9.4.14 Access Building Ventilation System

The access building ventilation system (ABVS) maintains room ambient conditions inside the Access Building to permit personnel access to the Nuclear Island (NI), and to control the concentration of airborne radioactive material in the controlled areas of the building during normal operation, including maintenance and refueling shutdowns, and during anticipated operational occurrences. The ABVS is composed of the following three subsystems:

- The supply of fresh air to all areas of the Access Building and the prestressing gallery underneath the Reactor Building (RB).
- The controlled area exhaust with radiation classification.
- The supervised areas exhaust with no radiation classification.

9.4.14.1 Design Bases

The ABVS performs no safety-related functions and is not required to operate during a design basis accident (DBA).

The ABVS monitors the controlled area exhaust air for potential radioactivity upstream of the prefilter and high efficiency particulate air (HEPA) filters by the sampling activity monitoring system (SAMS) prior to discharge into the plant vent stack. This complies with the requirements of GDC-60.

The controlled areas in the Access Building are maintained at a negative pressure, while the adjacent supervised areas are maintained at ambient pressure. Clean air from the supervised areas will flow to potentially contaminated areas in the controlled area, is filtered by a HEPA filtration unit, and is then exhausted to the plant vent stack.

The ABVS environmental operating conditions are specified in Table 9.4.14-1—ABVS Environmental Conditions.

9.4.14.2 System Description

9.4.14.2.1 General Description

Two of the three ABVS subsystems are located in the Access Building:

- The supervised areas (i.e., non-controlled areas with no radiation classification).
- The controlled areas (i.e., areas with radiation classification).

The ABVS also provides supply and exhaust air to the prestressing gallery, located in the RB at elevation -50 ft. The ventilation system is designed for fresh supply air and exhaust air operation; there is no air recirculation.

Refer to Section 12.3.6.5.6 for ventilation system design features which demonstrate compliance with the requirements of 10 CFR 20.1406.

Supply Air Subsystem

The ABVS supplies air to the Access Building and to the prestressing gallery underneath the RB. Figure 9.4.14-1—Access Building Ventilation System – Supply Air Subsystem, provides a simplified diagram of the supply air subsystem of the ABVS. Depending on the outdoor air conditions, the supply air can be cooled or heated, and humidified. The supply air is filtered with prefilters and roughing filters.

The supply air subsystem upstream of the fans is a two-train system arranged in a parallel configuration. Horizontal air ducts and vertical air shafts distribute the fresh air to both the supervised and controlled areas. The negative pressure in the controlled areas is maintained by a control damper in the controlled area supply air duct after the separation from the general supply air.

A pressure control damper is located in the supply ducting that provides ventilation air to the controlled areas in the Access Building. This damper modulates between open and close to adjust the supply of air flow, as required, to maintain a negative pressure in the controlled areas.

Controlled Area Exhaust Air Subsystem

The controlled area exhaust air subsystem of the ABVS is shown in Figure 9.4.14-2—Access Building Ventilation System – Supply and Exhaust Air Subsystem. The ABVS controlled area exhaust subsystem has the following functions:

- Maintains a negative pressure in the controlled areas of the Access Building, with respect to adjacent areas.
- Reduces airborne radioactivity by filtration of exhaust air from the controlled areas.
- Maintains airflow within the Access Building from the clean areas towards the controlled areas.

The exhaust air from the controlled areas of the Access Building is brought together through air ducts and vertical shafts. The combined exhaust air is routed through filter banks that consist of three trains of prefilters and HEPA filters, each designed for 50 percent of the volumetric air flow. The exhaust air filtering takes place continuously. After passing through the filters, the controlled area exhaust air is routed through a concrete duct outside the Access Building to the Nuclear Auxiliary Building (NAB) where two fans discharge the exhaust air to the vent stack. The controlled area exhaust is monitored for potential radioactivity upstream of the filters by the sampling activity monitoring system (SAMS).

The supervised areas adjacent to the controlled areas are maintained at ambient pressure, while the controlled areas are maintained at a negative pressure. The clean air from the supervised areas will flow towards the controlled areas, where it is filtered by a HEPA filter and then exhausted to the vent stack.

If contamination is detected by radiation monitors downstream of the HEPA exhaust filtration units, the control room receives an alarm. To prevent the release of potential airborne contaminants to the vent stack, the control room operators will shut down the ABVS supply fans, exhaust fans, inlet isolation dampers, and exhaust isolation dampers.

Supervised Area Exhaust Air Subsystem

The supervised area exhaust air subsystem of the ABVS is also shown in Figure 9.4.14-2. The ABVS supervised area exhaust subsystem exhausts the air of the Access Building cold rooms. The air is collected in ducts and vertical shafts. There are two exhaust fans, each sized for 100 percent of the volumetric flow. The supervised area exhaust air is discharged directly to the atmosphere.

The exhaust air unit of the prestressing gallery is considered part of the supervised area exhaust system. The prestressing gallery has its own exhaust fan that discharges directly to the atmosphere.

9.4.14.2.2 Component Description

The major components of the ABVS are described in the following paragraphs. Table 3.2.2-1 provides the seismic design and other design classifications for components in the ABVS.

Fans

The supply air fans, the controlled area exhaust fans, and the supervised area exhaust fans are centrifugal and are directly connected to the motor shaft. These fans are equipped with local heating units. The exhaust air fan of the prestressing gallery is axial. The fan operating characteristics (i.e., flow rate and pressure) provide required air delivery flow rates.

Dampers

The actuator-driven control damper is located in the supply air duct of the controlled area. The damper maintains a constant sub-pressure inside the controlled area of the Access Building by gradual reduction or increase of supply air flow. The actuator-driven control damper maintains a constant exhaust flow rate, compensating for the increased pressure loss through the exhaust air filters by gradually increasing the damper opening.

Manually adjusted dampers are tuned and permanently positioned during the initial plant startup period to establish accurate air flow balance between the rooms. These dampers fulfill the function of "baffles" and are considered part of the duct system and are therefore not explicitly coded or shown in the simplified diagrams.

Air Heaters

The space heating coils are used as preheaters and system heaters and are supplied with hot water from the space heating system (SHS). The heater maintains the Access Building above the minimum air temperature limits.

Air Coolers

The cooling coils are supplied with chilled water from the operational chilled water system (OCWS) to cool the fresh air to the required supply air temperature. The air coolers maintain the Access Building between the air temperature limits.

Air Prefilters

The supply air prefilters filter dust and airborne particulates from the fresh air and are located downstream of the preheaters. The exhaust air prefilters are used for exhaust air filtration and are located upstream of the HEPA filters. The supply and exhaust prefilters increase the service life of the roughing filters and HEPA filters. The prefilters are equipped with locally installed differential pressure gauges that indicate the degree of load and the need for filter change.

Air Filters

The supply air roughing air filters for fresh air filtration are located downstream of the prefilters to clean the supply air to the required cleanliness for personnel habitability. The filters are equipped with locally installed differential pressure gauges that indicate the degree of load and the need for filter change.

HEPA Filters

The exhaust air HEPA filters are installed in the controlled area exhaust air system for filtration of the entire air flow. These filters remove fine discrete particulate matter from the air stream. The HEPA filters are equipped with local differential pressure gauges that indicate the degree of load and the need for filter change.

Fire Dampers

Fire dampers are installed where ductwork penetrates a fire barrier. Fire damper design meets the requirements of NFPA 80 (Reference 1) and NFPA 90A (Reference 12). The damper fire rating is commensurate with the fire rating of the

barrier penetrated. Fire dampers are equipped with fusible links for automatic closure when the temperature reaches a predetermined setpoint.

Ducts

The supply air ducts are folded galvanized steel ducts. The exhaust air ducts are similar with the exception that the ducts inside the filter rooms are of air-tight welded construction.

9.4.14.3 System Operation

9.4.14.3.1 Normal Operation

Supply Air Subsystem

The ABVS supply air subsystem operates continuously. The ABVS supply air subsystem, as well as the controlled area and supervised area exhaust subsystems, are each operated from the main control room (MCR). A pressure control damper is located in the supply ducting that provides ventilation air to the controlled areas in the Access Building. This damper controls the supply airflow, as required, to maintain a negative pressure in the controlled areas, while the ABVS exhaust fan provides continuous exhaust from this area. The system is designed for fresh supply air and exhaust air operation; there is no air recirculation.

During operation, only one of the two supply air fans is running; the second is in standby. The supply air subsystem conditions the air by filtration, heating or cooling, and humidification, as required. The subsystem also supplies air to the supervised area, controlled area, and the prestressing gallery.

Air filter loading is monitored by regular inspection of the local differential pressure instrumentation at the filters. The prefilters and roughing filters can be replaced with the plant in operation or shutdown. Before a supply air filter train is taken out of service the damper in the supervised area exhaust air subsystem is moved to a predefined maintenance position. The train that requires the filter replacement is isolated while the other train remains in operation.

Controlled Area Exhaust Air Subsystem

The controlled area exhaust air subsystem operates continuously. The subsystem is operated from the MCR, along with the supply air subsystem and the supervised area exhaust air subsystem. During operation, only one of the two fans located in the NAB is running; the other is in standby. The exhaust air of the controlled area of the Access Building is filtered continuously through prefilters and HEPA filters and released to the atmosphere via the vent stack. Potential radioactivity in the controlled area exhaust air is monitored by the SAMS that takes samples upstream of the filter banks.

The areas within the Access Building adjacent to the controlled areas are clean areas. During normal operation, these clean areas are maintained at ambient pressure, while the controlled areas are maintained at a negative pressure relative to the outside ambient pressure. The ABVS is designed with a pressure control damper located in the supply ducting. This damper modulates between open and close to adjust the supply of air flow, as required, to maintain a negative pressure in the controlled areas, while the ABVS exhaust fan continuously operates to exhaust air from the controlled areas. Since the controlled areas are maintained at a negative pressure relative to the adjacent clean areas, air from clean areas flows towards the controlled areas.

There are three filter trains. Transferring operation from one filter train to another can be performed for maintenance and is possible during operation without changing the exhaust air flow capacity. The air-tight dampers of the standby train can be opened and those of the train to be maintained can be closed manually.

Air filter loading is monitored by regular inspection of the local differential pressure instrumentation at the filters.

Supervised Area Exhaust Air Subsystem

The supervised area exhaust air subsystem operates continuously. The subsystem is operated from the MCR, along with the supply air subsystem and the controlled area exhaust air subsystem. The control functions work automatically, and the air flow is maintained constant.

During normal operation, only one of the two fans is running; the other is in standby. The exhaust air of the supervised area of the Access Building is released continuously via a concrete air shaft to the atmosphere.

The exhaust air fan of the prestressing gallery operates in conjunction with its manual supply air damper. The ventilation of the prestressing gallery operates continuously.

9.4.14.3.2 Shutdown

When the plant is shut down, the operation of the supply air subsystem and exhaust air subsystems is the same as described in Section 9.4.14.3.1.

9.4.14.3.3 Abnormal Operation

Fan Failures

In case of failure of one supply air fan, one supervised area exhaust air fan or one controlled area exhaust air failure, the unaffected standby fan switches on automatically. Since redundant fans are provided, failure of one fan does not result in the loss of the system function. A failure of the prestressing gallery exhaust air fan leads to the loss of the ventilation of the prestressing gallery.

Failure of an Intake Line

Two supply air intake lines are provided so that the failure of one component in one air intake line does not affect the other intake line. The loss of one air intake train due to a component failure or the securing of one air intake for maintenance does not create a significant heating or cooling concern in the Access Building. This situation allows one air intake line to provide approximately 70 percent of the design air flow rate during normal plant operation. Considering the low likelihood of this situation and the fact that the ABVS heating and cooling functions are not safety functions, two 50 percent intakes are provided.

Loss of Offsite Power (LOOP)

A LOOP results in a loss of power to the ABVS electrical components, such as fans, dampers, cooling units, and heaters. The ABVS system is not provided with emergency power.

9.4.14.4 Safety Evaluation

The operation of the ABVS is not required for the safe shutdown of the plant or for mitigating the consequences of a DBA. Therefore, the system has no safety-related function and requires no nuclear safety evaluation.

To meet the requirements of GDC-60, the ABVS is designed, installed, and tested in accordance with RG 1.143, RG 1.140 and ANSI/ASME N509 (Reference 2), ANSI/ ASME N510 (Reference 3), and ASME AG-1 (Reference 4).

9.4.14.5 Testing and Inspection Requirements

The ABVS major components, such as dampers, motors, fans, filters, coils, heaters, and ducts are located to provide access for initial and periodic testing to verify their integrity.

Initial in-place acceptance testing of the ABVS is performed as described in Section 14.2 (test abstracts #224), Initial Plant Test Program, to verify the system is built in accordance with applicable programs and specifications.

The ABVS is designed with adequate instrumentation for differential pressure, temperature, and flow indicating devices to enable testing and verification of equipment function, heat transfer capability and air flow monitoring.

During normal plant operation, periodic testing of ABVS is performed to demonstrate system and component operability and integrity.

Isolation dampers are periodically inspected and damper seats replaced as required.

Fans are tested by the manufacturer in accordance with Air Movement and Control Association (AMCA) standards (References 5, 6, and 7). Air filters are tested in accordance with the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) standards (Reference 8). Cooling coils are hydrostatically tested and their performance is rated in accordance with the Air Conditioning and Refrigeration Institute (ARI) standards (Reference 9).

Housings and ductwork are leak-tested in accordance with ANSI/ASME N510 (Reference 3), RG 1.140 (Reference 11), and the Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) technical manual "HVAC Air Duct Leakage Test Manual" (Reference 10), American Society of Mechanical Engineers.

Periodic testing and inspections identify systems and components requiring corrective maintenance, and plant maintenance programs correct deficiencies.

9.4.14.6 Instrumentation Requirements

Indication of the operational status of the equipment, position of dampers, instrument indications and alarms are provided in the MCR. Fans, motor-operated dampers, heaters and cooling units are operable from the MCR. Local instruments are provided to measure differential pressure across filters, flow, temperature and pressure. The fire detection and sensors information is delivered to the fire detection system.

The radiation instrumentation requirements for controlling airborne radioactivity releases via the vent stack are addressed in Section 11.5.3.1.12 and Table 11.5-1, measurement point R-31.

9.4.14.7 References

1. NFPA 80, "Standard for Fire Doors and Other Opening Protectives," National Fire Protection Association Standards, 2007.

2. ANSI/ASME N509-1989, "Nuclear Power Plant Air-Cleaning Units and Components," American National Standards Institute/The American Society of Mechanical Engineers, 1989.

3. ANSI/ASME N510-1989 (R1995), "Testing of Nuclear Air-Treatment Systems," American National Standards Institute/The American Society of Mechanical Engineers, 1989.

4. ASME AG-1, "Code on Nuclear Air and Gas Treatment," The American Society of Mechanical Engineers, 2003 (including the AG-1a-2000, "Housings," Addenda).

5. ANSI/AMCA Standard 210-99, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating," American National Standards Institute/Air Movement and Control Association International, 1999.

6. AMCA Publication 211-87, “Certified Ratings Program – Air Performance,” Air Movement and Control Association International, December 1987.

7. ANSI/AMCA Standard 300-85, “Reverberant Room Method of Testing Fans for Rating Purposes,” American National Standards Institute/Air Movement and Control Association International, 1985.

8. ANSI/ASHRAE Standard 52.2-1999, “Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size,” American National Standards Institute/American Society of Heating, Refrigerating and Air Conditioning Engineers, 1999.

9. ANSI/ARI Standard 410-2001, “Forced-Circulation Air-Cooling and Air-Heating Coils,” Air Conditioning and Refrigeration Institute, 2001.

10. "HVAC Air Duct Leakage Test Manual," Sheet Metal and Air Conditioning Contractors' National Association, 1985.

11. NRC Regulatory Guide 1.140, “Design, Inspection, and Testing Criteria for Air Filtration and Adsorption Units of Normal Atmosphere Cleanup Systems in Light-Water-Cooled Nuclear Power Plants,” 2001.

12. NFPA 90A, “Standard for the Installation of Air Conditioning and Ventilation Systems,” National Fire Protection Association Standards, 2002.

Table 9.4.14-1—ABVS Environmental Conditions

Areas	Minimum Temperature	Maximum Temperature	Relative Humidity
Outdoor	-10°F	100°F Dry Bulb 77°F Wet Bulb	N/A
Changing Rooms, Showers	68°F	77°F	10 – 70%
Permanent Work Areas, Offices	68°F	77°F	10 – 70%
Toilets	68°F	77°F	10 – 70%
Rooms for I&C and Electrical Equipment, Stores	59°F	95°F	10 – 95%
Staircases, Corridors	59°F	95°F	10 – 95%
Supply Air Chambers	59°F	95°F	10 – 95%
Prestressing Gallery	Not Controlled	Not Controlled	Not Controlled

Next File