9.4.5 Safeguard Building Controlled-Area Ventilation System

Each of the four safeguard divisions is separated into two functional areas:

- Hot mechanical area (controlled area) serviced by the safeguard building controlled-area ventilation system (SBVS).
- Electrical, instrumentation and control (I&C) and heating, ventilation and air conditioning (HVAC) area serviced by the electrical division of the safeguard building ventilation system (SBVSE). Refer to Section 9.4.6.

The SBVS provides a suitable and controlled environment, in the hot mechanical areas of the Safeguard Buildings (SB) where engineered safety feature components are located, for personnel access and to allow safe operation of the equipment during normal plant operation, outages, under anticipated operational occurrences, and postulated accidental events.

The SBVS, through its interconnections to the SBVSE and the nuclear auxiliary building ventilation system (NABVS), provides conditioned air for ventilation to the controlled area of the SBs. The conditioned air supply to all four divisions of SB controlled areas is provided independently for each division by the SBVSE (refer to Section 9.4.6). The exhaust air (normal exhaust) from the four divisions of the SB is processed by the NABVS (refer to Section 9.4.3).

9.4.5.1 Design Bases

The SBVS is safety-related and designed to Seismic Category I requirements, except the following:

- Electric heaters which are non-safety-related and non-seismic. These heaters are located in stairwell and service access areas and are used for personnel comfort only. For non-safety-related equipment located in the same room with safety-related equipment, the seismic classification for the non-safety-related equipment is described in Section 3.7.3.8 for interaction of Seismic Category I subsystems.

The safety-related components of the SBVS are located inside the SB that is designed to withstand the effect of natural phenomena, such as earthquake, tornados, hurricanes, floods and external missiles (GDC 2).

The safety-related components of the SBVS are appropriately protected against dynamic effects and designed to accommodate the effects of, and to be compatible with, the environmental conditions associated with normal operation, maintenance, testing and postulated accidents. The safety-related components of the SBVS remain functional and perform their intended safety function after anticipated operational occurrences and design basis accidents, such as a fire, internal missiles, or pipe break (GDC 4). Refer to Section 3.5.1.1, Section 3.5.1.4, Section 3.5.2, and Section 3.6.1 for information on compliance with GDC 4 as it relates to protection from missiles and postulated piping failures.

The safety-related components and systems of the SBVS are not shared among nuclear power units (GDC 5).

The essential onsite electrical power systems meet the guidance of NUREG-CR/0660 (subsection A–item 2, and subsection C-item 1) (Reference 1) for protection of essential electrical components (such as contactors, relays, circuit breakers) from failure due to the accumulation of dust and particulate materials (GDC 17). This is accomplished by the roughing prefilters and filters of the supply air units of the SBVSE as described in Section 9.4.6.

The release of radioactive materials to the environment is controlled by meeting the guidance of RG 1.52 (position C.3) (GDC 60). Upon receipt of a high radiation alarm in the hot mechanical areas of the SBs (refer to Table 11.5-1, Monitor R-25), the SBVS will direct the exhaust air (accident exhaust) through NABVS activated charcoal filtration beds located in the NAB prior to release through the vent stack.

Filtration during normal operation is provided by the NABVS by meeting the guidance of RG 1.140 (positions C.2 and C.3). Refer to Section 9.4.3.

Capability for withstanding or coping with a station blackout (SBO) event is provided to comply with the requirements of 10 CFR 50.63. Acceptance is based on meeting the applicable guidance of RG 1.155, including position C.3.2.4. Refer to Section 8.4 for a description of the design features to cope with the SBO event.

The SBVS provides isolation and confinement of the hot mechanical areas of the SBs. The system also provides reduction of a possible radioactive release into the environment.

In case of fuel handling accident in the FB, the exhaust air (accident air) from the FB fuel pool area is directed through the SBVS activated charcoal filtration beds located in the FB prior to release through the vent stack.

On receipt of containment isolation signal, the SB hot mechanical areas are isolated and the SBVS iodine filtration trains are initiated. The SBVS maintains negative pressure in the FB and SB hot mechanical areas to capture potential bypass leakage from primary containment. The exhaust air is directed to the SBVS iodine filtration trains before being released into the environment (refer to Section 9.4.2).

The SBVS can be used for containment building ventilation system (CBVS) low flow containment purge in an emergency for redundancy to the CBVS iodine filtration trains (refer to Section 9.4.7).

The seismic design of the system meets the guidance of RG 1.29 (position C.1 for the safety-related portions and position C.2 for the non-safety-related portions).

Air conditioning and heating loads for the SBVS rooms are calculated using methodology identified in ASHRAE Handbook (Reference 11).

- Summer air conditioning loads will be calculated with a maximum outside air design temperature 0 percent exceedance value, using U.S. EPR Site Design Envelope Temperature (See Table 2.1-1). The analysis will be completed for both a normal and accident plant alignment configuration.
- The recirculation cooling units are designed to provide cooling as required to prevent the SBVS room temperatures from exceeding their maximum design temperature.
- Winter heating loads are calculated with the plant operating in an outage alignment configuration. Winter heat loads will be calculated with a minimum outside air design temperature 0 percent exceedance value, using U.S. EPR Site Design Envelope Temperature (See Table 2.1-1).
- With outside air ambient design temperature conditions of -40°F to 115°F, the SBVS maintains the following temperature and humidity ranges for the areas serviced.
  - Minimum temperature 50°F.
  - Maximum temperature 104°F.
  - Humidity 10 to 60 percent.

The SBVS performs the following safety-related system functions:

- Controls and maintains a negative pressure within the hot mechanical areas of Safeguard Buildings and Fuel Building relative to the outside environment during accident conditions.
- Maintains acceptable ambient conditions for the safety-related components in the hot mechanical rooms in the SB during accident conditions, taking into account internal and external heat loads.
- Maintains acceptable ambient conditions inside the emergency feed water system (EFWS) pumps and component cooling water system (CCWS) valve rooms of the SB during accident conditions, taking into account internal and external heat loads.
- Maintains a negative pressure and filters the hot mechanical areas of Safeguard Buildings and Fuel Building upon receipt of a containment isolation signal.

The SBVS performs the following non-safety-related system functions:

- Controls and maintains a negative pressure within the hot mechanical areas of Safeguard Buildings relative to the outside environment during normal plant operation and plant maintenance.
- Maintains acceptable ambient conditions (temperature and humidity) in the SB hot mechanical rooms for equipment operation and personnel comfort during normal plant operation and plant maintenance.
- Ventilates the hot mechanical rooms in the SB to maintain a good working environment for personnel in these areas during normal plant operation and plant maintenance.
- Provides personnel comfort heating for the service access areas and the stairwell areas during normal plant operation and plant maintenance.

9.4.5.2 System Description

9.4.5.2.1 General Description

The SBVS is composed of following subsystems:

- SB controlled-area air supply subsystem (see Figure 9.4.5-1).
- SB controlled-area exhaust air subsystem (see Figure 9.4.5-2).

The SBVS provides ventilation and cooling to the hot mechanical areas of the four divisions of the SBs. The SB divisions one and four are located on opposite sides of the RB, while SB divisions two and three are housed together and located next to the RB.

During normal operation the conditioned air supply to the hot mechanical areas of the SBs is provided independently for each division by the SBVSE (refer to Section 9.4.6). The supply duct of each SB division is equipped with two isolation dampers and one pressure control damper. The conditioned air is supplied to the hot mechanical areas via a ductwork distribution network. The flow rate to each room is calculated based on the minimum air renewal rate, equipment heat loads and heat balance between the rooms to make sure that ambient conditions are maintained within prescribed limits for operation of equipment and the safety and comfort of personnel.

The SBVS air supply and exhaust flows are designed to prevent the spread of airborne contamination and to maintain a negative pressure in the hot mechanical areas of the SBs with respect to the outside environment.

The SBVS has two separate modes of exhaust:

- Operational Air Exhaust Mode–The exhaust air (normal exhaust) from all four divisions of the SBs (hot mechanical areas) connects to a single concrete duct in the annulus, which then runs via the FB and connects to the exhaust duct of the NABVS. The exhaust duct of each SBVS train is equipped with two isolation dampers and one volume control damper. The exhaust air is processed by the NABVS through a filtration train prior to release through the vent stack (refer to Section 9.4.3). If high radiation is detected in the SBVS exhaust duct by monitor R-25, the exhaust is diverted to one of the NABVS iodine filtration trains and released through the vent stack.

- Accident Air Exhaust Mode–If airborne contamination is detected in any of the four hot mechanical areas of the SBs or there is a containment isolation signal, the SBVS will automatically direct the exhaust air (accident exhaust) via four separate exhaust air ducts, each with two parallel isolation dampers, to one common concrete duct in the annulus. This exhaust duct connects to two accident iodine exhaust filtration trains located in the FB. The exhaust air is processed through one of two redundant and independent iodine filtration trains prior to release through the vent stack. Each iodine filtration train includes inlet and outlet dampers, moisture separator, two stage electric heater, prefilter, high efficiency particulate air (HEPA) filter, carbon adsorber, post filter, exhaust fan, and backdraft damper. The fans direct the exhaust air to the vent stack.

In case of a fuel handling accident in the FB, the accident exhaust air from the FB fuel pool area is directed and filtered through the SBVS iodine exhaust filtration trains located in the FB, and released through the vent stack. (Refer to Section 9.4.2.)

In case of a fuel handling accident in containment, the SBVS can act as backup to the CBVS low flow purge exhaust system (Refer to Section 9.4.7).

In case of containment isolation signal, the SBVS maintains a negative pressure and filters all areas of the FB and the hot mechanical area of the SB in addition to performing the SBVS accident air exhaust filtration function.

The supply and exhaust duct network of the hot mechanical area in the SBs is equipped with isolation dampers to isolate the following areas from the other rooms:

- Rooms where safety injection and residual heat removal system components in divisions one through four are installed.
- Rooms where severe accident heat removal system components in division four are installed.
- Personnel air lock area in division two.

Recirculation cooling units are provided for the following rooms where high heat load equipment is located:

- Rooms in the SB, divisions one through four, where safety injection and residual heat removal system components are installed.
- Valve rooms in the SB, divisions one through four, where component cooling water system and emergency feedwater system components are installed.

- Rooms where hydrogen and containment atmosphere monitoring system (divisions one through four), and severe accident sampling system (division four) components are installed.

Electric heaters are provided in the service corridors, interconnecting passageway, and stairways to maintain the minimum allowable temperatures in these areas.

The SBVS is designed to circulate sufficient air to prevent accumulation of flammable or explosive gas or fuel-vapor mixture from components such as storage batteries and stored fuel.

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

9.4.5.2.2 Component Description

The major components of the SBVS are listed below, along with the applicable code and standards. Table 3.2.2-1 provides the seismic design and other design classifications for components in the SBVS.

Ductwork and Accessories

The main supply and exhaust air shafts are constructed of concrete with painted surfaces. The air supply and exhaust duct branches for each area are fed from the main supply and exhaust air shafts. These ducts are constructed of steel and structurally designed for fan shutoff pressures. The ductwork meets the design, testing and construction requirements per ASME AG-1 (Reference 2).

Electric Heaters

Electric heaters are installed to maintain room ambient conditions. The heaters are controlled by local room temperature sensors and control circuits.

Moisture Separator

The moisture separator meets the requirements of RG 1.52 (Reference 10), ANSI/ASME N509 (Reference 9), and ASME AG-1 (Reference 2). The moisture separator is located upstream of the filter air heater and the prefilter to protect the HEPA filter and carbon adsorber from potentially high humidity level by removing the entrained water droplets from the inlet air stream. The moisture separator design shall be qualified by testing in accordance with the procedure described in ANSI/ASME N509.

Filter Air Heaters

Two stage electric heaters are located upstream of HEPA and iodine filtration units to prevent excessive moisture accumulation in the charcoal filter beds. At the start of an accident, full power of two stage electric heater is switched on when the fans start and filter bank isolation dampers open. As the negative pressure is drawn in the FB and SB, and when the temperature downstream of heater increases to 158°F, one step of heater power is switched off automatically. As the temperature downstream of heater reaches 176°F, second step of the heater is also switched off automatically. The heaters meet the requirements of ASME AG-1 (Reference 2).

Prefilters

The prefilters are located upstream of the HEPA filters and collect large particles to increase the useful life of the HEPA filters. The prefilters meet the requirements of ANSI/ASHRAE Standard 52.2 (Reference 3).

HEPA Filters

HEPA filters are constructed, qualified and tested in accordance with ASME AG-1 (Reference 2). The periodic inplace testing of HEPA filters to determine the leak tightness is performed per ANSI/ASME N510 (Reference 4).

Adsorbers

Carbon adsorbers are used to remove radioactive iodine from the exhaust air. The efficiency for removal of methyl iodine is based on the decontamination efficiency assigned during the laboratory tests. The periodic inplace testing of adsorbers to determine the leak-tightness is performed per Reference 4.

Post Filters

The post filter is located downstream of the carbon adsorber. During operation of the carbon filtration exhaust, the air flow rate will be low through the carbon adsorber to prevent spread of the carbon dust. However, the post filter ensures that carbon dust or carbon fines are removed prior to the air being distributed further. The post filter meets the requirements of ASME AG-1 (Reference 2), and has an average atmospheric dust efficiency of 95% in accordance with ANSI/ASHRAE Standard 52.2 (Reference 3). The post filter is equipped with differential pressure measurement which indicates the degree of particulate loading and the need for filter change.

Fans

The supply and exhaust fans are centrifugal or vane-axial design with electrical motor drivers. Fan performance is rated in accordance with ANSI/AMCA 210 (Reference 5), AMCA 211 (Reference 6), and ANSI/AMCA 300 (Reference 7).

Isolation Dampers

Manual dampers are adjusted during initial plant startup testing to establish accurate air flow balance between the rooms. The motor-operated isolation dampers will fail as-is in case of power loss. Backdraft dampers prevent air flow to non-operating air supply and exhaust trains. The performance and testing requirements of the dampers are per ASME AG-1 (Reference 2).

Fire Dampers

Fire dampers are installed where ductwork penetrates a fire barrier. Fire damper design meets the requirements of NFPA 80 (Reference 8) and NFPA 90A (Reference 17) and 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.

Recirculation Cooling Units

The recirculation cooling units consist of a fan section, a water cooling section, and a moisture separator. The fan is driven by an electric motor. The cooling coils are finned coil type and are connected to the safety chilled water system (SCWS). The total cooling capacity for the SBVS recirculation cooling units is as follows:

- KLC 51/54 AN001

  64,800 Btu/hr.

- KLC 51/54 AN002

  32,400 Btu/hr.

- KLC 51/54 AN003

  21,600 Btu/hr.

- KLC 52/53 AN001

  54,000 Btu/hr.

- KLC 52/53 AN002

  32,400 Btu/hr.

The cooling coils are designed in accordance with ASME AG-1 (Reference 2). The moisture separator collects condensate which is directed to drain system.

9.4.5.2.3 System Operation

Normal Plant Operation

During normal plant operation, the fresh conditioned air is supplied to four divisions of the SBs independently for each division by the SBVSE (refer to Section 9.4.6). The isolation dampers on each supply duct are in the open position and the pressure control dampers on each supply duct are set to a flow rate in order to maintain a negative pressure in the controlled areas compared to the atmospheric pressure.

The room air conditioning is obtained by the supply and exhaust air flows based on the minimum air renewal rate, equipment heat load, and heat balance between the rooms. The air is heated or cooled to maintain the required ambient conditions of the rooms.

The operational air exhaust from the four divisions of the SBs (hot mechanical area) is processed by the NABVS. The isolation dampers on each exhaust duct are in open position, and the volume control dampers on each exhaust duct are pre-set to an air flow rate that maintains a negative pressure in the controlled areas.

The accident air exhaust isolation dampers are in open position, and the iodine filtration trains located in the FB are in a standby mode.

Isolation dampers for switching the fuel handling accident exhaust from both FB and Containment Building are in the closed position.

The associated dampers for the following areas are in the open position:

- Supply and exhaust air flow to the rooms where safety injection and residual heat removal system equipment is located in divisions 1 through 4.
- Supply and exhaust air flow to the rooms where severe accident heat removal system components are located in division 4.
- Supply and exhaust air flow to and from the personnel air lock area in division 2.

A negative pressure is maintained in the SB controlled areas. A negative pressure is also maintained for the iodine risk rooms (safety injection, residual heat removal, and severe accident heat removal systems equipment rooms) relative to the outside environment. The air supplied to the SB controlled areas by the electrical division of the safeguard building ventilation system (SBVSE) is automatically adjusted by a damper in the supply air ducting that receives a pressure control signal, which maintains a negative pressure in the SB controlled areas, relative to the outside environment (ambient pressure). The SBVS maintains the non-controlled areas of the SB at ambient pressure. This system design configuration maintains potentially contaminated SB controlled areas at a negative pressure, relative to the clean areas of the non-controlled areas of the SB.

The electric heaters are used in the service corridors, interconnecting passageway, and stairways to maintain comfortable temperatures in these areas. The operation of fan heaters is automatically controlled by the temperature sensors located in these areas.

The recirculation cooling units provide recycled cool air to the rooms where high heat load equipment is located. The operation of recirculation cooling units is automatically controlled by the temperature sensors located in these rooms.

Plant Outage Condition

During the plant outage condition, the system configuration will remain the same as during normal plant operation except the following:

- Air supply and exhaust of the rooms where the safety injection and residual heat removal systems equipment are located in hot mechanical areas of the SB divisions 1 through 4 are isolated by closing the associated dampers.
- If the personnel air lock is open, the supply air flow continues in service and the associated isolation dampers remain open. The exhaust air from the personnel air lock area is stopped by closing the associated exhaust isolation damper. The supply air travels through the air lock into the containment and is exhausted by the containment building ventilation system.
- If maintenance is performed on the equipment or systems which pose delayed iodine release hazard, the exhaust air from these areas is diverted to the iodine filtration plenum of the NABVS prior to discharge through the vent stack (refer to Section 9.4.3).

Abnormal Operating Conditions

Loss of Recirculation Cooling or Area Ventilation

Failure of recirculation cooling or area ventilation in one SB division has no effect on safety function of SBVS since other three unaffected SB divisions are capable of performing the necessary safety function.

Two supply and exhaust dampers are provided for isolation of the hot mechanical area of each SB division. If one damper fails, the other damper can perform the safety function.

Loss of an Accident Iodine Exhaust Filtration Train

The SBVS provides two accident exhaust iodine filtration trains. Failure of one filtration train has no effect since the unaffected train can perform the necessary filtration function.

Redundant switching dampers are arranged in parallel configuration. As such failure of one damper has no consequence since the unaffected damper can perform the necessary function.

The fuel handling accident exhaust in the RB can be provided by the exhaust filtration trains of CBVS (refer to Section 9.4.7).

Loss of Offsite Power

The following equipment will remain operational during loss of offsite power (LOOP). The power supply for this equipment is supplied from the corresponding emergency diesel generators.

- Dampers in all SBVS trains.
- Iodine exhaust filtration trains located in the FB.
- Dampers to the zones that need to be isolated and confined.

Station Blackout

Station black out (SBO) does not lead to release of radioactivity inside the SB, FB and RB. The system filtering function is therefore not required during SBO. However, the following components are supplied from the SBO diesel generators alternate AC (AAC) power:

- Normal operation supply and exhaust air isolation dampers for the hot mechanical areas in SB divisions one through four to isolate these areas when exhaust is not in operation due to SBO.
- Recirculation cooling units in the SB divisions one and four, where the EFW valves are located.

Loss of Ultimate Heat Sink

During loss of ultimate heat sink (LUHS), the air flow of the recirculation cooling units is cooled by the chilled water provided by the SCWS. Two water-cooled chillers are located in SB divisions two and three, and two air-cooled chillers are located in SB divisions one and four. In case of LUHS, the water-cooled chillers are not available. With the safety chilled water divisions 1/2 or divisions 3/4 interconnect, the safety chilled water is then supplied by air-cooled chillers which provide the cooling function for the recirculation cooling units located in divisions one, two, three and four.

Loss of Coolant Accident

Upon receipt of a containment isolation signal, the following functions are initiated automatically:

- Closes SBVS supply air isolation dampers from SBVSE.
- Closes SBVS exhaust air isolation dampers to NABVS.

- Opens SBVS exhaust air isolation dampers to exhaust air from the hot mechanical areas of SB and the FB to the SBVS Accident Exhaust Iodine Filtration Trains (located in the FB).

- Opens isolation dampers for the SBVS Accident Exhaust Iodine Filtration Trains.

- Starts SBVS iodine filtration train fans to pull air through SBVS Accident Exhaust Iodine Filtration Trains and to direct exhaust air to the vent stack.

In the event of a LOCA, the containment isolation signal initiates isolation of the FB from NABVS supply and exhaust duct to limit leakage into the FB. The SBVS maintains a negative pressure in the FB and exhaust air from the FB is directed to the SBVS iodine filtration trains (refer to Section 9.4.2).

Iodine Presence in the SB Rooms

In the event of a failed fuel element and residual heat removal pump seal leakage, high iodine is expected to be present in only one of the four SB divisions at a time, and it is necessary to purify the air in this division for personnel access. The air supply and exhaust flow for the affected division is increased to purge the possibly contaminated areas, while air supply and exhaust for the other three divisions is decreased. This is achieved by partially opening the exhaust volume control dampers and by partially closing the exhaust volume control dampers of the other three divisions in order to maintain an acceptable total exhaust air flow to the NABVS iodine filtration train. The airflow is diverted within the normal exhaust pathway to the NABVS iodine filtration train on a high activity alarm from the radiation detector in the NABVS normal exhaust duct.

Fuel Handling Accident in the FB

In the event of a fuel handling accident in the FB, the exhaust air from the FB is processed through the SBVS iodine filtration trains located in the FB. The damper configuration is as follows:

- Associated dampers in the ducts from the FB to the SBVS filtered exhaust are in the open position.

- Associated dampers in the ducts from the RB to the SBVS filtered exhaust are in the closed position.

- Associated dampers for the SBVS accident air exhaust to the SBVS filtered exhaust are in the closed position.

- One (or both) SBVS iodine filtration trains are in service.

Fuel Handling Accident in the RB

In the event of a fuel handling accident in the Reactor Building, the personnel air lock isolation dampers are automatically closed. In the event of a fuel handling accident in the RB, the SBVS can provide backup filtration for the CBVS. The damper configuration is as follows:

- Associated dampers in the ducts from the RB are in the open position.
- Associated dampers in the ducts from the FB are in the closed position.
- Associated dampers for the SBVS accident air exhaust from the SB are in the closed position.
- One (or both) SBVS iodine filtration trains are in service.

Residual Heat Removal System Break outside Containment

The rooms inside SB divisions one through four containing the residual heat removal (RHR) equipment and piping are equipped with isolation dampers in the supply and exhaust air ducts. These dampers are manually closed during RHR operation to prevent the spread of steam and airborne contamination due to a pipe failure.

Operation of Containment Heat Removal System in Severe Accidents

The rooms inside SB division four containing the severe accident heat removal system equipment are isolated from the other rooms by closing the associated dampers located in the supply air ducts for each room.

9.4.5.3 Safety Evaluation

The SBVS is designed to maintain ambient conditions in the hot mechanical areas of the SB divisions one through four (refer to Section 11.5.3.1.9 and Table 11.5-1, Monitor R-25) one through four where engineered safety equipment is located. This permits personnel access and allows safe operation of the equipment during normal plant operation, outages, and under all anticipated occupational occurrences, including postulated accident events.

The SBVS provides isolation and confinement of the hot mechanical areas of the SBs (refer to Section 11.5.3.1.9 and Table 11.5-1, Monitor R-25). Two isolation dampers and one volume control damper are provided in the supply and exhaust ducts to make sure that hot mechanical areas can be purged or isolated without any leakage. The hot mechanical areas of the SBs and Fuel Building are maintained at negative pressure with respect to the outside atmospheric air pressure. The system also provides reduction of radioactive release into the environment.

Each recirculation cooling unit for SB divisions one through four operates independently of the recirculation cooling unit in the other divisions. In case of a recirculation cooling unit failure of one train, the recirculation cooling units for the other three trains are unaffected.

Upon receipt of a high radiation alarm in the hot mechanical areas of the SBs (refer to Section 11.5.3.1.9 and Table 11.5-1, Monitor R-25), the SBVS directs the exhaust through the NABVS activated charcoal filtration beds located in the NAB prior to release through the vent stack. Sufficient redundancy provides reasonable assurance of proper system operation with one active component out of service.

Confinement of the four SB hot mechanical areas and startup of the SBVS accident iodine filtration trains is initiated by the safety automation system (SAS) signal.

Isolation dampers in the supply and exhaust ducts are provided for the SB division one through four rooms where safety injection and residual heat removal system equipment is located. These dampers close during RHR operation to prevent the spread of steam and airborne contamination due to a RHR system pipe failure.

Redundant components are powered from different electrical divisions to remain available in case of failure of one division. As a backup, power is supplied to the engineered safety equipment by the emergency diesel generators (EDG).

Capability for withstanding or coping with an SBO event is met by the design of the AAC power source satisfying the ten minute criteria; (i.e., the AAC power source can be started from the main control room (MCR) within ten minutes of the onset of an SBO event). The SBO diesel generators are designed to operate for a minimum of eight hours with available onsite fuel supplies.

9.4.5.4 Inspection and Testing Requirements

The SBVS 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.

Test and analysis will be completed during normal operation with the system operating in an accident alignment. Analysis will use as-built information from equipment to extrapolate the performance of the air-conditioning system. Analysis will show that the equipment performance is adequate to maintain design conditions during plant operating conditions.

Initial in-place acceptance testing of the SBVS is performed as described in Section 14.2 (test abstracts #083 and #203), Initial Plant Test Program, to verify the system is built in accordance with applicable programs and specifications.

The SBVS 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 SBVS is performed to demonstrate system and component operability and integrity.

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

Per IEEE 334 (Reference 12), type tests of continuous duty class 1E motors for SBVS are conducted to confirm ESF system operation and availability.

Recirculation cooling units and fans are tested by 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 3). Cooling coils are hydrostatically tested in accordance with ASME AG-1 (Reference 2) and their performance is rated in accordance with the Air Conditioning and Refrigeration Institute (ARI) standards (Reference 13).

Housings and ductwork are leak-tested in accordance with the Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) technical manual “HVAC Air Duct Leakage Test Manual” (Reference 14), American Society of Mechanical Engineers, ANSI/ASME N510 (Reference 4), ASME AG-1 (Reference 2), and RG 1.52 (Reference 10).

Emergency filtration units are tested by manufacturer for housing leakage, filter bypass leakage and airflow performance. Periodically and subsequent to each filter or adsorber material replacement, the unit is inspected and tested in-place in accordance with the requirements of RG 1.52 (Reference 10), ANSI/ASME N510 (Reference 4) and ASME AG-1 (Reference 2). The charcoal adsorber samples are tested for efficiency in accordance with RG 1.52 (Reference 10) and ASTM D3803 (Reference 15). Air filtration and adsorption unit heaters are tested in accordance with ANSI/ASME N510 (Reference 4).

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

In-service test program and test frequency requirements are described in Section 16, "Technical Specification" Subsection 3.7.12 and per Ventilation Filter Test Program (VFTP) described in Section 16, "Technical Specification" Subsection 5.5.10.

9.4.5.5 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 11.5.3.1.9 and Table 11.5-1, Monitor R-25.

The minimum instrumentation, indication and alarms for the SBVS ESF filter system are provided in Table 9.4.5-1 per the requirements of ANSI/ASME N509 (Reference 9).

9.4.5.6 References

1. NUREG-CR/0660, Boner, G.L. and Hanners, H.W., “Enhancement of Onsite Emergency Diesel Generator Reliability,” (subsection A–item 2, and subsection C-item 1), University of Dayton Research Institute UDR-TR-79-07 for U.S. Nuclear Regulatory Commission, January 1979.

2. ASME AG-1, “Code on Nuclear Air and Gas Treatment,” The American Society of Mechanical Engineers, 1997 (including the AG-1a-2000, “Housings” Addenda).

3. 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.

4. ANSI/ASME N510-1989, “Testing of Nuclear Air-Treatment Systems,” American National Standards Institute/The American Society of Mechanical Engineers, 1989.

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, 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.

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Table 9.4.5-1—Minimum Instrumentation, Indication and Alarm Features for SBVS (Accident Iodine Exhaust Filtration Trains)

Sensing Location	Local Indication/Alarm	MCR Indication/Alarm
Electric Heater Inlet	Temperature Indication	
Electric Heater	Status Indication	Status Indication
Electric Heater Outlet	Temperature Indication	Temperature Indication / High Temperature Alarm
Prefilter	Pressure Drop Indication / High Alarm	
HEPA	Pressure Drop Indication / High Alarm	
Adsorber	Pressure Drop Indication / High Alarm	
Adsorber Outlet	Temperature Indication	Temperature Indication / High Temperature Alarm
Post Filter	Pressure Drop Indication / High Alarm	
System Filters Inlet to Outlet		Summation of pressure drop across entire filtration train (Indication / High Pressure Drop Alarm)
Fan	Pressure Drop Indication	Handswitch / Status Indication
Damper / Operator	Position Indication	Position Indication
Unit Outlet	Flow Rate Indication	Flow Rate (recorded indication, high alarm signal)
Unit Outlet	Radiation Indication	Radiation Indication / High Radiation Alarm

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