9.4 Air Conditioning, Heating, Cooling and Ventilation Systems

The heating, ventilation, and air-conditioning (HVAC) system for each major building or area is provided in the following subsections.

9.4.1 Main Control Room Air Conditioning System

The main control room air conditioning system (CRACS) is designed to maintain a controlled environment in the control room envelope (CRE) area for the comfort and safety of control room personnel and to support operability of the control room components during normal operation, anticipated operational occurrences and design basis accidents. CRACS is also relied upon to cope with and recover from a station blackout (SBO) event.

Under normal operating conditions, the control room air conditioning system operates with fresh outside air (bypasses the control room emergency filtration (CREF) trains. The inlet air is pulled into the common recirculation plenum and mixes with air recirculated back from the rooms within the CRE. This mixture of outside air and recirculated air is pulled into the CRACS cooling units where it is filtered and cooled. The conditioned air is then supplied to CRE rooms. During a site radiological contamination event, the fresh air intake is redirected through the CREF iodine filtration trains. During an outside fire or smoke event, the fresh air intake at the location of the alarm is manually isolated.

The main control room (MCR) habitability system, including the definition of the CRE area, is addressed in Section 6.4.

9.4.1.1 Design Bases

The CRACS is primarily a safety-related system with portions serving non-safety-related functions. The non-safety-related portions of the CRACS are the restroom/kitchen exhaust fan and smoke detectors, with the exception of restroom/kitchen exhaust from the backdraft damper to SBVSE. This portion of the system is designated as safety-related to prevent potential backflow of SBVSE exhaust air into the CRACS duct.

The safety-related portions are designed to Seismic Category I criteria requirements.

The U.S. EPR meets:

- GDC 2, as it relates to meeting the guidance of RG 1.29 (position C.1 for the safety-related portions of the CRACS and position C.2 for those non-safety-related portions of which failure could reduce the functioning of any safety-related or Seismic Category I system components to an unacceptable safety level). The CRACS components are located inside the Safeguard Building (SB) divisions two and three. These buildings are designed to withstand the effect of natural phenomena, such as earthquake, tornados, hurricanes, floods, and external missiles

- GDC 4, as it relates to the CRACS by design, to protect against adverse environmental conditions and dynamic effects. The CRACS accommodates the effects of, and is compatible with the environmental conditions associated with normal operation, maintenance, testing, and postulated accidents.

- GDC 5, as it relates to the CRACS system because safety-related components are not shared with any other nuclear power units.

- GDC 19, as it relates to the CRACS system to provide adequate protection against radiation releases and outside fire or smoke events to permit access to and occupancy of the control room under accident conditions. The control room occupancy protection requirements meet the guidance of RG 1.78. RG 1.52 and 1.140 (GDC 60). In case of an alarm from the inlet air radiation monitors (refer to Section 11.5.3.1.11 and Table 11.5-1, Monitors R-29 and R-30), the CRACS directs the air intake automatically through activated carbon filtration beds. The air from CRE areas can also be recirculated through the same activated carbon filtration beds. The evaluation of potential toxic chemical accidents is addressed by the COL applicant in Section 2.2.3 and includes the identification of toxic chemicals. As described in Section 6.4.1, the COL applicant evaluates the impact of toxic chemical accidents on control room habitability in accordance with RG 1.78.

- GDC 60, as it relates to the release of radioactive materials to the environment.

Consideration of the environmental and dynamic effects of internal and external missiles and postulated piping failures on the CRACS is addressed in Section 3.5.1.1, Section 3.5.2, and Section 3.6.1.

Capability for withstanding or coping with a SBO event is provided to comply with the requirements of 10CFR 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 CRACS maintains habitability of the CRE areas during a site radiological event (Refer to Section 6.4).

During a postulated event, the control room is maintained at a minimum positive pressure of greater than or equal to 0.125 inches water gauge relative to the surrounding environment to prevent uncontrolled incoming leakage.

During normal operation, the control room is maintained at a pressure above ambient.

The CRACS maintains system performance in the event of failure of a single active safety-related component.

The CRACS outside air intake is capable of detecting radiation (see Section 6.4.2.4), and smoke. Associated monitors actuate alarms in the MCR. Upon receipt of a containment isolation signal, or high radiation alarm signal in the outside air intake duct (Monitors R-29 and R-30, Table 11.5-1), the CREF (iodine filtration) train starts automatically and the outside air and CRE recirculation air are automatically diverted through the CREF (iodine filtration) train. The outside makeup air maintains a positive pressure inside the CRE area relative to the adjacent areas. The CRE air inlet and recirculation dampers operate automatically.

The CRACS is capable of isolating all non-safety-related system penetrations of the CRE boundary so that occupation and habitability of the control room is not compromised.

Air conditioning and heating loads for the CRE rooms is calculated using methodology identified in ASHRAE Handbook (Reference 8) as follows:

- Summer air conditioning loads are 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 is completed for both a normal and accident plant alignment configuration.
- The CRACS cooling supply units are designed to provide cooling as required to prevent the CRE 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 are 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).

The CRACS supply air duct heaters are designed to operate for "comfort conditions only" as required when the CRE room temperature is less than the minimum "comfort temperature" set point value. The CRACS supply air duct heaters are not required to operate during accident conditions.

The CRACS maintains the following temperature and humidity ranges for the areas serviced:

Room	Temperature	Humidity
– Main Control Room:	68°F to 78°F	30 – 60%
– I&C Computer Rooms:	65°F to 78°F	30 – 60%
– HVAC Rooms:	50°F to 95°F	20 – 80%
– Other areas of CRE:	65°F to 78°F	20 – 80%

9.4.1.2 System Description

9.4.1.2.1 General Description

The CRACS is designed to maintain acceptable ambient conditions inside the CRE areas to provide for proper operation of equipment and for personnel access to conduct inspection, testing and maintenance. The CRE area is shown in Figures 6.4-1 through 6.4-3.

The CRACS consists of following subsystems:

- Air intake.
- CREF (iodine filtration) train.
- Air conditioning and recirculation air handling.
- CRE air supply and recirculation.
- Kitchen and restroom exhaust.

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

Air Intake Subsystem

The air intake subsystem is illustrated in Figure 9.4.1-1—Control Room Air Intake and CREF (Iodine Filtration) Train Subsystem.

The CRACS has two outside air intakes. The train 1 intake is located in Safeguard Building 2 and the train 4 intake is located in Safeguard Building 3. Outside air is supplied by each outside air intake through a wire mesh grille. Each outside air intake is equipped with an electrically heated, weather protected grille to prevent ice formation. Smoke detectors and radiation monitors (refer to Section 11.5.3.1.11 and Table 11.5-1, Monitors R-29 and R-30) are installed in the outside air intake ducting.

Outside air intakes on each train are interconnected through ducting to allow the outside inlet air to travel through a CREF iodine filtration unit (filtered alignment), or the outside air can bypass the CREF iodine filtration unit (unfiltered bypass alignment).

Trains 1 and 4 outside air intakes each are equipped with a motor-operated isolation damper. These isolation dampers are normally open but they can be manually closed as necessary to isolate the outside air intake from the control room.

CREF (Iodine Filtration) Train Subsystem

The CREF (iodine filtration) train subsystem is illustrated in Figure 9.4.1-1.

The train 1 outside air inlet duct and train 1 CREF (iodine filtration) train is located in Safeguard Building 2. The train 4 outside air inlet duct and train 4 CREF (iodine filtration) train is located in Safeguard Building 3. Each CREF (iodine filtration) train pulls air from its respective outside air inlet. The outside inlet air for each CREF is ducted to allow the CREF (iodine filtration) train to operate in the filtered or the unfiltered (bypass) alignment.

In the CREF filtered alignment, a maximum of 1000 cfm of outside air mixes with 3000 cfm of CRE recirculated air and is pulled through the CREF (iodine filtration) train by the CREF booster fan and delivers this air to the common recirculation plenum. In the filtered alignment, the filter bypass duct has two motor-operated bypass dampers in series. In the filtered alignment both of these dampers close to provide redundancy and single-failure protection to prevent the outside air from bypassing the CREF (iodine filtration) trains.

In the CREF unfiltered (bypass) alignment, the CREF filtration unit inlet, outlet and CRE recirculation dampers are all closed and both bypass dampers are open. The outside unfiltered air bypasses the CREF iodine filtration unit. In the unfiltered (bypass) alignment, the outside air flows through a prefilter and a preheater that is temperature controlled. The outside air then flows through ducting and is pulled into the common recirculation plenum. In this unfiltered (bypass) alignment, the CREF booster fan does not operate and outside air is pulled into the common recirculation plenum by the CRACS air handling units.

Air Conditioning and Recirculation Air Handling Subsystem

The air conditioning and recirculation air handling subsystem is illustrated in Figure 9.4.1-2—Control Room Air Conditioning and Recirculation Air Handling Subsystem.

There are four recirculation air handling units located in Safeguard Buildings 2 and 3 (two trains in each building). Recirculated and fresh air is processed through these air handling units and supplied to a common supply air plenum. Each train includes an isolation damper, a volume control manual damper, a cooling coil, a moisture separator, fan suction and discharge silencers, a supply air fan, a HEPA filter, and a non-return damper. The cooling coil is supplied with chilled water from the safety chilled water system (SCWS).

During normal and emergency operation, each CRACS cooling unit provides 50 percent of the cooling for the rooms within the CRE. Each CRACS air handling unit is designed for 50 percent cooling of the normal and emergency cooling load to allow two CRACS air handling units to cool the CRE rooms during a station blackout (SBO) event. During an SBO, two CRACS air handling units prevent the CRE room temperature from exceeding 104°F.

The air conditioning system for the CRE area operates in the recirculation mode with fresh air makeup. The fresh air flow rate corresponds to the exhaust of kitchens and restrooms and the leakage rate in the CRE area due to controlled overpressure. The exhaust from the kitchen and restrooms is directed to the electrical division of the SB ventilation system (SBVSE) air outlet duct (refer to Section 9.4.6).

CRE Air Supply and Recirculation Subsystem

The CRE air supply and recirculation subsystem is illustrated in Figure 9.4.1-3—Control Room Envelope Air Supply and Recirculation Subsystem.

The common supply air plenum receives air from the operating CRACS air handling units and provides conditioned air to the CRE areas through the duct distribution network. Electric heaters are installed in the supply air ducts to maintain individual room temperatures. The exhaust air from the CRE area, except from the kitchen and restrooms, flows through the recirculation air handling units. The exhaust from kitchen and restrooms is separated from the recirculated return air and is processed separately through the SBVSE.

9.4.1.2.2 Component Description

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

Ductwork and Accessories

The main supply and exhaust air plenums 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 plenum. These ducts are constructed of galvanized sheet steel and are structurally designed for fan shutoff pressures. The ductwork meets the design, testing and construction requirements per ASME AG-1 (Reference 1).

Electric Heaters (Duct Heaters)

The electric heaters (duct heaters) are installed in the supply duct to maintain room ambient conditions. These are controlled by local room temperature sensors and control circuits. The heaters meet the requirements of ASME AG-1 (Reference 1).

Moisture Separator

The moisture separator meets the requirements of RG 1.52 (Reference 12), ANSI/ASME N509 (Reference 16), and ASME AG-1 (Reference 1). 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

Iodine filter unit air heaters are located upstream of iodine filters to prevent excessive moisture accumulation in the carbon filter beds. The heaters meet the requirements of ASME AG-1 (Reference 1).

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 2).

HEPA Filters

HEPA filters are constructed, qualified and tested in accordance with ASME AG-1 (Reference 1). The periodic inplace testing of HEPA filters to determine the leak tightness is performed per ANSI/ASME N510 (Reference 3).

Iodine Filters (Carbon Adsorbers)

Iodine filters are used to remove radioactive iodine from the supply of fresh and recirculated air. The efficiency of removal of methyl iodine is based on the decontamination efficiency assigned during the laboratory tests. The periodic inplace testing of carbon adsorbers to determine the leak tightness is performed per ANSI/ASME N510 (Reference 3).

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 1), and has an average atmospheric dust efficiency of 95% in accordance with ANSI/ASHRAE Standard 52.2 (Reference 2). 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 type with electric motor drivers that are direct drive. Fan performance is rated in accordance with ANSI/AMCA 210 (Reference 4), AMCA 211 (Reference 5) and ANSI/AMCA 300 (Reference 6).

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 1).

Fire Dampers

Fire dampers are installed in fire barrier walls or floors. Fire damper design meets the requirements of NFPA 80 (Reference 7) and NFPA 90A (Reference 18) 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.

Cooling Coils and Moisture Separator

The cooling coils are of the finned tube, coil type and are connected to the safety chilled water system (SCWS). The cooling coils have a total cooling capacity of 473,000 Btu/hr and are designed in accordance with ASME AG-1 (Reference 1). The moisture separator collects condensate which is directed to the drain system.

9.4.1.2.3 System Operation

Normal Plant Operation

During normal plant operation, fresh air is admitted via air intake trains 1 and 4. The fresh air passes through the unfiltered bypass duct and bypass dampers. The fresh air is then mixed with the recirculated air from the CRE area, and the mixed air passes through a prefilter and electrical heater. Two sets of temperature sensors are located downstream of the electrical heater. One temperature sensor turns on the heater when the air inlet temperature drops below 37°F; the other temperature sensor turns off the heater when the air inlet temperature reaches 50°F.

The fresh and recirculated air is admitted through two of four air handling units which provide heating and cooling of the supply air. The conditioned air is then distributed through a ductwork distribution network to the CRE area. The room air conditioning is provided by the supply and exhaust air flows based on minimum air renewal rate, equipment and personnel heat loads and heat balance between the rooms.

Heating of air streams is provided by electric heaters located in the supply air ducts. The operation of heaters is automatically controlled by the temperature sensors located in the corresponding rooms.

The CRE area is maintained at a pressure above atmospheric pressure to provide habitability in the event of radioactive contamination of the environment.

Both CREF (iodine filtration) trains are isolated with outside air bypassing the CREF (iodine filtration) trains. The CREF iodine filtration train inlet and outlet motor operated isolation dampers are closed. In addition, the CRE recirculation motor operated isolation damper is closed to prevent the recirculation of air from the CRE rooms.

The air conditioning system for the CRE area operates in the recirculation mode with fresh air makeup. During the recirculation mode, the fresh air supply rate is equal to the rate of exhaust air from the kitchens and restrooms plus accounting for the leakage rate in the area due to controlled overpressure.

Exhaust air from the kitchen and restrooms is not recirculated. During normal operation, air is exhausted from the restrooms and the kitchen area to the SBVSE CREF (iodine filtration) air outlet. The CRACS has design features which will allow it to continue to maintain a positive pressure of greater than or equal to 0.01 inches water gauge in the CRE. Approximately twice as much outside air is supplied to the CRE during normal operation compared to operation during accident conditions. Each train of the CRACS is equipped with a pressure control damper. This damper will open and close as required to increase or decrease the amount of outside air that enters the control room. During normal operation, air is exhausted from the restrooms and the kitchen area through a small throttle damper that minimizes the open CRE boundary area.

Abnormal Operating Conditions

Redundancy of air supply and air conditioning trains is provided. A loss of function or power to any single train or component does not affect overall system operation. The train separation and independent power source limit common mode failure of active multiple trains and abnormal operating conditions.

Loss of a single CRACS air conditioning train will not result in a loss of system functional capability because only two of the four cooling trains are required to operate for both normal and accident operation. The CREF (iodine filtration) trains do not operate during normal plant operation, but loss of a single CREF (iodine filtration) train during any design basis accident will not result in a loss of iodine filtration capability because two CREF (iodine filtration) trains are provided.

Loss of Coolant Accident

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

- Opens Control Room Emergency Filtration (CREF) iodine filtration trains isolation dampers.
- Closes CREF iodine filtration trains bypass dampers.
- Opens Control Room Envelope (CRE) recirculation dampers to provide clean air and positive pressurization for the rooms within the CRE.

Loss of Offsite Power

During loss of offsite power (LOOP), the air intake and air conditioning and recirculation air handling electrical components located inside SB division two receive power for one train from the emergency diesel generators (EDG) of division two, and for the other train from the EDGs of division one. The electrical components located inside the SB division three receive power on one train from the EDGs of division three, and for the other train from the EDGs of division four.

During LOOP, the CREF (iodine filtration) train electrical components located inside the SB division two receive power from the EDGs of division one. The electrical components located inside the SB division three receive power from the EDGs of division four.

Station Blackout

- In the event of station blackout (SBO), the electrical components, which receive power from the EDGs of divisions one and two, are backed-up by alternate AC (AAC) power from the SBO diesel generator (SBODG) of train one. The electrical components, which receive power from the EDGs of divisions three and four, are backed up by the AAC power from a SBODG of train four.
- In the event of a simultaneous SBO and site radiological event, the CRE area is isolated and CRACS is maintained in a full recirculation mode through the CREF (iodine filtration) train until site power is restored or EDGs are started. Power restoration is assumed to occur within eight hours following the occurrence of a SBO event.

Loss of Ultimate Heat Sink

The conditioned air supply is cooled by 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 loss of ultimate heat sink (LUHS), the water-cooled chillers are not available. The safety chilled water is then supplied by air-cooled chillers which provide the cooling function for the filtration trains located in divisions one and four, which also include both CREF (iodine filtration) trains. The cooling function for any two of the four CRACS cooling units in divisions 1, 2, 3, and 4 will continue to be available.

Operation During Radiological Site Contamination

In the event of a radiological site contamination and receipt of high radiation alarm from either of the two CRACS outside air intake safety-related radiation monitors, the train 1 and train 4 CREF iodine adsorption filter units are automatically placed in the filtered alignment with all outside air going through the iodine adsorption units. A total of 4,000 cfm (1,000 cfm of outside air and 3,000 cfm of CRE recirculation air) is pulled through each CREF iodine adsorption unit. The CRE is maintained at a positive pressure of greater than or equal to 0.125 inches water gauge. This provides an unlimited stay by the CRE personnel.

Exhaust from the kitchen and restrooms is stopped and all other exhaust air is recirculated.

The operation of CRACS creates pressure of greater than or equal to 0.125 inches of water gauge inside the CRE area with respect to the surrounding area. This limits unfiltered incoming air leakage into these areas.

Operation During External Fire or Smoke Release

In the event of an external fire and receipt of a smoke detection alarm in the MCR from one of the outside air intakes, the CREF iodine adsorption units are automatically placed in the filtered alignment mode and the outside inlet air dampers manually closed from the control room. With the outside air inlets closed, the CRACS air conditioning units will continue recirculating air to rooms in the CRE.

9.4.1.3 Safety Evaluation

The CRACS is designed to maintain ambient conditions inside the CRE area for personnel comfort and to allow safe operation of the equipment during normal plant operation, outages, and under all anticipated occurrences including postulated accidental events (refer to Section 15.0.3 for a discussion of radiological consequences).

The CRACS keeps the CRE area at a positive pressure of greater than or equal to 0.125 inches water gauge with respect to the surrounding area to provide habitability in the event of radioactive contamination of the environment, and to prevent uncontrolled incoming air leakage.

During a site radiological contamination event, the fresh air intake is redirected through the CREF (iodine filtration) trains. The CRACS also can be operated in full recirculation mode without fresh air during abnormal operation or postulated accident events.

Redundancy for air cooling and iodine filtration is provided by multiple independent trains for critical functions. Sufficient redundancy is provided for proper operation of the system when one active component is out of service.

In case of fire in any room within the CRE area, the room air supply and exhaust are isolated by fire dampers and, if necessary, the plant is controlled by the remote shutdown station (RSS). The four air conditioning trains are installed in four different fire zones. Two of these zones contain the two CREF (iodine filtration) trains.

Capability for withstanding or coping with an SBO event is met by the design of the AAC power source satisfying the ten minutes criteria; that is, the AAC power source can be started from the MCR within ten minutes after the onset of an SBO event. The SBODGs are designed to operate for a minimum of eight hours with available onsite fuel supplies.

9.4.1.4 Inspection and Testing Requirements

The CRACS 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 CRACS is performed as described in Section 14.2 (test abstracts #082 and #203), Initial Plant Test Program, to verify the system is built in accordance with applicable programs and specifications.

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

During normal operation, equipment rotation is utilized to reduce and equalize wear on redundant equipment during normal operation.

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

Per IEEE 334 (Reference 9), type tests of continuous duty class 1E motors for CREF are conducted to maintain ESF system operation and availability.

Air handling units are tested by manufacturer in accordance with Air Movement and Control Association (AMCA) standards (References 4, 5, and 6). Air filters are tested in accordance with the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) standards (Reference 2). Cooling coils are hydrostatically tested in accordance with ASME AG-1 (Reference 1) and their performance is rated in accordance with the Air Conditioning and Refrigeration Institute (ARI) standards (Reference 10).

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 11), ANSI/ASME N510 (Reference 3), ASME AG-1 (Reference 1), and RG 1.52 (Reference 12).

Outside air inlet heaters are tested in accordance with ASME AG-1, Section CA (Reference 1).

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 12), ANSI/ASME N510 (Reference 3) and ASME AG-1 (Reference 1). The charcoal adsorber samples are tested for efficiency in accordance with RG 1.52 (Reference 12) and ASTM D3803 (Reference 13). Air filtration and adsorption unit heaters are tested in accordance with ANSI/ASME N510 (Reference 3).

In-service test program requirements, including the unfiltered in-leakage into the CRE testing will be performed per RG 1.197 (Reference 14) and ASTM E741-2000 (Reference 15).

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 Chapter 16, "Technical Specification" Sections 3.7.10, 3.7.11 and per Ventilation Filter Test Program (VFTP) described in Chapter 16, "Technical Specification" Section 5.5.10.

9.4.1.5 Instrumentation Requirements

Indication of the operational status of the equipment, position of dampers, and 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 monitor flow, temperature and pressure. The fire detection and sensor information are delivered to the fire detection system (refer to Section 9.5.1).

The minimum instrumentation, indication and alarms for CREF ESF filter system are provided in Table 9.4.1-1 per the requirements of ANSI/ASME N509 (Reference 16).

9.4.1.6 References

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

2. 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.

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

4. 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.

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

6. 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.

7. NFPA 80, “Standard for Fire Doors and Other Opening Protectives,” National Fire Protection Association Standards, 2007.

8. “ASHRAE Handbook Fundamentals,” American Society of Heating, Refrigeration and Air Conditioning Engineers, Inc., 2005.

9. IEEE 334-1974, "IEEE Standard for Type Tests of Continuous-Duty Class 1E Motors for Nuclear Power Generating Stations," Institute of Electrical and Electronics Engineers, 1974.

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

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

12. NRC Regulatory Guide 1.52, Rev. 3, "Design, Inspection, and Testing Criteria for Air Filtration and Adsorption Units of Post Accident Engineered Safety Feature

Atmosphere Cleanup Systems in Light-Water-Cooled Nuclear Power Plants," 2001.

13. ASTM D3803-89, "Standard Test Method for Nuclear Grade Activated Carbon," 1989.

14. NRC Regulatory Guide 1.197, "Demonstrating Control Room Envelope Integrity at Nuclear Power Reactors," 2003.

15. ASTM E741-2000, "Standard Test Methods for Determining Air Change in a Single Zone by Means of a Tracer Gas Dilution," 2000.

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

17. Deleted.

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

Table 9.4.1-1—Minimum Instrumentation, Indication, and Alarm Features for CREF (Iodine Filtration) Train Subsystem

Sensing Location	Local Indication/Alarm	MCR Indication/Alarm
Inlet Outside Air	Radiation Indication	Radiation Indication / High Radiation 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)

Next File