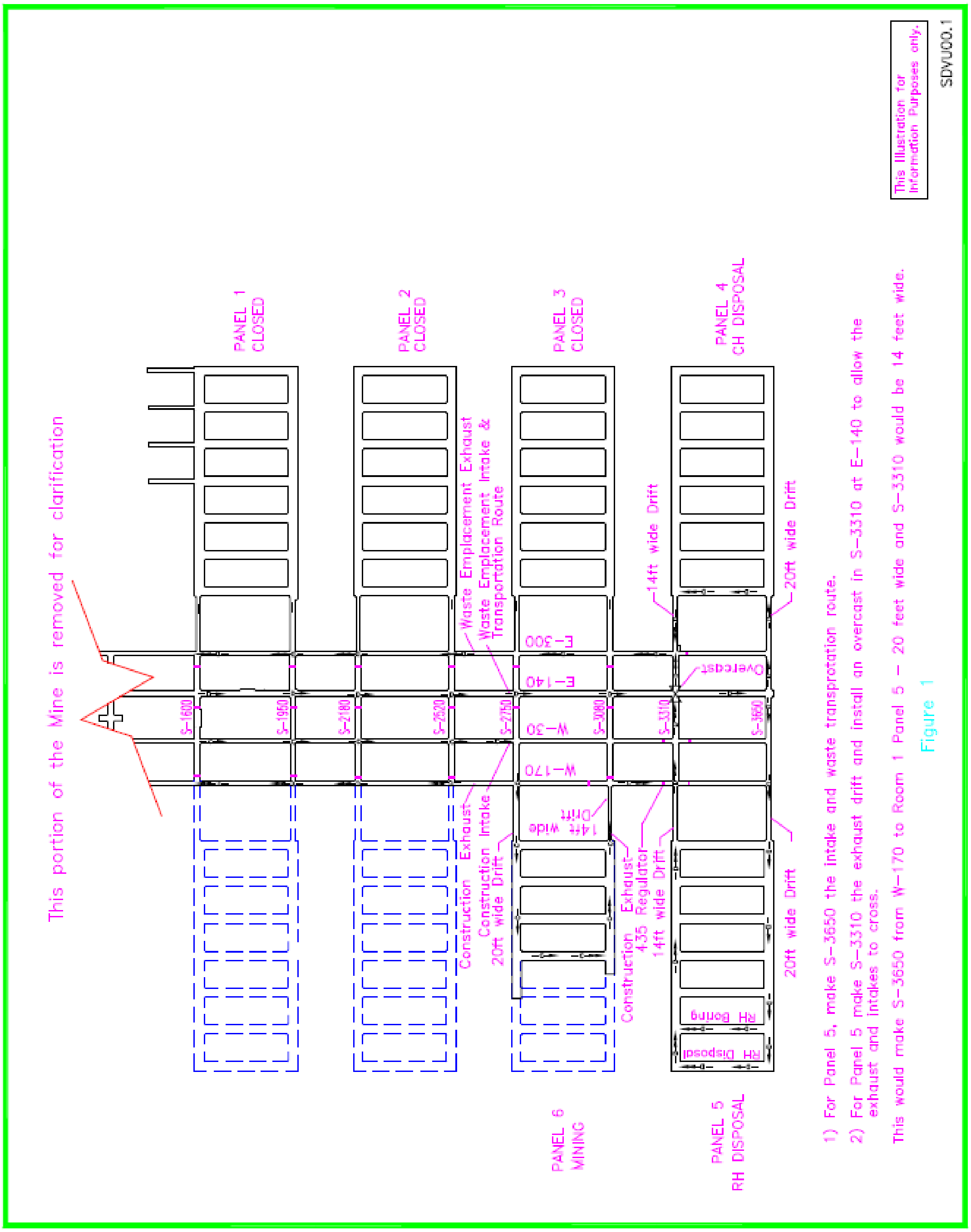

FIGURE 1 App – 16 Conceptual Configuration

Appendix N – Conceptual Future Ventilation Configurations

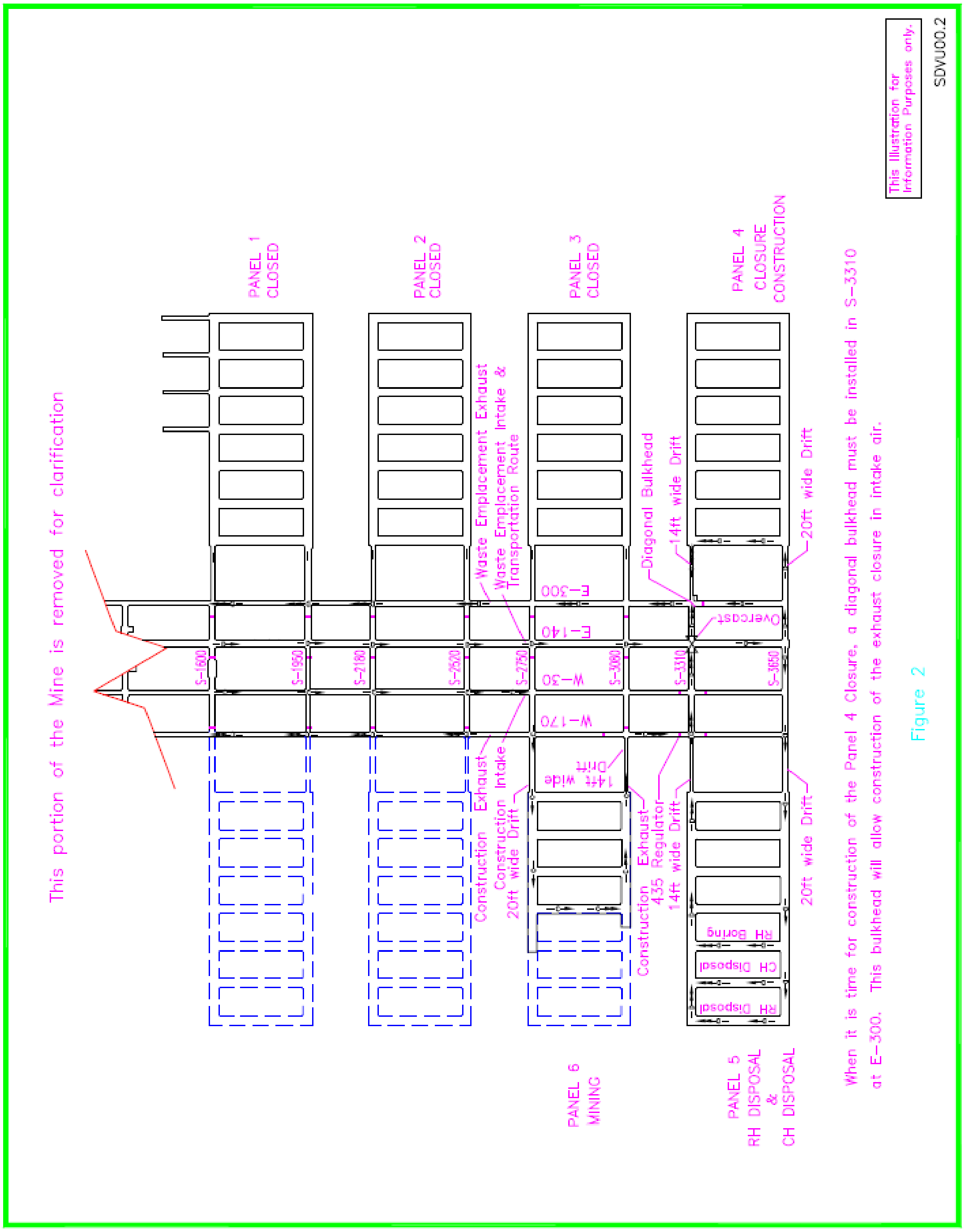

FIGURE 2 App — 16 (cont.) Conceptual Configuration

Appendix N – Conceptual Future Ventilation Configurations

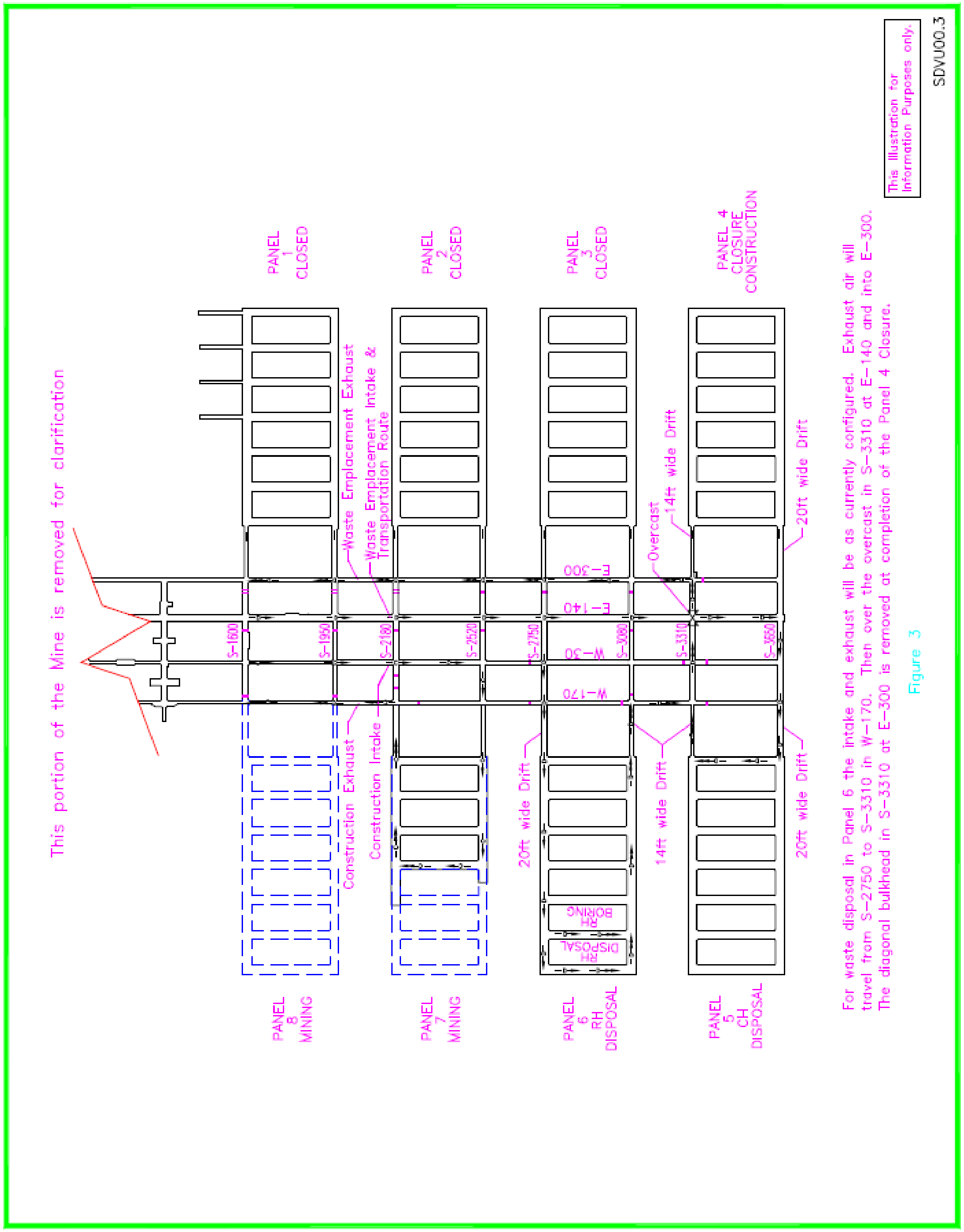

FIGURE 3 App – 16 Conceptual Configuration

Appendix N – Conceptual Future Ventilation Configurations

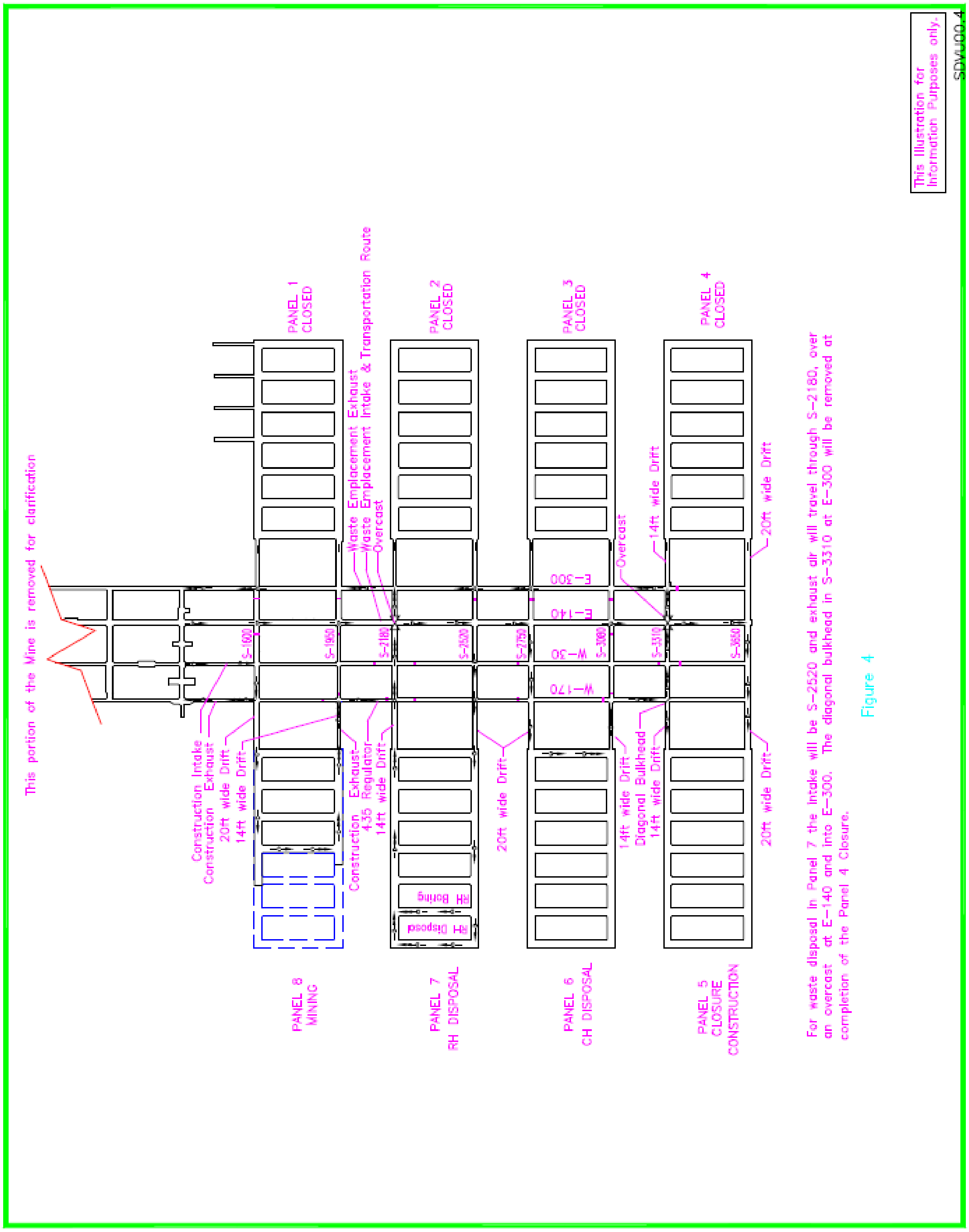

FIGURE 4 App – 16 (cont.) Conceptual Configuration

Appendix N – Conceptual Future Ventilation Configurations

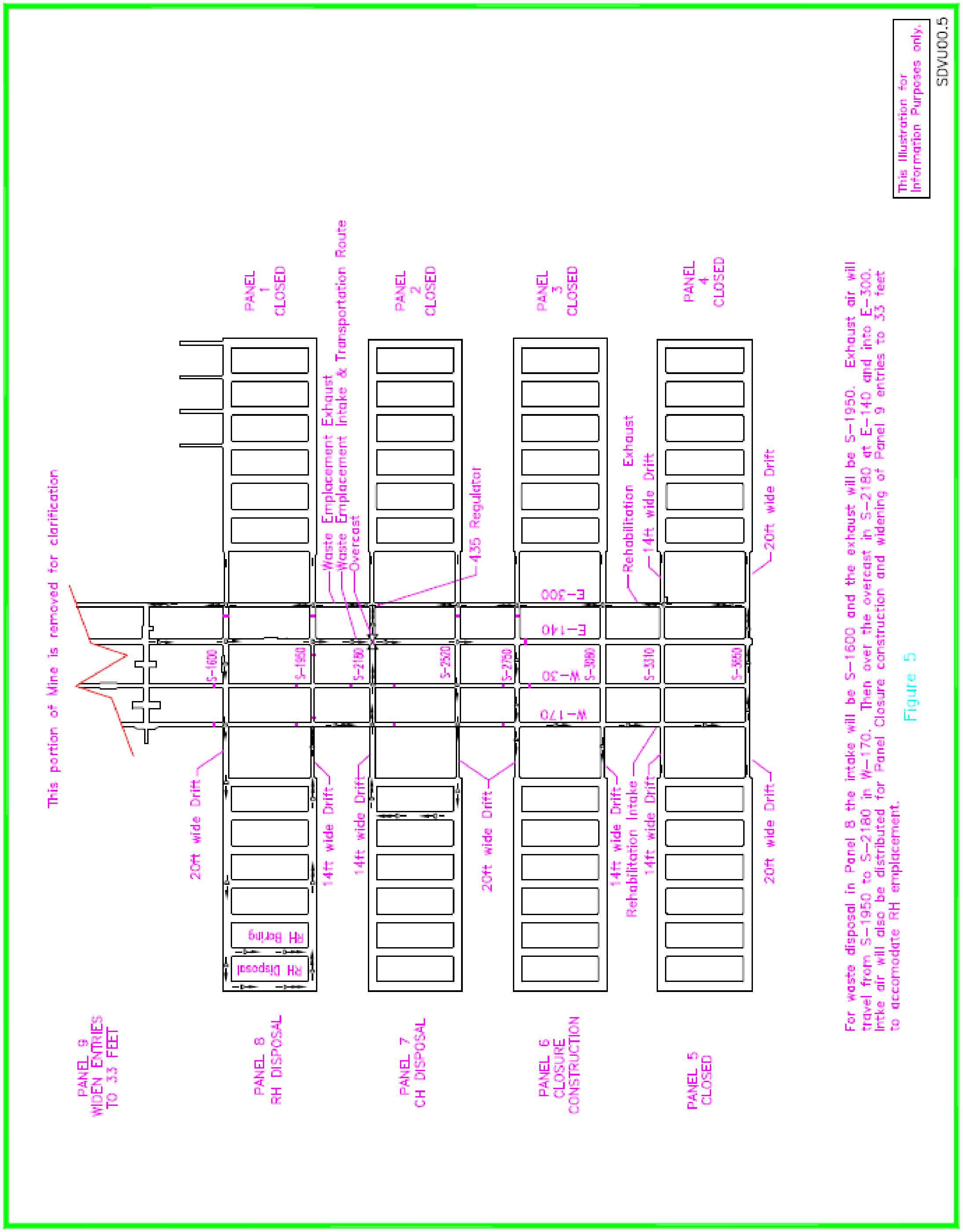

FIGURE 5 App – 16 (cont.) Conceptual Configuration