9.4 AIR CONDITIONING, HEATING, COOLING, AND VENTILATION SYSTEMS

9.4.1 CONTROL BUILDING HVAC SYSTEM

The control building heating, ventilation, and air conditioning (HVAC) system is divided into two distinct areas of operation: (1) the control room, and (2) the control building exclusive of the control room.

9.4.1.1 Control Room

9.4.1.1.1 Design Bases

Criteria for the selection of design bases are stated in paragraph 1.1.2.2.

9.4.1.1.1.1 Safety Design Bases. Safety design bases for the control room emergency HVAC system are discussed in section 6.4.

9.4.1.1.1.2 Power Generation Design Bases.

9.4.1.1.1.2.1 Power Generation Design Basis One. During normal operation, the control room normal HVAC system is designed to maintain the control room dry bulb temperature within the comfort zone recommended in the American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) Comfort Standard 55-74.

9.4.1.1.1.2.2 Power Generation Design Basis Two. The control room normal HVAC system is designed to permit periodic inspection, testing, and maintenance of principal components with a minimum interruption of normal operation.

9.4.1.1.1.3 Codes and Standards. Codes and standards applicable to the control room normal HVAC system are listed in table 3.2-1. The system is designed in accordance with Air Moving and Conditioning Association (AMCA) standards.

9.4.1.1.2 System Description

9.4.1.1.2.1 General Description. The control room normal HVAC system is shown schematically in figure 9.4-1. The major components of the system include one normal supply/recirculation air handling unit (AHU), two smoke removal fans, one normal toilet exhaust fan, one normal kitchen exhaust fan, and electric duct heaters.

9.4.1.1.2.2 Component Description. Design data for major components of the control room normal HVAC system are presented in table 9.4-1. The control room emergency HVAC system includes two emergency supply/recirculation AHUs and two emergency filtration trains. The control room emergency HVAC system is discussed in section 6.4.

9.4.1.1.2.2.1 Normal Supply/Recirculation Air Handling Unit. One 100 percent capacity normal recirculation AHU is provided for normal conditions with a capacity of 41,200 ft^3/min. The unit inducts a fixed flowrate of air from the outside atmosphere, the remainder being recirculation flow from the control room. The unit is composed of the following elements:

A. A moderate efficiency filter

B. A chilled water cooling coil

C. A recirculation fan

D. Associated ductwork and controls.

9.4.1.1.2.2.2 Recirculation/Normal Ducting. The recirculation/normal ducting system is connected with one of the recirculation/emergency ducting system.

The normal supply/recirculation AHU is provided with one outside air intake. The air intake is equipped with one motor-operated isolation damper.

9.4.1.1.2.2.3 Smoke Removal Fan. Two 50 percent capacity normal smoke removal fans are provided. The fans draw air from the control room, switchgear room, upper cable spreading room, and lower cable spreading room atmosphere, and discharge into the exhaust duct leading to the outside atmosphere. The control room, switchgear room, upper cable spreading room, and lower cable spreading room exhaust duct is equipped with power-operated isolation dampers at their room boundary. The smoke removal fans draw air from one level at a time.

All ductwork penetrations into the control room are provided with fire dampers.

9.4.1.1.2.2.4 Normal Toilet Exhaust Fan. One 100 percent capacity exhaust fan is provided. The fan draws air from the toilet rooms, and discharges into a separate exhaust duct leading to the outside atmosphere. The exhaust duct is equipped with two air operated isolation dampers in series.

9.4.1.1.2.2.5 Normal Kitchen Exhaust Fan. One 100 percent capacity exhaust fan is provided. The fan draws air from the kitchen and pantry, and discharges into a separate exhaust duct leading to the outside atmosphere. The exhaust duct is equipped with two air operated isolation dampers in series.

9.4.1.1.2.2.6 Electric Duct Heaters. Heating for the control room is provided by electric duct heaters, located in the supply air ducts serving the control rooms. Each heater is thermostatically controlled to maintain the space design temperature requirements.

9.4.1.1.2.3 System Operation.

9.4.1.1.2.3.1 Normal Mode. During normal operation air is supplied to the control room through the normal supply/ recirculation AHU. The majority of the total airflow into the control room is recirculation air that has been conditioned by the normal recirculation AHU, with the remainder inducted from the outside atmosphere into the return air duct. The normal toilet exhaust fan and the normal kitchen exhaust fan operate continuously during normal operation. Infiltration into the control room is inhibited by the difference between the outside air supply and the normal exhaust flowrate.

The chilled water flowrate to the cooling coils in the supply/ recirculation AHUs is controlled by a temperature controller maintaining the control room temperature within the ASHRAE comfort zone. The electric duct heaters are controlled by a thermostat located in the control room.

During normal operation the control room emergency HVAC system is not functional.

9.4.1.1.2.3.2 Smoke Removal Mode. Should the control room be filled with smoke or noxious vapors, the control room HVAC system is shifted manually to the smoke removal mode to clear the atmosphere. The two isolation dampers mounted in series in the purge exhaust line are opened, and all control room doors are opened. The airflow regime thus established changes control room air at a rate of 21,000 ft^3/min.

9.4.1.1.2.3.3 Emergency and Isolation Mode. The operation of the control room emergency HVAC system is discussed in section 6.4.

9.4.1.1.3 Safety Evaluation

Safety evaluations for the control room emergency HVAC system, including the control room emergency filtration, air conditioning systems (including emergency and isolation modes), radiation monitoring systems, emergency lighting system, and the isolation dampers, are discussed in section 6.4.

9.4.1.1.4 Tests and Inspections

Fans are tested in accordance with AMCA standards, and ductwork is tested for leakage during installation. All systems are tested and balanced to provide design air quantities within a tolerance of plus or minus 10 percent.

Inspection and maintenance of all control room normal HVAC components can be made during normal operation.

9.4.1.1.5 Instrumentation Applications

All fans of the control room normal HVAC system are operable from the control room, whereas all dampers are operable either locally or from the control room. Indications are displayed in the control room for fan status and remote operable isolation valve position. In addition, local indication of differential pressure is provided at each filter section.

The control room temperature is automatically controlled by room thermostats that regulate controls on the duct heaters, and by the temperature transmitter located in the AHU exhaust duct that controls the chilled water supply to the cooling coils of the supply/recirculation AHUs.

9.4.1.2 Other Control Building Areas

The HVAC systems for other control building areas include HVAC systems serving the following:

A. Switchgear rooms

B. Battery rooms

C. Upper and lower cable spreading rooms

D. The control building HVAC room.

9.4.1.2.1 Design Bases

Criteria for the selection of design bases are stated in section 1.1.

Protection of the switchgear/battery room AHUs from wind and typhoon effects is discussed in section 3.3, flood design in section 3.4, missiles in section 3.5, dynamic effects associated with the postulated rupture of piping in section 3.6, and environmental design in section 3.11.

9.4.1.2.1.1 Safety Design Bases.

9.4.1.2.1.1.1 Safety Design Basis One. The battery room exhaust system is designed to prevent combustible concentrations of hydrogen gas from accumulating within the battery rooms.

9.4.1.2.1.1.2 Safety Design Basis Two. The switchgear/ battery room HVAC system, and the battery room emergency exhaust system are designed to remain functional following a safe shutdown earthquake (SSE).

9.4.1.2.1.1.3 Safety Design Basis Three. The switchgear/ battery room HVAC system is designed to maintain room ambient air temperatures. During equipment operation under accident conditions the Class 1E ac switchgear room and the Class 1E dc switchgear room ambient air temperatures are not allowed to exceed the maximum operating temperature of 104F. The Class 1E battery rooms are maintained between 77F and 95F.

9.4.1.2.1.1.4 Safety Design Basis Four. The switchgear/ battery room HVAC system is designed so that a single failure of any active component, assuming loss of offsite power, cannot result in loss of Class 1E ac and dc switchgear, and Class 1E battery function.

9.4.1.2.1.2 Power Generation Design Bases.

9.4.1.2.1.2.1 Power Generation Design Basis One. The HVAC systems for the control building HVAC equipment room, upper cable spreading room, lower cable spreading room, battery rooms, and switchgear rooms are designed to permit periodic inspection, testing, and maintenance of principal components with a minimum interruption of normal operation.

9.4.1.2.1.2.2 Power Generation Design Basis Two. The HVAC systems for the HVAC room, upper cable spreading room, and lower cable spreading room are designed to maintain the ambient air temperature in the rooms between 50F to 104F under plant operating and shutdown conditions.

9.4.1.2.1.3 Codes and Standards. Codes and standards applicable to the control building HVAC systems are listed in table 3.2-1.

9.4.1.2.2 System Description

9.4.1.2.2.1 General Description. The HVAC systems for the HVAC room, upper cable spreading room, lower cable spreading room, battery rooms, and switchgear rooms are shown schematically in figure 9.4-1. Major components of the various HVAC systems include the following:

A. Two switchgear/battery room emergency AHUs

B. Two control building AHUs

C. Two chiller room exhaust fans

D. Four battery room exhaust fans (two normal and two safety-related)

E. Four electric heating coils.

Of these systems only the switchgear/battery room AHUs and two battery exhaust fans are safety-related.

9.4.1.2.2.2 Component Description. Design data for major components of the control building HVAC systems are listed in table 9.4-2.

9.4.1.2.2.2.1 Switchgear/Battery Room Emergency Air Handling Units. A switchgear/battery room AHU is provided in each of the two supply/recirculation trains of the switchgear room and battery room HVAC system. Each train supplies air to its respective battery room, the dc switchgear room, Class 1E switchgear rooms, motor control center (MCC) rooms, and HVAC rooms.

The two switchgear/battery room AHUs receive outside air through separate intake louvers. The AHUs each process approximately 90 percent of recirculation air, the remaining 10 percent being inducted from the outside atmosphere. The switchgear AHUs each are composed of a moderate efficiency filter, an electric heating coil, a chilled water cooling coil, a fan, and associated ductwork and controls. Water is supplied to the cooling coils by the essential chilled water system.

9.4.1.2.2.2.2 Control Building Air Handling Units. Redundant AHUs are provided to process the flow of normal recirculated air supplied to the upper and lower cable spreading rooms, battery rooms, dc switchgear rooms, Class 1E switchgear rooms, MCC rooms, and HVAC rooms. The AHUs are composed of a moderate efficiency filter, an electric heating coil, a chilled water cooling coil, a fan, and associated ductwork and controls. Water is supplied to the cooling coils by the central chilled water system. During smoke purge, makeup air is supplied by infiltration.

9.4.1.2.2.2.3 Switchgear/Battery Room Emergency HVAC Duct System. The switchgear/battery room emergency HVAC duct system is arranged to have separated ducting and outside air intake.

Air passes through the switchgear/battery room AHUs before entering the switchgear rooms. Recirculation of switchgear room air is accomplished through a return air duct that leads to the intake of the switchgear/battery room AHUs.

9.4.1.2.2.2.4 Control Building Normal HVAC Duct System. The control building normal HVAC duct system supplies air to the switchgear/battery rooms. The ducting to the switchgear/battery rooms is separated by an isolation damper for each supply and return duct. The two control building AHUs are provided with an outside air intake.

9.4.1.2.2.2.5 Chiller Room Exhaust Fans. Two normal 100 percent capacity exhaust fans are provided for chiller rooms. Each chiller room is provided with one exhaust fan. The fans draw air from the chiller rooms and discharge it to the outside atmosphere.

9.4.1.2.2.2.6 Battery Room Exhaust Fans. Two normal 100 percent capacity exhaust fans are provided. The normal fans draw air from the four battery rooms and discharge it to the outside atmosphere. Two safety-related emergency exhaust fans are also provided to serve the battery rooms. Each of the emergency battery room exhaust fan discharge ducts is equipped with individual dampers.

9.4.1.2.2.2.7 Computer Room Humidifier. One normal 100 percent capacity computer room humidifier is provided in the air duct to keep enough humidity in the air to operate the computer satisfactorily.

9.4.1.2.2.3 System Operation.

9.4.1.2.2.3.1 Switchgear/Battery Room HVAC System. During normal operation the switchgear/battery room AHUs are not functional. The switchgear/battery room AHUs and the battery room emergency exhaust fans are required to function following a postulated design basis accident or SSE. The switchgear/battery room AHUs supply and recirculate air to the dc switchgear rooms, ESF switchgear rooms, MCC rooms, cooler rooms, battery rooms, and chiller rooms. The air from the battery rooms is exhausted to the outside atmosphere by the battery room emergency exhaust fans. The switchgear/battery room AHUs draw in outside air to replace the air exhausted from the battery rooms.

9.4.1.2.2.3.2 Control Building HVAC System. During normal operation the control building AHU recirculates filtered conditioned air through the cooler room, upper and lower cable spreading rooms, dc switchgear room, Class 1E switchgear rooms, MCC rooms, battery rooms, and chiller rooms. The air from the battery rooms and the chiller rooms is exhausted to the outside atmosphere by the two redundant battery room normal exhaust fans and two chiller rooms normal exhaust fans.

Makeup air to the system is supplied from outside air ducted into the chiller room.

The cooling capacity in the air handling units is controlled by a temperature controller.

Purging of the cable spreading rooms and the ESF switchgear rooms of smoke or noxious vapors is accomplished by two smoke purge fans that serve these rooms. The rooms may be purged either individually or simultaneously. During purging of the rooms makeup air is supplied by infiltration. If required, the infiltration is increased by opening the room access doors.

9.4.1.2.3 Safety Evaluation

Safety evaluations are numbered to correspond with the safety design bases.

9.4.1.2.3.1 Safety Evaluation One. The switchgear/battery room HVAC system is designed to maintain the combustible gas concentration in the battery rooms below the lower flammability limit of hydrogen (4.1 volume percent). To accomplish this, air in the battery rooms is exhausted to the outside atmosphere in order to continuously sweep combustible gases out of the battery rooms. The exhaust is located at the ceiling level to avoid formation of hydrogen pockets.

9.4.1.2.3.2 Safety Evaluation Two. The switchgear/battery room AHUs and the battery room emergency exhaust fans are designed in accordance with the Seismic Category I requirements as specified in section 3.2. The components (and supporting structures) of any system, equipment, or structure that is not Seismic Category I and whose collapse could result in loss of a required function of the ventilating equipment through either impact or flooding, are analytically checked to determine that they will not collapse when subjected to seismic loading resulting from the SSE.

9.4.1.2.3.3 Safety Evaluation Three. The switchgear/battery room HVAC system is capable of maintaining, during equipment operation under accident conditions, the ambient air temperature below 104F, and in the battery rooms between 77F and 95F. The ESF switchgear and dc switchgear are designed to operate continuously at 104F maximum.

9.4.1.2.3.4 Safety Evaluation Four. Each AHU of the switchgear/battery room HVAC system is sized to provide adequate switchgear/battery room ventilation as discussed in Safety Evaluation Three above. The unit is capable of supplying this ventilation without augmentation from other sources. Each AHU is powered by the electrical train with which its cooling function is associated. Because of these arrangements and redundancy of electrical design, a failure of any single active component of the switchgear/battery HVAC system cannot result in a complete loss of Class 1E switchgear or battery function. Alternately considered, a single failure of the switchgear/battery HVAC system may be assessed as a failure of the switchgear/battery train with which it is associated. In such a circumstance power required for safe shutdown is provided by the appropriate redundant switchgear/battery train.

9.4.1.2.4 Tests and Inspections

Fans are tested in accordance with AMCA standards and ductwork is tested for leakage during installation. All systems are tested and balanced to provide design air quantities within a tolerance of plus or minus 10 percent.

9.4.1.2.5 Instrumentation Applications

Fans and power-operated isolation dampers of the control building HVAC systems are operable from the control room. Indications are displayed in the control room for fan status and isolation damper position.

Hydrogen detectors are provided in the battery rooms, and activate an alarm in the control room in the event the hydrogen concentration in the battery rooms reaches 3 percent.

9.4.2 AUXILIARY BUILDING HVAC SYSTEM

The auxiliary building heating, ventilating, and air conditioning (HVAC) system includes those subsystems that function during normal plant operating and shutdown conditions, and subsequent to a design basis accident (DBA) to maintain a suitable environment for equipment and operating personnel.

9.4.2.1 Design Bases

Criteria for the selection of design bases are stated in paragraph 1.1.2.2.

Protection of auxiliary building HVAC system from wind and typhoon effects is discussed in section 3.3. Flood design in section 3.4, missiles in section 3.5, dynamic effects associated with postulated rupture of piping in section 3.6, and environmental design in section 3.11.

9.4.2.1.1 Safety Design Bases

9.4.2.1.1.1 Safety Design Basis One. The auxiliary building HVAC system reduces the air temperature within the auxiliary building safety-related equipment areas to permit adequate air cooling for engineered safety feature (ESF) pump installations, including associated motor control centers (MCCs) and load centers.

9.4.2.1.1.2 Safety Design Basis Two. Local essential air handling units supplying ventilation cooling air for the auxiliary building ESF pump installations including associated MCCs and load centers are designed to remain functional during and after a safe shutdown earthquake (SSE).

9.4.2.1.1.3 Safety Design Basis Three. The auxiliary building HVAC system is designed so that a single failure of any active component, assuming loss of offsite power, cannot result in loss of an ESF system function.

9.4.2.1.1.4 Safety Design Basis Four. The auxiliary building HVAC system ensures that local concrete temperatures in the vicinity of high temperature piping is maintained below 150F and below 200F for containment penetration to assure structural integrity.

9.4.2.1.2 Power Generation Design Bases

9.4.2.1.2.1 Power Generation Design Basis One. The auxiliary building HVAC system is designed to maintain ambient air temperatures within all normally accessible auxiliary building areas between 50F and 104F during normal plant operating and shutdown conditions.

9.4.2.1.2.2 Power Generation Design Basis Two. Local air handling units are designed to minimize the quantity of air that must be exhausted during normal operations.

9.4.2.1.2.3 Power Generation Design Basis Three. A ventilation flow pattern is established in the auxiliary building such that air tends to move from regions of low potential airborne radioactive contamination to areas of higher airborne potential radioactive contamination.

9.4.2.1.2.4 Power Generation Design Basis Four. The smoke removal fan is designed such that smoke can be removed from each level of the auxiliary building where a fire might occur.

9.4.2.1.3 Codes and Standards

Codes and standards applicable to the auxiliary building HVAC system are listed in table 3.2-1. The system is designed and constructed in accordance with the requirements of Air Moving and Conditioning Association (AMCA) Standards. Safety-related components meet IEEE Standards 323-1974 and 344-1975.

9.4.2.2 System Description

9.4.2.2.1 General System Description

The auxiliary building HVAC system is shown schematically in figure 9.4-2. The system consists of two 100 percent capacity redundant outside air supply units, 17 normal local air cooling 10 units, two 100 percent redundant exhaust trains, 18 ESF local air handling units, one smoke removal fan, two motor generator (MG) set fans, one radioactive pipe trench exhaust fan, two 100 percent redundant main steam support structure outside air supply fans, two 50 percent capacity HVAC equipment room exhaust fans, four 50 percent capacity HVAC equipment room electric unit heaters, one nuclear sample room outside supply air fan and duct heater and four 50 percent capacity component cooling water pump room unit heaters.

9.4.2.2.2 Component Description

Design data for major components of the auxiliary building HVAC system are listed in table 9.4-3.

9.4.2.2.2.1 Supply Air Handling Units. Outside air is supplied through a single air intake louver to the two 100 percent redundant supply air handling units. Each supply air handling unit consists of a moderate efficiency filter, an electric heating coil, a chilled water cooling coil, a supply fan, and a power-operated damper. The cooling coil receives water from the central chilled water system. The outside air is delivered through the supply ducts associated with these units to the building.

10 9.4.2.2.2.2 Local Air Cooling Units. Of the 35 local air handling cooling units, 14 are installed and equipped for post-DBA cooling of safety-related pump rooms, i.e., centrifugal charging pumps, containment spray pumps, component cooling water pumps, residual heat removal (RHR) pumps, and auxiliary feedwater pumps. Four coolers are installed and equipped for post-accident cooling of the ESF switchgear rooms, and the electrical penetration rooms. Each of the above ESF units consist of a cooling coil and recirculation fan. Cooling water is supplied from the essential chilled water system. The chilled water systems are discussed in subsection 9.2.9.

10 The remaining 17 air handling units operate during normal plant operation to cool selected portions of the auxiliary building, including the component cooling water pump rooms, penetration rooms, charging pump rooms, and letdown heat exchanger rooms. Each unit consists of a chilled water cooling coil and a recirculation fan. The chilled water to these units is supplied from the central chilled water system.

9.4.2.2.2.3 Filtration Exhaust Train. Two 100 percent redundant filtration trains are provided to exhaust air from the auxiliary building during normal operation. Each train includes a power-operated inlet damper, a moderate efficiency filter, an electric heating coil, a high efficiency particulate air (HEPA) filter, a carbon adsorber, a downstream HEPA filter, a fan, and associated ductwork and controls. The carbon adsorber is equipped with a water spray system for fire protection.

9.4.2.2.2.4 Smoke Removal Fan. One 100 percent capacity smoke removal fan is provided. The fan draws air from each level of the auxiliary building through the common auxiliary building exhaust duct and discharges to the outside atmosphere. The operator can isolate each level of the auxiliary building by closing the motorized damper on that floor. The exhaust rate is based upon 1.5 standard $ft^3/min/ft^2$ per ASHRAE standards.

9.4.2.2.2.5 Motor Generator Set Room Fans. One supply and one exhaust fan operate during normal plant operation to provide ventilation for both auxiliary building MG set rooms. The MG set rooms air handling unit has the filter and cooling coil installed in the duct separately from the fan. 10

9.4.2.2.2.6 Radioactive Pipe Trench Exhaust Fan. One 100 percent capacity radioactive pipe trench exhaust fan is provided for ventilation. This air is filtered through the auxiliary building normal filtration units before exhausting to the atmosphere.

9.4.2.2.2.7 Main Steam Support Structure Supply Fans. Two 100 percent capacity circulation fans are provided to maintain concrete temperatures around the main steam and main feedwater torsional and bending restraints below 150F.

9.4.2.2.2.8 HVAC Equipment Room Exhaust Fans and Electric Unit Heaters. Two 50 percent capacity exhaust fans and four 25 percent capacity electric unit heaters are provided to maintain the room temperature between 50F and 104F during normal plant operation.

9.4.2.2.2.9 Nuclear Sample Room Supply Fan. One 100 percent capacity outside supply fan and one electric duct heater are provided to maintain room temperature between 50F and 104F during normal plant operation.

9.4.2.2.2.10 MSIV/MFIV Supply Air Handling Unit, and Electric Unit Heaters. One 100 percent air handling unit and two 50% capacity electric unit heaters are provided to maintain the room temperature between 50°F and 104°F during normal plant operation. The air handling unit consists a filter, a direct expansion cooling coil and two 100% fans. 486

9.4.2.2.2.11 AUX. F.W Pump Room Supply Fan and Exhaust Fan. One supply and one exhaust fan operate during normal plant operation to provide ventilation.

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9.4.2.2.2.12 AUX. F.W Pump Area Exhaust Fan and Electric Unit Heaters. One exhaust fan and two 50% capacity electric unit heaters are provided to maintain the room temperature between 50°F and 104°F during normal plant operation.

9.4.2.2.3 System Operation

During normal operation outside air is supplied to the auxiliary building by one of the two redundant supply air

In the event of a fire in any area of the auxiliary building, the auxiliary building smoke removal fan will operate to purge the auxiliary building of smoke.

In the event of an accident, the charging pump rooms, containment spray pump rooms, and RHR pump rooms, are maintained at negative pressure by exhaust through the fuel building emergency exhaust filtration system as shown in figure 9.4-2.

9.4.2.3 Safety Evaluation

Safety evaluations are numbered to correspond to the safety design bases.

9.4.2.3.1 Safety Evaluation One

The local ESF air cooling units of the auxiliary building HVAC system are capable of maintaining the ambient air temperatures within the auxiliary building ESF areas below 104F. The motors, MCCs, load control centers, and associated electrical equipment for the ESF pump installations, i.e., component cooling water pumps and auxiliary feedwater pumps, are designed to operate continuously at 104F ambient temperature. The centrifugal charging pumps, residual heat removal pumps, and containment spray pumps are designed to operate continuously at a 120F ambient temperature.

9.4.2.3.2 Safety Evaluation Two

The local ESF air cooling units that provide cooling and ventilation for safety-related pump rooms, including associated MCCs and load centers, are designed to operate subsequent to an SSE. Consequently, the local ESF air cooling units must also remain functional during and after an SSE, and are designed in accordance with Seismic Category I requirements as specified in section 3.2. The components (and supporting structures) of any system, equipment, or structure that are not Seismic Category I and whose failure could result in loss of a required function of the auxiliary building local ESF air cooling units through either impact or flooding, are supported to ensure that they will not fail when subjected to seismic loading resulting from the SSE.

9.4.2.3.3 Safety Evaluation Three

Each local ESF air handling unit installed is sized to provide adequate ESF pump installation cooling as discussed in Safety Evaluation One above. The unit is capable of supplying this cooling without augmentation from other sources. The unit is powered by the same bus as the ESF pump with which it is associated. Because of these arrangements and the redundancy included in ESF system design, a failure of any single active component of the auxiliary building HVAC system cannot result in a complete loss of any ESF system function. Alternatively considered, a single failure may be assessed as a failure of the ESF system with which it is associated; in such a circumstance safe shutdown is attained and maintained by the appropriate redundant ESF system. The auxiliary building HVAC single active failure analysis is shown in table 9.4-4.

9.4.2.3.4 Safety Evaluation Four

The local ESF air handling unit installed in each piping penetration room is capable of supplying enough cooling air to limit the local temperature around all containment penetrations to 200F. The local concrete temperature in the vicinity of the containment penetrations in the main steam support structure is maintained below 200F by natural convection.

9.4.2.4 Tests and Inspections

One fan in each group of local air cooling units is tested in accordance with AMCA standards to assure characteristic performance curves. All other fans in the auxiliary building HVAC system are AMCA rated. Ductwork is tested for leakage during installation. All systems are tested and balanced to provide design air quantities within a tolerance of plus or minus 10 percent. Water coils are pneumatically tested under water or hydrostatically tested to assure leaktightness.

The HEPA filters are manufactured and tested prior to installation in accordance with ASME AG-1-1997, as modified by USNRC Health and Safety Information Issue 306. After installation, HEPA filters are tested in accordance with ASME N510-1989, Testing of Nuclear Air Cleaning Systems. Carbon adsorbers are tested after installation in accordance with ASME N510-1989. In addition, a periodic laboratory test of a representative sample of the impregnated activated carbon is performed within a maximum period of 18 months to verify the iodine removal efficiencies. 437

9.4.2.5 Instrumentation Applications

Indication is provided in the control room for status of dampers and fans. Temperatures of pump rooms are indicated locally and annunciated (high) in the control room. Failure of a running supply or exhaust fan is annunciated in the control room. Local differential pressure indication is provided across all filters.

Fan motors and motor-operated dampers are interlocked as required to activate systems. Water flow through cooling coils (exclusive of local air cooling unit cooling coils) is controlled by room thermostats.

Continuous radiation monitoring is provided in the discharge duct of the exhaust train. Radiation monitoring systems are discussed in section 11.5.

9.4.3 RADWASTE BUILDING HVAC SYSTEM

The system described hereunder covers HVAC systems for radwaste building and hot machine shop. 1

9.4.3.1 Design Bases

Criteria for the selection of design bases are stated in paragraph 1.1.2.2.

9.4.3.1.1 Safety Design Bases

The radwaste building and hot machine shop heating, ventilation, and air conditioning (HVAC) systems have no safety design basis. Failure of the systems do not affect safe shutdown of the plant. 1

9.4.3.1.2 Power Generation Design Bases

9.4.3.1.2.1 Power Generation Design Basis One. The radwaste building HVAC system is designed to maintain the temperature in the radwaste building control room, sample laboratory, and personnel service facility area between 68F and 78F, pipe chase and filter and demineralizer vaults and tank rooms between 50F and 120F, and gaseous radwaste system and all other areas between 50F and 104F.

9.4.3.1.2.2 Power Generation Design Basis Two. The radwaste building supply system is designed to provide cooled or tempered outside air.

9.4.3.1.2.3 Power Generation Design Basis Three. The radwaste building HVAC system is designed with an exhaust flowrate greater than the inlet air flowrate, in order to inhibit the uncontrolled exfiltration of building air to the outside atmosphere.

9.4.3.1.2.4 Power Generation Design Basis Four. A ventilation flow pattern is established in the radwaste building such that air moves from areas of low potential airborne radioactive contamination to areas of higher potential airborne radioactive contamination.

9.4.3.1.2.5 Power Generation Design Basis Five. The hot machine shop HVAC system is designed to maintain the building temperature at a minimum of 50F during winter and at a maximum of 104F during summer.

9.4.3.1.2.6 Power Generation Design Basis Six. The hot machine shop HVAC system is designed to maintain the building at a slightly negative pressure by exhausting approximately
1 10 percent more air than is being supplied to the building.

9.4.3.1.2.7 Power Generation Design Basis Seven. The ventilation flow pattern in the hot machine shop area is from areas of low potential contamination to areas of higher potential contamination.

9.4.3.1.2.8 Power Generation Design Basis Eight. The air exhausted from the potentially contaminated areas is not recirculated back into the hot machine shop.

9.4.3.1.3 Codes and Standards

Codes and standards applicable to the radwaste building and hot machine shop HVAC system are listed in table 3.2-1.

9.4.3.2 System Description

9.4.3.2.1 General Description

The radwaste building HVAC system is shown schematically in figure 9.4-3. Major components of the system consist of two 100 percent capacity redundant outside air supply air handling units, two 100 percent capacity redundant exhaust filtration trains, one 100 percent capacity control room supply air handling unit, six air handling units, one recycle holdup tank air handling unit, one smoke removal fan, and one utility exhaust fan.

The hot machine shop HVAC system is shown schematically in figure 9.4.3a. Major components of the system consist of two outside air supply air handling units, two exhaust air fans and four unit heaters. 1

9.4.3.2.2 Component Description

Design data for major components of the radwaste building HVAC system are listed in table 9.4-5.

9.4.3.2.2.1 Radwaste Building Supply Air Handling Unit. The radwaste building supply air handling unit provides fresh outside air, heated or cooled as required, to all levels of the building and radioactive pipe trench. Each supply air handling unit consists of a moderate efficiency filter, an electric heating coil, a chilled water cooling coil, a supply fan, and a motor-operated damper. The cooling coils receive water from the central chilled water system. The tempered outside air through the supply ducts associated with these units is delivered both directly and through the recirculating units to the building.

9.4.3.2.2.2 Radwaste Building Exhaust Filtration Train. The radwaste building exhaust filtration train exhausts air from the building. Each train includes a pneumatic outlet damper, a moderate efficiency filter, a high efficiency particulate air (HEPA) filter, an exhaust fan, associated ductwork and controls. 2

9.4.3.2.2.3 Radwaste Building Exhaust . The radwaste building exhaust filtration train processes the exhaust air prior to discharging through the building vent. The exhaust air is monitored for radioactivity in accordance with the requirements of Regulatory Guide 1.21.

9.4.3.2.2.4 Local Air Handling Unit. Each area containing equipment that is heat sensitive is provided with a local air handling unit. Six local air handling units operate during normal plant operation to cool the BRS evaporator room and other areas, LRS evaporator room and other areas, electrical equipment room, LRS pump room and other areas, and BRS recycle evaporator pump room and other areas. Each unit consists of a central chilled water cooling coil, a recirculation fan, associated instrumentation and controls.

9.4.3.2.2.5 Recycle Holdup Tank Air Handling Unit. The recycle holdup tank air handling unit recirculates air inside the BRS holdup tanks and through vent lines, and discharges to the room. The unit consists of a moderate efficiency filter, a centrifugal fan, two manually-operated dampers, and associated ductwork and controls.

9.4.3.2.2.6 Radwaste Building Control Room. The radwaste building control room, sample laboratory, and personnel service facility are served by a building control room supply air handling unit. The unit consists of a moderate efficiency filter, an electric heating coil, a central chilled water cooling coil, and a centrifugal fan. Electric duct heaters provide zone heating for the control room, sample laboratory, and personnel service facility.

9.4.3.2.2.7 Smoke Removal Fan. The smoke removal fan draws air from the fire floor of the radwaste building through the common exhaust duct and discharges to the outside atmosphere.

9.4.3.2.2.8 Radwaste Building Utility Exhaust Fan. The radwaste building utility exhaust fan draws air from the clean toilet room and exhausts to the atmosphere.

9.4.3.2.2.9 Hot Machine Shop Supply Air Handling Units. The hot machine shop supply air handling units provide fresh outside air, filtered and heated as required, to all areas of the building. The supply air registers are located in contamination free areas.

9.4.3.2.2.10 Hot Machine Shop Exhaust Air Fans. The hot
1 machine shop exhaust air fans collect exhaust from welding and other potentially contaminated areas and discharge to the outside atmosphere.

9.4.3.2.2.11 Hot Machine Shop Unit Heaters. The hot machine shop unit heaters are installed to provide additional heating for the building as required. Unit heaters recirculate the tempered air inside the building.

9.4.3.2.3 System Operation

9.4.3.2.3.1 Radwaste Building 1

Outside air to each supply air handling unit is provided by an outside air louver and motor operated inlet shut-off damper. The damper operates in conjunction with its respective fan, opening when the fan starts and shutting when the fan stops.

The radwaste building supply air handling unit is started manually from the building control room. One of the two supply units runs continuously during normal plant operations. The standby unit is designed to start automatically on failure of the operating fan. The supply unit fan and the exhaust filtration train fans are interlocked to prevent the supply fan from being started before the exhaust fan.

The supply air unit draws in outside air filtering it through moderate efficiency filters, heating it with an electric heating coil and cooling it with a chilled water coil, then distributing the conditioned air to all floors of the radwaste building and radioactive trench. In addition to the outside air cooling, supplemental cooling is provided by local air handling units that utilize chilled water coils for cooling.

When the outside air temperature rises above 65F, the temperature switch associated with the cooling system activates the supply unit cooling control system. This control system then functions to maintain a constant supply air temperature of 65F by modulating the flow of chilled water to the coil.

While the outside air temperature is below 65F the supply unit continues to operate, supplying unconditioned air to the building. 1

The operation of the local air handling units is controlled by a temperature switch located in the respective room and/or area served. This switch activates the unit fan when the room or area temperature approaches the design limits.

Each local air handling unit temperature switch is set to initiate operation of the unit when the room temperature exceeds 90F, and stops the unit when the room temperature falls below 80F.

The radwaste building control room supply air handling unit operates during the normal mode to maintain the control room, sample laboratory, and personnel service facility temperature between 68F and 78F. A temperature controller located downstream of the cooling coil regulates chilled water flow to hold the coil leaving air temperature at 56F.

Heating is provided by electric duct heaters located in the supply ducts serving the control room, sample laboratory, and personnel service facility. The heaters are thermostatically controlled to maintain the space at or above 68F. These heaters serve no safety function.

Air from the clean toilet is removed by the radwaste building utility exhaust fan. This fan runs continuously during normal plant operation.

One of the two radwaste building exhaust filtration trains runs continuously during normal plant operations. The standby train is designed to start automatically on failure of the operating train. The pneumatic outlet shutoff dampers (one associated with each train) operate in conjunction with their corresponding trains.

All exhaust air from the radwaste building is processed through the building exhaust filter train for cleanup prior to monitoring and discharge through the building vent.

Each filter bank in the filtration train is provided with a pressure differential indicator. A pressure differential switch is provided across the exhaust-filter assembly. High differential pressure across the filter is alarmed in the radwaste building control room with a common trouble alarm in each main control room.

2 The exhaust air flow exceeds the supply air flow to assure that the building always remains under a negative pressure.

The radwaste building HVAC system main exhaust duct headers at each level are provided with isolation dampers to isolate other floors except the fire floor, in the event of a fire.

A smoke removal fan is provided to remove products of combustion from fire floor of the radwaste building during a fire. The smoke removal mode is initiated manually. Upon initiation, both filtration trains are automatically shut down. Makeup air is supplied by infiltration.

Fire dampers will be used where there are fire-rated barriers, and will equal the rating of the barrier.

9.4.3.2.3.2 Hot Machine Shop

The hot machine shop supply air handling units, exhaust air fans and the area unit heaters can be manually started from the hot machine shop.

The supply air handling units and exhaust air fans may also be activated automatically should the space temperature rise above 104F. The heating coils of the air handling units and the area unit heaters would automatically cycle to maintain space temperature at or above 50F.

The hot machine shop air handling units and the exhaust air fans are interlocked to start at the same time to assure that the building is maintained under negative pressure whenever the HVAC system is operating.

9.4.3.3 Safety Evaluation

Inasmuch as the radwaste building and hot machine shop HVAC systems have no safety design basis, no safety evaluation is provided.

9.4.3.4 Tests and Inspections

Fans are rated in accordance with standards of the Air Moving and Conditioning Association (AMCA). Cooling coils are hydrostatically tested to assure integrity. Ductwork is tested for leakage during installation. The system is tested and balanced to provide design air quantities within a tolerance of plus or minus 10 percent and water quantities within a tolerance of plus or minus 5 percent.

Inspection and maintenance of the supply fans and all exhaust train components can be carried out during normal operation.

Each assembled HEPA filter is tested with thermally generated challenge gas(e.g., DOP, PAO) of uniform 0.3 micron droplet size, in accordance with ASME N510-1989 and ERDA 76-21, to demonstrate removal efficiency of no less than 99.97 percent at rated flow and at ±10 percent of rated flow through frame and media. HEPA filters will be replaced when the pressure differential across them exceeds 2.0 inches WG. 437

Major components are accessible during normal plant operation for inspection, maintenance, and periodic testing.

9.4.3.5 Instrumentation Applications

All fans and dampers of the radwaste building HVAC system are operable in the building control room. Indications are displayed in the building control room for fan status, shutoff damper position, system flowrates, and differential pressure across HEPA filters.

1| The radwaste building exhaust air is monitored for radioactivity as discussed in section 11.5. High radioactivity levels are annunciated in the main control room and isolate gaseous radwaste discharge header.

1| Interlocks are provided on the radwaste building and hot machine shop HVAC system fans to prevent operation of the supply fans without concurrent operation of the exhaust fans.

1| Failure of any radwaste building running fan or high differential pressure across the filters are alarmed in the radwaste building control room for each unit by the building HVAC common malfunction alarm.

9.4.4 TURBINE BUILDING AND SWITCHGEAR BUILDING HVAC SYSTEMS

This subsection describes the design of the turbine building and switchgear building ventilation systems, which ventilate the turbine building and the switchgear building.

9.4.4.1 Design Bases

Criteria for the selection of design bases are stated in paragraph 1.1.2.2.

9.4.4.1.1 Safety Design Bases

The turbine building and switchgear building ventilation systems have no safety design basis. Failure of the system does not affect the safe shutdown of the plant.

9.4.4.1.2 Power Generation Design Bases

9.4.4.1.2.1 Power Generation Design Basis One. The turbine building ventilation system is designed to maintain the inside ambient temperatures between 50°F and 104°F in normally occupied areas of the building. The switchgear building ventilation system is designed to maintain the inside ambient temperature between 77°F and 104°F. | 462

9.4.4.1.2.2 Power Generation Design Basis Two. The switchgear building battery room ambient temperature is maintained between 77°F and 104°F. | 462

9.4.4.1.3 Codes and Standards

Codes and standards applicable to the turbine building and switchgear building ventilating system are listed in table 3.2-1. The systems are designed and constructed in accordance with the requirements of Air Moving and Conditioning Association (AMCA) and Sheet Metal and Air Conditioning Contractors National Association Inc. (SMACNA) standards.

9.4.4.2 System Description

9.4.4.2.1 General Description

The turbine building ventilation system is shown schematically in figure 9.4-4. The system consists of a supply system and an exhaust system.

9.4.4.2.2 Component Description

Design data for major components of the turbine building and switchgear building ventilation systems are listed in table 9.4-6.

9.4.4.2.2.1 Turbine Building Ventilation System. The turbine building ventilation system consists of nine supply fans located in the basement and eight supply fans located in mezzanine level. The supply fans draw outside air through louvers to the basement and mezzanine of the turbine building.

Twenty-two exhaust fans located on the roof above the operating floor exhaust the air from the basement, mezzanine floor, and operating floor. The outside air to the mezzanine floor and operating floor is drawn through outside air louvers located above the mezzanine and operating floors. Ten unit heaters are located in the basement, ten more in the mezzanine floor area, and ten others in the operating floor area.

Outside air is drawn into the lube oil reservoir room through louvers, and is ducted by the lube oil reservoir room exhaust fan to the outside.

9.4.4.2.2.2 Switchgear Building Ventilation System. The ventilation system for the switchgear building consists of two supply air handling units and two exhaust fans. Each supply air handling unit consists of a moderate efficiency filter, an electric heating coil, and a supply fan. Outside air is supplied through ducts to the building and the building air is exhausted to the atmosphere by the two exhaust fans.

The battery room is serviced by a branch duct from the switchgear building supply unit, and room air is exhausted to the atmosphere by a separate battery room exhaust fan.

9.4.4.2.3 System Operation

9.4.4.2.3.1 General. The turbine building and switchgear building ventilation systems operate continuously during normal power generation operation and during plant shutdown periods. The systems are not designed to operate subsequent to a design basis accident or SSE.

Failure of a battery room exhaust fan initiates an alarm in the control room, concurrent with starting the second battery room exhaust fan.

9.4.4.2.3.2 Ventilation. Depending on turbine building and switchgear building, heat loads, the ventilation systems operate as required to keep the turbine building and switchgear building air temperature between 50F and 104F.

9.4.4.2.3.3 Air Circulation and Exhaust. Nine supply air fans are located at the basement level and eight supply air fans are located at the mezzanine level of the turbine building. These supply air fans deliver outside air to the basement and mezzanine levels. Outside air for the operating level is drawn through louvers. The air is drawn by the exhaust fans from the turbine building and discharged to the atmosphere.

Outside air is drawn through louvers and ducts into the lube oil reservoir room. The air from the lube oil reservoir room is exhausted by the room exhaust fan. Ventilation air of the room does not mix with the turbine building atmosphere.

Two supply air handling units located on the roof of the switchgear building supply outside air through ducts to ventilate the entire switchgear building and the battery room. The air from the switchgear building is exhausted by the two exhaust fans. The air from the battery room is exhausted by two separate battery room exhaust fans. Air used to ventilate the battery room does not mix with the switchgear building atmosphere. During winter an electric duct heater located in the supply air duct will maintain the battery room above a minimum temperature of 77°F. 462

9.4.4.2.3.4 Smoke Removal. In the event of fire, the switchgear building exhaust fans operate to vent smoke and heat directly to the atmosphere.

9.4.4.3 Safety Evaluation

Inasmuch as the turbine building and switchgear buildings ventilation systems have no safety design bases, no safety evaluation is provided.

9.4.4.4 Test and Inspections

Fans are tested and rated in accordance with AMCA standards, and ductwork is tested for leakage during installation. Systems are tested and balanced to provide design air quantities within a tolerance of plus or minus 10 percent.

9.4.4.5 Instrumentation Applications

Supply and exhaust fans can be operated from the control room. Battery room exhaust fans can be operated remotely from the control room. Indication is provided in the control room for operating status of battery room exhaust fans. Differential pressure indication is provided locally for filters of the switchgear building supply air handling unit. Failure of one of the battery room exhaust fans is alarmed in the control room and the other fan is started.

The duct heater located in the supply air duct to the battery room is controlled by the room thermostat to maintain the battery room above the minimum temperature of 77°F. A differential pressure switch will switch off the electric heater in case there is no airflow across the heater. 462

The battery room is provided with a combustible gas monitor. Presence of hydrogen gas in the battery room is alarmed in the control room before the hydrogen gas reaches a level of 3 percent by volume in the room air at any time.

The battery room, switchgear room, and electrical equipment room in the switchgear building are provided with temperature indicator switches to indicate the room temperatures. A high temperature of 110°F in these rooms is annunciated in the control room. 462

9.4.5 ACCESS CONTROL BUILDING HVAC SYSTEM

The access control building, heating, ventilation, and air-conditioning system functions to provide a suitable environment for personnel and equipment located within the access control building.

9.4.5.1 <u>Design Bases</u>

Criteria for selection of design bases are stated in paragraph 1.1.2.2.

9.4.5.1.1 Safety Design Basis

The access control building heating, ventilation, and air-conditioning (HVAC) system has no safety design basis.

9.4.5.1.2 Power Generation Design Basis

9.4.5.1.2.1 <u>Power Generation Design Basis One</u>. The access control building HVAC system is designed to maintain occupied areas of the building between 68°F and 78°F and maintain equipment rooms below or at 104°F. 462

9.4.5.1.3 Codes and Standards

Codes and standards applicable to the access control building HVAC system are listed in table 3.2-1.

9.4.5.2 System Description

9.4.5.2.1 General Description

The access control building HVAC system is shown schematically in figure 9.4-5. Major components of the system include two supply air handling units, eleven supply air electric duct heaters and three exhaust fans.

9.4.5.2.2 Component Description

Design data for major components of the access control building HVAC system are listed in table 9.4-7.

9.4.5.2.2.1 Access Control Building Supply Air Handling Unit. The supply air handling unit is designed to supply air to all parts of the building, and to return the air for recirculation solely from the rooms as shown in figure 9.4-5. The unit consists of a mixing box with opposed blade dampers for mixing the return air and outside air, a filter section for V stacking of moderate efficiency filters, an electric heating coil, a chilled water cooling coil section, and a centrifugal fan section. Cooling water is supplied from the central chilled water system.

9.4.5.2.2.2 Electrical and Instrument Repair Room Air Handling Unit. The air handling unit is designed to serve the electrical repair room, instrument repair, cable tray corridor, storage room, and corridor. The unit consists of a moderate efficiency filter, electric heating coil, direct expansion (DX) cooling coil, supply air centrifugal fan, air cooled condenser, and condenser cooling air fan section. 1

9.4.5.2.2.3 Access Control Building Exhaust Fans. The three exhaust fans for the building are divided into three systems. One fan is for general building exhaust system requirements, a second fan is for the laundry room dryers and a third fan is for exhausting air from the three fume hoods. 1

9.4.5.2.2.4 Access Control Building Electrical Duct Heaters. The supply air system is divided into eleven zones. Each zone has an electric duct heater for heating and maintaining the air temperature within the designed environmental conditions.

9.4.5.2.3 System Operation

9.4.5.2.3.1 Access Control Building. A constant air volume system is used to supply conditioned air to all parts of the building. Outside air and return air are mixed and conditioned for supplying the building during normal operations by the supply air handling unit. Thermostats located in the various zones energize electrical duct heaters when heating is required. A supply air duct thermostat regulates the cooling capacity to satisfy cooling requirements of the building.

A 100 percent capacity exhaust fan is provided to exhaust air from the locker rooms, shower rooms, decontamination areas,
1 toilet rooms, corridors, storage rooms, mechanical rooms, janitor closets, chemical laboratory, and laundry areas. The fan is manually started from the control room.

The fume hood exhaust fan collects and removes air contaminants associated with the fume hood located in the radio chemistry and turbine chemical laboratories, and exhausts it to the atmosphere. The fume hood exhaust fan is manually actuated
1 and runs continuously.

The laundry room exhaust fan, which is manually actuated and runs continuously, provides 100 percent capacity to exhaust air from the laundry room dryers.

A 100 percent capacity electrical and instrument repair room air handling unit serves the electrical repair room, instrument
1 repair, cable tray corridor, storage room, and corridor. The unit provides cooling or heating as required to maintain the air temperature within the designed environmental condition.
1 The unit is locally controlled in the room by a handswitch and temperature controller. The unit is powered from a non-Class 1E AC power system. 462

9.4.5.3 Safety Evaluation

Inasmuch as the access control building HVAC system has no safety design basis, no safety evaluation is provided. System design and operation is described in paragraph 9.4.5.2

9.4.5.4 Tests and Inspections

Fans are rated in accordance with standards of the Air Moving and Conditioning Association (AMCA). Ductwork is tested and balanced to provide design air quantities within a tolerance of plus or minus 10 percent.

9.4.5.5 Instrumentation Applications

All fans except the air handling unit for the electrical and instrument repair room, which has a local handswitch, have handswitches for the start of operation in the control room. Equipment status indications are displayed in the control room for the equipment shown in figure 9.4-5. 1

Temperatures are automatically controlled by zone thermostats, which regulate duct mounted electric duct heaters. In addition, a thermostat for the building supply unit modulates the chilled water three-way valve to maintain constant supply air temperature. Temperature in the electrical and instrument repair rooms is controlled by the heating controller or cooling controller. 1 1

9.4.6 FUEL BUILDING HVAC SYSTEM

The fuel building normal ventilation system provides a suitable environment for personnel and equipment located within the fuel building. Following a fuel handling accident, the fuel building emergency exhaust system will filter the radioactive airborne fission products through charcoal adsorbers. The fuel building emergency exhaust also serves to filter exhaust from the engineered safety features (ESF) pump rooms following a loss-of-coolant accident (LOCA).

9.4.6.1 Design Bases

Criteria for the selection of design bases are found in paragraph 1.1.2.2.

Protection of the fuel building safety-related systems from wind and typhoon effects is discussed in section 3.3, flood design in section 3.4, missiles in section 3.5, dynamic effects associated with the postulated rupture of piping in section 3.6, and environmental design in section 3.11.

9.4.6.1.1 Safety Design Bases

9.4.6.1.1.1 Safety Design Basis One. The fuel building emergency exhaust system is designed to inhibit unfiltered leakage of air following a fuel handling accident that releases radioactivity. This system is also designed to exhaust air from ESF pump rooms located in the auxiliary building following a LOCA. Redundant intake and exhaust dampers are powered by separate Class 1E sources to assure closure.

9.4.6.1.1.2 Safety Design Basis Two. The fuel pool pump room cooling units maintain the ambient air temperature in the fuel pool pump and heat exchanger room below 120°F. 462

9.4.6.1.1.3 Safety Design Basis Three. The fuel building safety-related HVAC systems are designed to remain functional in the event of a single active failure of any component, assuming the loss of off-site power. 462

9.4.6.1.1.4 Safety Design Basis Four. The fuel building safety-related HVAC systems and the intake air isolation system are designed to function following a safe shutdown earthquake (SSE).

9.4.6.1.2 Power Generation Design Bases

9.4.6.1.2.1 Power Generation Design Basis One. The fuel building normal ventilation system is designed to maintain the space temperature between 50°F and 104°F. 462

9.4.6.1.2.2 Power Generation Design Basis Two. The fuel building normal ventilation system normally maintains the building under a slightly negative pressure by exhausting approximately 10 percent more air than is being supplied to the space, the difference being made up by infiltration into the building.

9.4.6.1.2.3 Power Generation Design Basis Three. The fuel building HVAC system is designed to maintain during normal plant operation the airborne activity levels within the maximum permissible concentration (MPC) defined in 10 CFR 20.

9.4.6.1.3 Codes and Standards

Codes and standards applicable to the fuel building ventilation system are listed in table 3.2-1. The system is designed in conformance with the requirements of Air Moving and Conditioning Association, Inc. (AMCA) standards and Regulatory Guide 1.52. Conformance with Regulatory Guide 1.52 is discussed in appendix 3A.

9.4.6.2 System Description

9.4.6.2.1 General System Description

The fuel building ventilation system is shown schematically in figure 9.4-6. The system consists of two redundant normal supply units, two redundant normal exhaust fans, two redundant emergency exhaust trains, and two fuel pool pump room cooling units.

9.4.6.2.2 Component Description

Design data for components of the fuel building ventilation systems are listed in table 9.4-8.

9.4.6.2.2.1 Normal Ventilation System. The fuel building normal ventilation supply units include the following elements: an outside air intake louver, power-operated isolation dampers, two 100 percent redundant normal ventilation supply units, ductwork, associated instrumentation and controls, and two 100 percent exhaust fans. Each normal ventilation supply unit is composed of a power-operated inlet damper downstream of the unit, moderate efficiency prefilter, a chilled water cooling coil, electric heating coil, and a supply fan. The heating coil is controlled by a temperature sensor in the outside air duct. The cooling coil is thermostatically controlled by a sensor located in the common air supply duct downstream of the supply fans. Cooling water is supplied from the central chilled water system. The supply fans and filters are located on the intermediate level of the fuel building. Air from the supply fans is distributed by a supply duct. The air is continuously exhausted to the atmosphere by one of the normal exhaust fans. 1

The supply fans are interlocked with the exhaust fans such that an exhaust fan must be running to allow either supply fan to start or remain running.

9.4.6.2.2.2 Emergency Exhaust Trains. The fuel building emergency exhaust system includes two 100 percent redundant exhaust trains. Each train consists of a power-operated inlet isolation damper, a moderate efficiency filter, an electric heating coil, a charcoal adsorber, two high efficiency particulate air (HEPA) filters (one upstream and one downstream of the charcoal adsorber), an exhaust fan, a back-draft damper, associated ductwork, and control instrumentation.

9.4.6.2.2.3 Fuel Pool Pump Room Cooling Units. Two fuel pool pump room cooling units, one in each pump room, are provided. Each cooling unit consists of a cooling coil and fan. Chilled water to the cooling coils is supplied from the essential chilled water system.

9.4.6.2.2.4 Fuel Building Doors. The fuel building doors are
1 provided with self-closers to prevent the doors, if inadvertently left open, from disrupting fuel building ventilation.

9.4.6.2.3 System Operation

During normal operation, the fuel building is ventilated by distributing tempered outside air throughout the building. The outside air is cooled by the chilled water cooling coil, which uses central chilled water. The air is exhausted continuously to the atmosphere. The fuel building is maintained under a negative pressure to ensure that all leakage is into the building.

In the event of a fuel handling accident, the fuel building is isolated automatically by the closure of the isolation dampers
in the normal ductwork upon sensing a high level radiation 462
signal. There are four Seismic Category I dampers, two in the normal supply and two in the normal exhaust ducts. The high radiation signal also starts the emergency exhaust trains. The air from the fuel building is, after filtration, exhausted to the atmosphere. The emergency exhaust trains draw air from the building, thus keeping the building under negative pressure. In the event of LOCA the fuel building emergency exhaust system filters and exhausts air drawn from auxiliary building ESF pump rooms to atmosphere.

Each fuel pool pump room cooling unit operates to cool the pump and the heat exchanger compartments. Each cooling unit is automatically started by the fuel building emergency ventilation actuation signal or SIS signal and operates in a complete recirculation mode.

An evaluation of the effects of a fuel handling accident in the fuel building is described in paragraph 15.7.4.1. The charcoal adsorber portion of each filter train is provided with a fire
1 detection system and a water spray system to allow cooling with water spray of the charcoal bed in the event of bed ignition. Refer to subsection 9.5.1 for additional information.

9.4.6.3 Safety Evaluations

Safety evaluations are numbered to correspond with safety design bases.

9.4.6.3.1 Safety Evaluation One

The fuel building emergency exhaust system restricts the discharge of radioactivity to the outside environment following a fuel handling accident and following a LOCA so that the exclusion boundary dose does not exceed the guidelines of 10 CFR 100. A safety injection actuation signal, or fuel building high radiation signal, automatically stops the fuel building normal ventilation system, closes the redundant isolation dampers on the intake and normal exhaust, and starts the fuel building emergency filtration system and the fuel pool pump room cooling units. The emergency exhaust system draws air from the fuel building or the auxiliary building ESF pump room and filters it through HEPA and charcoal filters. 1
Since the building will be under negative pressure, there will be no unfiltered air leaking from the building.

9.4.6.3.2 Safety Evaluation Two

Each fuel pool pump room cooling unit is designed to maintain the ambient air temperature in the fuel pool pump room below 120°F. One 100 percent capacity unit is provided for each fuel 462 1
pool pump room. Each 100 percent unit is powered from the same Class 1E bus that powers the associated fuel pool pump.

9.4.6.3.3 Safety Evaluation Three

Two separate 100 percent capacity independent emergency exhaust systems provide complete mechanical backup. Each 100 percent system is powered from an independent Class 1E emergency bus.

9.4.6.3.4 Safety Evaluation Four

The fuel building safety-related systems and the intake and exhaust air isolation system are designed in accordance with Seismic Category I requirements as specified in section 3.2. The components (and supporting structures) of any system, equipment, or structure that is not Seismic Category I, and whose collapse could result in a loss of a required function of the fuel building emergency exhaust system or any other safety-related system through either impact or flooding, are supported to ensure they will not collapse when subject to seismic loading resulting from the SSE. The single failure analysis for the emergency exhaust system, fuel pool pump room coolers, and fuel building HVAC isolation is shown in table 9.4-9.

9.4.6.4 Tests and Inspections

A capability is provided to test fans in accordance with standards of AMCA. Ductwork is tested for leakage during installation. All systems are tested and balanced to provide design air quantities within a tolerance of plus or minus 10 percent.

High efficiency particulate filter banks are tested in-place prior to operation, and
periodically thereafter to verify efficiency of at least 99.95 percent with a
cold-generated poly disperse 0.7 micron challenge gas(e.g., DOP, PAO). Testing is in 437
462 accordance with ASME N510-1989, Testing of Nuclear Air Cleaning Systems.
Preoperational testing is described in chapter 14.

Impregnated, activated carbon is batch-tested prior to loading
into the adsorber bed. Acceptance criteria are those described
in ASTM D3803 "Nuclear Grade Gas-phase adsorbents Standard
method of radioiodine testing of" Post-installation testing is
6 in accordance with ASME N510-1989. The carbon adsorber vessel is filled with 437
carbon in a manner to ensure a uniform packing density and to
minimize dusting. The adsorber vessel is freon leak-tested prior
to operation, and periodically thereafter to verify less than 0.05
percent bypass. In addition, a periodic laboratory test of a repre-
sentative sample of the impregnated activated carbon is performed
to verify iodine removal efficiencies. Conformance with the
testing procedures of Regulatory Guide 1.52 (Rev3) is discussed in section 7. 437

Instruments are calibrated during testing and automatic controls are tested for actuation at the proper set point.

Alarm functions are checked for operability and limits during preoperational testing.

9.4.6.5 Instrumentation Applications

Duct-mounted temperature controllers are provided to control the supply of chilled water to the normal air handling unit cooling coil.

All fans can be controlled remotely from the main control room. Indication is provided in the control room for position of dampers and operating status of all fans in the exhaust train. Failure of any fan in the fuel building ventilation system is alarmed in the control room.

Continuous airborne radioactivity monitoring is provided in the fuel building in the discharge duct of the normal exhaust fans. High airborne radioactivity conditions are indicated locally and in the control room. Ventilation airborne radioactivity monitoring systems are further discussed in section 11.5.

Temperature sensor elements are provided in the emergency exhaust unit charcoal adsorbers to indicate excessive bed heating. Differential pressure sensors are provided across each emergency exhaust filter to indicate the amount of filter loading.

A high room temperature and low AHU air flow alarm for each fuel pool pump room is provided in the control room.

Low flow switches are provided downstream of each emergency exhaust unit heating coil to turn off the heating coil.

A heating coil upstream of the HEPA filters in the emergency exhaust trains is automatically turned on if the moisture controller detects higher than allowable humidity. The heating coil is interlocked with the fan such that the fan must be running when the heating coil is on.

9.4.7 CONTAINMENT BUILDING HVAC SYSTEM

The containment building heating, ventilation, and air conditioning (HVAC) system includes the following: the containment fan coolers, recirculation fans, high volume purge system, low volume purge system, control rod drive mechanism (CRDM) shroud fans, tendon gallery fans, hydrogen recombiner system, post-accident hydrogen purge unit, and reactor cavity cooling units. All of these systems except the containment fan coolers and the hydrogen recombiners are discussed in this subsection. The containment fan coolers are discussed in paragraph 6.2.2.2. The hydrogen recombiners are discussed in subsection 6.2.5.

9.4.7.1 Design Bases

Criteria for the selection of design bases are stated in paragraph 1.1.2.2.

9.4.7.1.1 Safety Design Bases

There are no safety design bases for the containment HVAC system discussed herein. The safety-related containment fan coolers are discussed in paragraph 6.2.2.2 and the safety-related hydrogen recombiners in subsection 6.2.5.

9.4.7.1.2 Power Generation Design Bases

9.4.7.1.2.1 Power Generation Design Basis One. The containment HVAC systems, operating in conjunction with the containment fan cooler system, are designed to maintain a containment ambient air temperature during normal plant operation that permits continued operation of all equipment within the containment. The system is also designed to prevent concrete structures within the containment from exceeding the maximum design temperature during normal operation.

9.4.7.1.2.2 Power Generation Design Basis Two. The containment low volume purge system is designed to control containment airborne fission products during normal plant operation and shutdown in order to allow containment access while limiting personnel exposures to less than the dose limits of 10 CFR 20 for occupational exposure, and while limiting annual releases to the environment within the requirements of 10 CFR 50, Appendix I.

9.4.7.1.2.3 Power Generation Design Basis Three. The containment high volume purge system is designed to provide the proper atmosphere and adequate ventilation for personnel before and during periods of personnel access for refueling operations and maintenance when the plant is shut down.

9.4.7.1.2.4 Power Generation Design Basis Four. Selected portions of the containment HVAC systems, operating in conjunction with the containment fan cooler system, are designed to provide adequate heat removal and internal recirculation to ensure thorough mixing of air throughout the containment, with the containment closed to the outside atmosphere and pressurized to design pressure, so that periodic containment integrated leakage rate tests can be conducted in accordance with 10 CFR 50, Appendix A, and General Design Criterion 52.

9.4.7.1.3 Codes and Standards

Codes and standards applicable to the containment HVAC systems are listed in table 3.2-1.

9.4.7.2 System Description

9.4.7.2.1 General Description

The containment HVAC systems described in this subsection are the CRDM shroud fans, reactor cavity cooling units, recirculation fans, tendon gallery fans, post-accident hydrogen purge unit, high volume purge system, and low volume purge system. These systems are not required for safe shutdown. The containment HVAC systems are shown schematically in figures 9.4-7 and 9.4-8.

9.4.7.2.2 Component Description

Design data for major components of the containment HVAC systems are listed in table 9.4-10.

9.4.7.2.2.1 Reactor Cavity Cooling Units. Two redundant 100 percent capacity fan-coil units with associated ductwork are provided for cooling of the reactor cavity. The units are designed to circulate cooled air through the incore instrumentation tunnel, and up through the cavity around the reactor vessel and its supports. The cooling units are designed to handle that portion of the reactor vessel and cavity cooling load that occurs below the cavity seal. Air flows required for the cooling units are calculated based on design heat losses from the reactor vessel insulation and heating resulting from attenuation of radiation in the cavity wall. Cooling water is supplied to the coils of the units from the central chilled water system.

9.4.7.2.2.2 Control Rod Drive Mechanism Cooling Fans. Four fans mounted on the removable CRDM shroud draw air from the area surrounding the CRDMs to remove heat from the area above the reactor vessel and discharge to the containment atmosphere during plant operation. Each CRDM shroud fan is sized to handle 50 percent of the total cooling air flow. The four fans are arranged in two pairs, with one fan of each pair normally operating.

9.4.7.2.2.3 Containment High Volume Purge. The containment high volume purge system is designed to provide adequate ventilation for personnel before and during personnel access for refueling operation, and maintenance when the plant is shut down.

9.4.7.2.2.4 Containment Low Volume Purge. The containment low volume purge supply and exhaust units operate as required during normal power plant operation to maintain containment atmosphere inventories of airborne radioactivity at an acceptably low level to permit containment entry. Airborne particulates and radioiodides are removed by the low volume exhaust filter train.

9.4.7.2.2.5 Post-Accident Hydrogen Purge Exhaust Unit. The post-accident hydrogen purge exhaust unit operates, if required, to purge excess hydrogen from the containment atmosphere subsequent to a LOCA. The post-LOCA hydrogen purge system consists of one 100 percent open ventilation system equipped with compressed air connection for supply air purposes, and an exhaust train.

9.4.7.2.2.6 Recirculation Fans. Six recirculating fans, two per steam generator compartment, are provided to maintain temperatures in the associated compartments within allowable limits. In addition, two of the above recirculation fans provide air circulation for the pressurizer compartment. Ducts are provided to direct air to miscellaneous compartments in the lowest level of the containment and to supply pressurizer compartment cooling.

9.4.7.2.2.7 Tendon Gallery Fans. One supply fan and one exhaust fan are provided to ventilate the tendon gallery.

9.4.7.2.3 System Operation

The reactor cavity cooling units and CRDM cooling fans are located within the reactor containment structure and maintain (in conjunction with the containment fan cooler system) the containment air temperature between 60°F and 120°F. 462

The reactor cavity cooling units and CRDM cooling fans function continuously during normal plant operation. Portions of the system may be operating during plant shutdown periods, if needed for additional cooling.

The low volume purge supply and exhaust units are located outside the containment. The exhaust filter unit maintains the containment atmosphere at low radioactive level by removing airborne particulates and radioiodides.

The high volume purge system provides approximately one air change per hour in the containment. The low volume purge system provides approximately 0.1 air change per hour in the containment.

The high and low volume purge systems are powered by Non-Class 1E supply. Chilled water for these air supply units are provided by the central chilled water system. | 462

The recirculation fans operate to direct air to various hot spots within the containment, and provide mixing and distribution functions. The reactor cavity cooling units and the recirculation fans are powered by Non-Class 1E electric power sources. | 462

Variables such as the temperature and humidity of the containment atmosphere can affect the results of the integrated leakage rate test (ILRT) performed in accordance with Appendix J and General Design Criterion 52 of 10 CFR 50. In order to monitor accurately the containment atmosphere for indications of changes in these variables, it is necessary to mix the containment atmosphere thoroughly. Three containment fan coolers are operated during the ILRT.

The post-accident combustible gas control is accomplished by operating the post-LOCA hydrogen recombiner systems to remove hydrogen from the containment atmosphere should the concentration build up to a non-permissible level. Should hydrogen recombiner systems No. 1 and 2 fail to function when required, the post-accident hydrogen purge system is activated.

9.4.7.3 Safety Evaluation

Inasmuch as these systems have no safety design bases, no safety evaluation is provided.

9.4.7.4 Tests and Inspections

Fans are tested in accordance with standards of the Air Moving and Conditioning Association (AMCA). Ductwork is tested for leakage during installation. All systems are tested and balanced to provide design air quantities within a tolerance of plus or minus 10 percent.

The high efficiency particulate air (HEPA) filters are manufactured and tested prior to installation in accordance with ASME-AG1-1997. After installation HEPA filters are tested in accordance with ASME N510-1989. Carbon adsorbers are tested after installation in accordance with ASME N510-1989. In addition, a periodic laboratory test of a representative sample of the impregnated activated carbon is performed within a maximum period of 18 months to verify the iodine removal efficiencies. 437

6

9.4.7.5 Instrumentation Applications

All fans are remotely operable from outside the containment.

Dry bulb temperature sensors are located throughout the containment to provide ambient air temperature measurements during plant operation, plant shutdown, and containment integrated leakage rate testing. Dewpoint temperature sensors are located throughout the containment to provide air moisture content measurements during plant operation, and water vapor pressure measurements during containment integrated leakage rate testing. The reactor coolant leakage detection function of these sensors is discussed in subsection 5.2.5.

Readouts for the above temperature sensors are provided in the main control room. An alarm in the control room is tripped when any dry bulb temperature sensor exceeds its setpoint. Also, selected dry bulb temperature and dewpoint temperature sensor readouts are provided for the containment ILRT test console located in the auxiliary building. Additional instrumentation in the ILRT test console includes a digital display unit for dry bulb and dewpoint temperature readouts, a precision pressure gauge with digital display to monitor containment atmosphere pressure, a digital clock, a scanner-programmer, a multi-variable recorder, a multi-variable indicator, and imposed leakage flow indication (high accuracy flow measuring devices are used to bleed controlled flow of air from the containment during the verification test portion of the ILRT).

9.4.8 DIESEL GENERATOR BUILDING HVAC SYSTEM

The standby power supply for each safety-related load group consists of a diesel generator system which is provided to supply loads essential to reliable and safe shutdown of the reactor. The diesel generator building ventilation system described in this subsection maintains the diesel generator building temperature within the operational limits imposed by the diesel generator system.

9.4.8.1 Design Bases

Criteria for selection of design bases are stated in paragraph 1.1.2.2. Protection of the diesel generator building ventilation system from wind and typhoon effects is discussed in section 3.3, flood design in section 3.4, missiles in section 3.5, dynamic effects associated with postulated rupture of piping in section 3.6, and environmental design in section 3.11.

9.4.8.1.1 Safety Design Bases

9.4.8.1.1.1 Safety Design Basis One. The diesel generator building emergency ventilation system is designed to remain functional subsequent to an SSE.

9.4.8.1.1.2 Safety Design Basis Two. The diesel generator building emergency ventilation system is designed to limit the building ambient temperature to a maximum of 120F for sustained diesel operation. 1

9.4.8.1.2 Power Generation Design Bases

9.4.8.1.2.1 Power Generation Design Basis One. The diesel generator building normal ventilation system provides a means to maintain the temperature below 110F in the diesel generator room during periods when the diesel generator is not operating. Normal unit heaters are provided for heating and temperature control dampers to minimize natural ventilation in the winter in order to maintain the air temperature above 50F.

9.4.8.1.2.2 Power Generation Design Basis Two. The day tank room ventilation system is designed to maintain the day tank room below 110F. The fans are also used to reduce temperature prior to personnel entry or, in case of a fire, for smoke removal.

9.4.8.1.3 Codes and Standards

Codes and standards applicable to the diesel generator building ventilation system are listed in table 3.2-1. The system is constructed and designed in accordance with the requirements of Air Moving and Conditioning Association (AMCA) Standards. The components of emergency ventilation system are designed in accordance with the requirement of IEEE Standards 323-1974 and 344-1975.

9.4.8.2 System Description

9.4.8.2.1 General Description

The diesel generator building ventilation system is shown schematically in figure 9.4-9 and consists of the following:

A. Diesel generator building emergency ventilation system

B. Diesel generator building normal ventilation system

C. Day tank room ventilation system (common for both day tank rooms)

D. Diesel generator building normal heating system

E. Temperature control dampers.

A separate system is provided for each diesel generator room. Major components are two engineered safety features (ESF) exhaust fans, a normal exhaust fan, and five normal unit heaters. The day tank room ventilation system consists of one 100 percent capacity exhaust fan.

The diesel generator engine exhaust stacks are located to prevent induction of the diesel engine exhaust gases into the control room through the normal and emergency control room intakes.

9.4.8.2.2 Component Description

Design data for major components of the diesel generator building ventilation system are listed in table 9.4-11.

9.4.8.2.2.1 Ventilation System. Each diesel generator building ventilation system consists of two 50 percent capacity ESF exhaust air fans, outside intake louver, exhaust air louver, a normal exhaust air fan, and associated ductwork and instrumentation.

The ESF exhaust air fans are physically located inside the exhaust air fan room which is located above the diesel generator room. The normal exhaust fan, with exhaust ducts, is installed in the diesel generator room.

The day tank room ventilation system consists of a normal exhaust fan, exhaust duct, controls, and instrumentation. Temperature control dampers are provided in each diesel generator room to minimize loss of heat due to natural ventilation during cold weather when unit heaters are used.

9.4.8.2.3 System Operation

9.4.8.2.3.1 Ventilation System. One of the ESF exhaust air fans is automatically activated upon startup of the diesel generator, and three of the temperature control dampers are opened. The second ESF exhaust fan is started by the thermostatic control for maximum ventilation when the room temperature exceeds the setpoint of 120F. The remaining temperature control damper is opened at the time that the second ESF exhaust fan is started. When the diesel generator is shut down, one fan ceases operation and the temperature control damper is shut. The other fan must be stopped manually. At that time the remaining temperature control damper will be closed. 1

All cooling is accomplished by outside air. The outside air enters the room through the temperature control dampers, is drawn through the room and around the diesel, and is exhausted from the room by the ESF exhaust fans and discharged to the atmosphere.

During the period the diesel generator is not operating, the normal ventilation system is manually activated, if necessary, to provide ventilation. The exhaust air exits from the diesel generator rooms through the exhaust ducts and fan, and is discharged to the atmosphere. Unit heaters are manually or automatically activated by a room thermostat to provide heating during winter. Temperature control dampers will be closed when unit heaters are operating. The ESF exhaust fans are electrically connected to the Class 1E bus supplied by their respective diesel generator.

The day tank room normal exhaust fan is normally not in operation. The day tank room exhaust fan can be manually started by a local hand switch located outside the day tank rooms prior to personnel entry or following a fire for smoke removal. The failure of the day tank room normal exhaust fan is annunciated in the control room.

When the sprinkler system within the diesel generator room is activated, the normal ventilation system must be started or stopped remote/manual from the control room.

9.4.8.3 Safety Evaluation

Safety evaluations are numbered to correspond to the safety design bases.

9.4.8.3.1 Safety Evaluation One

The ESF exhaust fans of the diesel generator building ventilation system are designed in accordance with Seismic Category I requirements as specified in section 3.2.

The components and supporting structures of any system, equipment, or structure which are not Seismic Category I and whose collapse could result in loss of a required function of the ventilation system through either impact or flooding are supported to ensure that they will not collapse when subjected to seismic loading.

9.4.8.3.2 Safety Evaluation Two

Each diesel generator room is equipped with two ESF fans to ensure a high volume airflow with sufficient cooling capacity to maintain ambient room temperature at or below 120F. The diesel generator room emergency ventilation system for each room is powered from its associated diesel.

9.4.8.4 Tests and Inspections

A capability is provided to test fans in accordance with AMCA standards. Ductwork is tested for leakage during installation. The system is tested and balanced to provide design air quantities within a tolerance of plus or minus 10 percent.

9.4.8.5 Instrumentation Applications

The ventilating fans may be started and stopped manually from a handswitch located in the control room, in addition to automatic operation concurrent with diesel operation. Fan operating status is indicated in the control room. Alarms are provided in the control room for diesel generator room high temperature, ESF, and normal exhaust fan trips.

Temperatures are automatically controlled by room thermostat to regulate unit heaters in each room during the winter.

9.4.9 NUCLEAR SERVICE COOLING WATER PUMP HOUSE HVAC SYSTEM

The nuclear service cooling water pump house ventilation system is provided to ventilate the rooms containing the nuclear service cooling water pumps and electrical controls equipment located inside the electrical controls building. 1

9.4.9.1 <u>Design Bases</u>

Criteria for selection of design bases are stated in paragraph 1.1.2.2.

Protection of the nuclear service cooling water pump house ventilation system from wind effects is discussed in 1
section 3.3, flood design in section 3.4, missiles in section 3.5, dynamic effects associated with the postulated rupture of piping in section 3.6, and environmental design in section 3.11.

9.4.9.1.1 Safety Design Bases

9.4.9.1.1.1 <u>Safety Design Basis One</u>. The nuclear service cooling water pump house ventilation system is designed to maintain the ambient temperature in the nuclear service cooling water pump and electrical control equipment areas at a value that permits continuous operation. 1

9.4.9.1.1.2 <u>Safety Design Bases Two</u>. No single active failure of the nuclear service cooling water pump house ventilation system will impair the capability of the system to comply with safety design basis one.

9.4.9.1.1.3 <u>Safety Design Basis Three</u>. The nuclear service cooling water pump house ventilation system is designed to remain functional following a safe shutdown earthquake. 1

9.4.9.1.2 Power Generation Design Bases

The nuclear service cooling water pump house ventilation system is designed to maintain the temperature between 80F and 104F. 1

9.4.9.1.3 Codes and Standards

Codes and standards applicable to the nuclear service cooling water pump house ventilation system are listed in table 3.2-1. The system is designed and constructed in accordance with the requirements of Air Moving and Conditioning Association (AMCA) Standards and American Society of Heating, Refrigeration and Air Conditioning Engineers Standards (ASHRAE), Ventilating and Air Conditioning Guides.

9.4.9.2 System Description

9.4.9.2.1 General Description

The nuclear service cooling water pump house ventilation system is shown schematically in figure 9.4-10. The electrical control building HVAC system consists of exhaust fans, unit heaters, intake louvers, and associated controls. The pump house HVAC
1 consists of supply air fans, moderate efficiency air filters, unit heaters, intake louvers, and associated controls.

9.4.9.2.2 Component Description

Design data for major components of the nuclear service cooling water pump house ventilation system are listed in table 9.4-12.

The nuclear service cooling water pump house ventilation system is composed of four 100 percent ventilation systems, each consisting of an intake louver, moderate efficiency filters, one 100 percent supply-air exhaust fan and associated instrumen-
1 tation. Air is exhausted through an exhaust air opening in the wall. Each ventilation system train is powered by the same Class 1E electrical bus as its associated nuclear service water pump.

Four unit heaters are provided for heating and to maintain temperature limits during winter condition.

1 The nuclear service cooling water electrical control building ventilation system is composed of two 100 percent ventilation systems, each consisting of an intake louver, one 100 percent exhaust fan, and associated instrumentation. Air is exhausted through ventilation fans. Each room is provided with one unit heater.

9.4.9.2.3 System Operation

Ventilating fans for the nuclear service water pump house and
1 electrical control building may be started and stopped manually

in addition to automatic starting. The NSCW pump room ventilation fans start automatically upon operation of the NSCW pump and whenever the ambient temperature of the pump house reaches preset temperature. The electrical control building fans start automatically whenever the ambient temperature reaches a preset temperature level. The unit heaters are activated by room thermostats, when required, to maintain minimum 50F space temperature. 1 1

9.4.9.3 Safety Evaluation

Safety evaluations are numbered to correspond to the safety design bases.

9.4.9.3.1 Safety Evaluation One

Each nuclear service cooling water pump and its related electrical control equipment is equipped with a ventilation system to ensure a high volume airflow and sufficient cooling capacity to maintain average ambient room temperature below 104F. 1

9.4.9.3.2 Safety Evaluation Two

The nuclear service cooling water pump house ventilation system is powered by the same Class 1E electrical bus as its associated nuclear service water pumps or the associated electrical controls equipment inside the electrical control building. 1

9.4.9.3.3 Safety Evaluation Three

The nuclear service cooling water pump house and electrical control building ventilation systems are designed in accordance with Seismic Category I requirements as specified in section 3.2. 1

The components (and supporting structures) of any system, equipment, or structure which are not Seismic Category I and whose collapse could result in loss of a required function of the nuclear service cooling water system through either impact or flooding are supported to ensure that they will not collapse when subjected to seismic loading. 1

The nuclear service cooling water pump house and electrical control building ventilation fans are physically separated and shielded for protection from an external missile. 1

9.4.9.4 Tests and Inspections

The capability is provided to test fans and unit heaters in accordance with the AMCA Standards.

9.4.9.5 Instrumentation Applications

Ventilating fans for the nuclear service cooling water pump
1 house and electrical control building may be started and stopped from the control room in addition to automatic operation by preset ambient temperature. Fan operating status is indicated on the control room panel. The unit heaters are automatically started by room thermostat.

9.4.10 AUXILIARY BOILER AND WATER TREATMENT BUILDING AND FIRE WATER PUMP HOUSE HVAC SYSTEMS

The auxiliary boiler and water treatment building and fire water pump house HVAC systems are provided to ventilate the rooms containing water treatment, electrical equipment, auxiliary boiler, toilets, and fire pumps.

9.4.10.1 Design Bases

Criteria for selection of design bases are stated in paragraph 1.1.2.2.

1

9.4.10.1.1 Safety Design Bases

9.4.10.1.1.1 Safety Design Basis One. The auxiliary boiler and water treatment building and fire water pump HVAC systems serve no safety function. Failure of these systems will
1 not compromise the proper functioning of other safety-related systems and the safe shutdown of the plant.

9.4.10.1.2 Power Generation Design Bases

The auxiliary boiler and water treatment building and fire water pump house HVAC systems are designed to maintain inside building temperature between 50F and 104F. All heat removal is accomplished by 100 percent outside air during normal
1 operation.

9.4.10.1.3 Codes and Standards

Codes and standards applicable to auxiliary boiler and water treatment building and fire water pump house HVAC systems are listed in table 3.2-1. The systems are designed and constructed in accordance with the requirements of Air Moving and Conditioning Association (AMCA) Standards and American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) Standards, Ventilating and Air Conditioning Guides.

9.4.10.2 System Description

9.4.10.2.1 General Description

The auxiliary boiler and water treatment building HVAC system is shown schematically in figure 9.4-11 and the fire water pump house HVAC system is shown schematically in figure 9.4-12. The systems consist of supply fans, exhaust fan, unit heaters, intake louvers, and associated controls.

9.4.10.2.2 Component Description

Design data for major components of the auxiliary boiler and water treatment building and fire water pump house HVAC systems are listed in table 9.4-13.

The auxiliary boiler and water treatment building consists of five supply fans, one exhaust fan, six unit heaters, intake louvers, and associated instrumentation. In addition, six roof vent openings are provided.

The fire water pump house consists of one supply fan and two 100 percent capacity exhaust fans, three unit heaters, intake louvers, backdraft dampers, and associated instrumentation. 1

9.4.10.2.3 System Operation

The system is designed so the ventilation fans will start automatically when the ambient temperature in the buildings reaches a preset temperature. Ventilating fans for the auxiliary boiler and water treatment building and fire water pump house can be started and stopped locally. 1

9.4.10.3 Safety Evaluation

There is no safety evaluation.

9.4.10.4 Tests and Inspections

The capability is provided to test fans and unit heaters in accordance with the AMCA Standards.

9.4.10.5 Instrumentation Applications

Ventilating fans for the auxiliary boiler and water treatment building and fire water pump house may be started and stopped locally in addition to automatic operation.

The area unit heater fans are manually started from local hand switches. While the unit heater fans are operating, the heating elements are thermostatically controlled to prevent the room temperature from falling below 50F.

1

The toilet exhaust fan is actuated by a local handswitch. Additional temperature switches are provided for the fire water pumphouse to monitor room ambient temperature and alarm inside the control room when high ambient temperature is detected.

9.4.11 MISCELLANEOUS BUILDINGS HVAC SYSTEM

A number of minor ventilation systems for the miscellaneous buildings provide a favorable environment for the operation of systems and components. The buildings covered in these significant systems are the steam generator blowdown heat exchanger building, figure 9.4-13, the chlorination building, figure 9.4-14, and the circulating water intake structure. The ventilation systems are provided to maintain environment air temperature limits within the buildings to assure adequate performance of equipment and for personnel comfort.

9.4.11.1 Design Bases

Criteria for selection of design bases are stated in paragraph 1.1.2.2.

9.4.11.1.1 Safety Design Bases

These HVAC systems have no safety function.

9.4.11.1.2 Power Generation Bases

The miscellaneous buildings HVAC systems are designed to maintain inside building temperature between 50F and 104F. All heat removal is accomplished by 100 percent outside air during normal operation using mechanical exhaust fans. Ventilation outside air for the intake structure enters the building through louvers, while the other building cooling is accomplished by using supply fans to bring in outside air.

9.4.11.1.3 Codes and Standards

Codes and standards applicable to miscellaneous building HVAC systems are listed in table 3.2-1. The systems are designed and constructed in accordance with the requirements of Air Moving and Conditioning Association (AMCA) Standards and American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) Standards, Ventilating and Air Conditioning Guides.

9.4.11.2 System Description

9.4.11.2.1 General Description

The miscellaneous building HVAC systems are shown schematically in figures 9.4-13 and 9.4-14. The system consists of supply fan, exhaust fans, unit heaters, intake louvers and associated controls.

9.4.11.2.2 Component Description

Design data for major components of miscellaneous building HVAC systems are listed in table 9.4-14.

The steam generator blowdown heat exchanger building consists of one 100 percent supply fan, one 100 percent exhaust fan, and two unit heaters. The chlorination building consists of three 100 percent exhaust fans, two intake louvers, two motorized dampers, and associated instrumentation.

9.4.11.2.3 System Operation

Ventilating fans for the miscellaneous buildings may be started and stopped locally by a remote hand switch. The supply fan and exhaust fan at the steam generator blowdown heat exchanger building are interlocked with each other. The system operates or is stopped automatically whenever the ambient temperature of the building reaches preset temperature.

9.4.11.3 Safety Evaluation

There is no safety evaluation.

9.4.11.4 Tests and Inspections

The capability is provided to test fans and unit heaters in accordance with AMCA Standards.

9.4.11.5 Instrumentation Applications

Ventilating fans and unit heaters for the miscellaneous buildings may be started and stopped locally in addition to automatic operation.

Table 9.4-1

CONTROL ROOM HVAC SYSTEM DESIGN DATA
(Sheet 1 of 5)

Control Room Environmental Conditions			
	Normal	Maximum	Minimum
Temperature, °F	75	78	68
Control Building Smoke Removal Fans			
Type	Vaneaxial		
Quantity	2 at 50 percent capacity ea		
Flowrate, ea, ft^3/min	10,500		
Static pressure, in. WG	1.75		
Drive	Direct		
Normal Toilet Exhaust Fan			
Type	Vaneaxial		
Quantity	1 at 100 percent		
Flowrate, ft^3/min	300		
Static pressure, in. WG	2.0		
Drive	Direct		
Normal Kitchen Exhaust Fan			
Type	Vaneaxial		
Quantity	1 at 100 percent		
Flowrate, ft^3/min	1,000		
Static pressure, in. WG	2.0		
Drive	Direct		
Normal Supply/Recirculation Air Handling Unit			
Quantity	1 at 100 percent		
Flowrate, ft^3/min	41,200		

Table 9.4-1

CONTROL ROOM HVAC SYSTEM DESIGN DATA
(Sheet 2 of 5)

Normal Supply/Recirculation AHU Moderate Efficiency Filter	
Type	Dry, disposable
Quantity, per unit	1 bank
Filter media	Glass fiber
Capacity, ft^3/min	41,200
Pressure drop, clean, in. WG	0.3
Efficiency, percent	45
Normal Supply/Recirculation AHU Heating Coil	
Type	Electric
Quantity	1
Capacity, kW	120
Normal Supply/Recirculation AHU Cooling Coil	
Type	Fin-tube
Quantity	1
Heat transfer, Btu/h	1,755,000
Chilled water flowrate, gal/min	290
Normal Supply/Recirculation AHU Fan	
Type	Centrifugal
Quantity	1 at 100 percent
Flowrate, ft^3/min	41,200
Static pressure, in. WG	6.3
Drive	V-belt
Control Room Emergency Supply/Recirculation AHU	
Quantity	2 at 100 percent capacity ea
Flowrate, ea, ft^3/min	21,000

Table 9.4-1

CONTROL ROOM HVAC SYSTEM DESIGN DATA
(Sheet 3 of 5)

Control Room Emergency Supply/Recirculation AHU Moderate Efficiency Filters	
Type	Dry, disposable
Quantity, per unit	1 bank
Filter media	Glass fiber
Capacity, ft^3/min	21,000
Pressure drop, clean, in. WG	0.5
Efficiency, percent	45
Control Room Emergency Supply/Recirculation AHU Heating Coil	
Type	Electric
Quantity, per unit	1
Capacity, ea, kW	133
Control Room Emergency Supply/Recirculation AHU Cooling Coil	
Type	Fin-tube
Quantity, per AHU	1
Heat transfer, ea, Btu/h	769,200
Chilled water flowrate, gal/min	130
Control Room Emergency Supply/Recirculation AHU Fans	
Type	Centrifugal
Quantity, per unit	1
Flowrate, ea, ft^3/min	21,000
Static pressure, in. WG	4.5
Drive	Direct
Control Room Emergency Filtration Trains	
Quantity	2 at 100 percent ea
Flowrate, ea, ft^3/min	2,000

Table 9.4-1

CONTROL ROOM HVAC SYSTEM DESIGN DATA
(Sheet 4 of 5)

Control Room Emergency Train Moisture Separator	
9 Quantity Capacity, standard ft^3/min Pressure drop, in. WG	2 2,000 1.0
Control Room Emergency Train Fans	
Type Quantity, per train Flowrate, ea, ft^3/min Static pressure, in. WG Drive	Centrifugal 1 at 100 percent capacity 2,000 15 Direct
Control Room Emergency Train HEPA Filter	
Quantity Type Filter media Capacity, ea, ft^3/min Pressure drop, clean, in. WG Efficiency, percent	2 Dry, high efficiency Glass fiber 1,000 1.0 99.97
Control Room Emergency Train Carbon Adsorbers	
Type Media Bed depth, in. 5 Minimum gas stream residence time, second Pressure drop, clean, in. WG Efficiency, percent Elemental iodine, at 70 percent, relative humidity Organic iodine, at 70 percent, relative humidity	Gasketless Activated carbon 2 0.25 1.3 99 99

Table 9.4-1

CONTROL ROOM HVAC SYSTEM DESIGN DATA
(Sheet 5 of 5)

Control Room Emergency Train Heating Coil	
Type	Electric
Quantity, per train	1
Capacity, kW	9.3

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Table 9.4-2

CONTROL BUILDING HVAC SYSTEMS DESIGN DATA
(Sheet 1 of 3)

Control Building Environmental Conditions		
	Maximum	Minimum
Temperature, °F	104	50
Control Building Air Handling Unit		
Quantity Flowrate, ea, ft^3/min	2 at 100 percent capacity ea 27,765	
Control Building Air Handling Unit Filter		
Type Quantity, each unit Filter media Capacity, ft^3/min Pressure drop, clean, in. WG Efficiency, percent	Dry, disposable 1 bank Glass fiber 27,765 0.3 45	
Control Building Air Handling Unit Heating Coil		
Type Quantity, each unit Capacity, kW	Electric 1 156	
Control Building Air Handling Unit Cooling Coil		
Type Quantity, each unit Heat transfer, Btu/h Chilled water flowrate, gal/min	Fin-tube 1 1,140,000 190	

Table 9.4-2

CONTROL BUILDING HVAC SYSTEMS DESIGN DATA
(Sheet 2 of 3)

Control Building Air Handling Unit Fan	
Type Quantity, each unit Flowrate, ft^3/min Static pressure, in. WG Drive	Centrifugal 1 27,765 4.5 V-belt
Emergency Switchgear/Battery Room Air Handling Units	
Quantity Flowrate, ea, ft^3/min	2 at 100 percent capacity ea 12,300
Emergency Switchgear/Battery Room AHU Filters	
Type Quantity, per unit Filter media Capacity, ea, ft^3/min Pressure drop, clean, in. WG Efficiency, percent	Dry, disposable 1 bank Glass fiber 12,300 0.3 45
Emergency Switchgear/Battery Room AHU Heating Coils	
Type Quantity, per AHU Capacity, ea, kW	Electric 1 6
Emergency Switchgear/Battery Room AHU Cooling Coils	
Type Quantity, per AHU Heat transfer, ea, Btu/hr Chilled water flowrate, gal/min	Fin-tube 1 680,000 113

Table 9.4-2

CONTROL BUILDING HVAC SYSTEMS DESIGN DATA
(Sheet 3 of 3)

Emergency Switchgear/Battery Room AHU Fans	
Type	Centrifugal
Quantity, per AHU	1
Flowrate, ea, ft^3/min	12,300
Static pressure, in. WG	5.0
Drive	V-belt
Battery Room Normal Exhaust Fans	
Type	Vaneaxial
Quantity	2 at 100 percent capacity ea
Flowrate, ea, ft^3/min	6,600
Static pressure, in. WG	1.3
Drive	Direct
Battery Room Emergency Exhaust Fans	
Type	Vaneaxial
Quantity	2 at 100 percent capacity ea
Flowrate, ea, ft^3/min	2,960
Static pressure, in. WG	1.1
Drive	Direct
Chiller Room Normal Exhaust Fan	
Type	Vaneaxial
Quantity	2 at 100 percent capacity ea
Flowrate, ft^3/min	500
Static pressure, in. WG	1.0
Drive	Direct
Computer Room Humidifier	
Quantity	1
Capacity	35 lbs/hr
Codes and standards	UL listed

Table 9.4-3

AUXILIARY BUILDING HVAC SYSTEM DESIGN DATA (Sheet 1 of 8)

Auxiliary Building Environmental Conditions		
Temperature, °F	Maximum	Minimum
Normal operation	104	50
Auxiliary Building Supply Air Handling Unit		
Quantity	2 at 100 percent capacity each	
Flowrate, ea., ft^3/min	16,800	
Auxiliary Building Supply AHU Filters		
Type	Dry disposable	
Quantity	1 bank	
Filter media	Glass fiber	
Capacity, ft^3/min	16,800	
Pressure drop, clean, in. WG	0.5	
Efficiency, percent	45	
Auxiliary Building Supply AHU Fans		
Type	Centrifugal	
Quantity, per unit	1 at 100 percent	
Flowrate, ft^3/min	16,800	
Drive	V-belt	
Chilled water flowrate, gal/min	260	
Auxiliary Building Supply AHU Cooling Coils		
Type	Fin-tube	
Quantity, per unit	1	
Heat transfer, Btu/hr	1,551,200	
Auxiliary Building Supply AHU Heating Coils		
Type	Electric	
Quantity, per unit	1	
Capacity, ea, kW	330	

Table 9.4-3

AUXILIARY BUILDING HVAC SYSTEM DESIGN DATA (Sheet 2 of 8)

Normal Local Air Handling Units

A. Below Grade

1. Charging Pump Room

Quantity	3 at 100 percent capacity ea
Flow, ea, ft^3/min	1,600
Static pressure, in. WG	1.25
Cooling capacity, ea, Btu/hr	75,000
Chilled water flowrate, gal/min	20

2. Boron Injection Tank Room

10

Quantity	1 at 100 percent
Flow, ft^3/min	1300
Static pressure, in. WG	2.4
Cooling capacity, Btu/hr	80,000
Chilled water flowrate, gal/min	13

3. Valve Compartment

Quantity	1 at 100 percent
Flow, ft^3/min	1,100
Static pressure, in. WG	1.0
Cooling capacity, Btu/hr	39,200
Chilled water flowrate, gal/min	7

4. Letdown Heat Exchanger Room

Quantity	1 at 100 percent
Flow, ft^3/min	860
Static pressure, in. WG	1.0
Cooling capacity, Btu/hr	33,300
Chilled water flowrate, gal/min	6

5. East and West Corridors

Quantity	2 at 100 percent capacity ea
Flow, ea, ft^3/min	1,550
Static pressure, in. WG	2.1
Cooling capacity, ea, Btu/hr	67,600
Chilled water flowrate, gal/min	12

Table 9.4-3

AUXILIARY BUILDING HVAC SYSTEM DESIGN DATA (Sheet 3 of 8)

Normal Local Air Handling Units	
B. At Grade	
6. Pipe Penetration Room	
Quantity	2 at 100 percent capacity ea
Flow, ea, ft^3/min	1,100
Static pressure, in. WG	1.25
Cooling capacity, ea, Btu/hr	40,600
Chilled water flowrate, gal/min	7
7. Component Cooling Water Pump Room	
Quantity	2 at 100 percent capacity ea
Flow, ea, ft^3/min	10,400
Static pressure, in. WG	2.75
Cooling capacity, ea, Btu/hr	401,700
Chilled water flowrate, gal/min	67
8. Steam Generator Blowdown Flash Tank Room	
Quantity	1 at 100 percent
Flow, ft^3/min	900
Static Pressure, in.WG	2.0
Cooling Capacity, Btu/hr	35,200
Chilled water flow, gal/min	6
C. At Operating Level	
9. HVAC and Electrical Penetration Room	10
Quantity	2 at 100 percent capacity ea
Flow, ea, ft^3/min	6,200
Static pressure, in. WG	5.25
Cooling capacity, ea, Btu/hr	296,000
Chilled water flowrate, gal/min	50
10. Switchgear Room	
Quantity	2 at 100 percent capacity ea
Flow, ea, ft^3/min	11,175
Static pressure, in. WG	4.5
Cooling capacity, ea, Btu/hr	551,800
Chilled water flowrate, gal/min	92

Table 9.4-3

AUXILIARY BUILDING HVAC SYSTEM DESIGN DATA (Sheet 4 of 8)

Local Unit Heater			
	1.	Component Cooling Water Pump Room	
		Type	Electric
		Quantity	4 at 50 percent capacity ea
		Capacity, kW, ea	20
ESF Local Air Handling Units			
A.	Below Grade		
	1.	Charging Pump Room	
		Quantity	4 at 100 percent capacity ea
		Flow, ea, ft^3/min	1,600
		Total pressure, in. WG	2.0
		Cooling capacity, ea, Btu/hr	83,085
		Chilled water flowrate, gal/min	20
	2.	RHR - Pump Room	
		Quantity	2 at 100 percent capacity ea
		Flow, ea, ft^3/min	1,000
		Total pressure, in. WG	1.1
		Cooling capacity, ea, Btu/hr	45,900
		Chilled water flowrate, gal/min	13.5
	3.	Cont. Spray Pump Room	
		Quantity	2 at 100 percent capacity ea
		Flow, ea, ft^3/min	1,100
		Total pressure, in. WG	1.3
		Cooling capacity, ea, Btu/hr	65,700
		Chilled water flowrate, gal/min	11

Table 9.4-3

AUXILIARY BUILDING HVAC SYSTEM DESIGN DATA (Sheet 5 of 8)

ESF Local Air Handling Units (cont)	
B. At Grade	
4. Component Cooling Water Pump Room	
Quantity	2 at 100 percent capacity ea
Flow, ea, ft³/min	10,400
Total pressure, in. WG	2.55
Cooling capacity, ea, Btu/hr	436,300
Chilled water flowrate, gal/min	72
5. Auxiliary Feedwater Pump Room (Motor-Driven Pump)	
Quantity	2 at 100 percent capacity ea
Flow, ea, ft³/min	3,600
Total pressure, in. WG	1.25
Cooling capacity, ea, Btu/hr	140,000
Chilled water flowrate, gal/min	24
6. Auxiliary Feedwater Pump Room (Turbine-Driven Pump)	
Quantity	2 at 100 percent capacity ea
Flow, ea, ft³/min	2,400
Total pressure, in. WG	1.0
Cooling capacity, ea, Btu/hr	99,300
Chilled water flowrate, gal/min	17
7. ESF Switchgear Rooms	
Quantity	2 at 100 percent capacity ea
Flow, ea, ft³/min	7,250
Total pressure, in. WG	2.6
Cooling capacity, ea, Btu/hr	345,200
Chilled water flowrate, gal/min	58
8. Electrical Penetration Room	
Quantity	2 at 100 percent capacity ea
Flow, ea, ft³/min	7,400
Total pressure, in. WG	2.7
Cooling capacity, ea, Btu/hr	352,300
Chilled water flowrate, gal/min	59

Table 9.4-3

AUXILIARY BUILDING HVAC SYSTEM DESIGN DATA (Sheet 6 of 8)

Auxiliary Building Normal Exhaust Filtration Trains	
Quantity, 100 percent capacity ea	2
Flowrate, ea, ft^3/min	18,500
Normal Filtration Train Moderate Efficiency Filters	
Type	Dry, disposable
Quantity, per train	1 bank
Filter media	Glass fiber
Capacity, ea, ft^3/min	18,500
Pressure drop, clean, in. WG	0.3
Efficiency, percent	45
Normal Exhaust Filtration Train Fans	
Type	Centrifugal
Quantity, per train	1
Flowrate, ea, ft^3/min	18,500
Static pressure, in. WG	12.0
Drive	Direct
Normal Exhaust Filtration Train HEPA Filters	
Type	Dry, high efficiency
Filter media	Glass fiber
Capacity, ea, ft^3/min	1,000
Pressure drop, clean, in. WG	1.0
Efficiency, percent	99.97
Normal Exhaust Filtration Train Carbon Adsorbers	
Type	Tray
Media	Activated carbon
Bed depth, in.	4
Minimum gas stream residence time, s	0.5
Pressure drop, clean in. WG	2.5
Efficiency, percent	
Elemental iodine, at 70 percent relative humidity	95
Organic iodide, at 70 percent relative humidity	95

Table 9.4-3

AUXILIARY BUILDING HVAC SYSTEM DESIGN DATA (Sheet 7 of 8)

Normal Exhaust Filtration Train Heating Coil		
Type	Electric	
Quantity, per train	1	
Heat transfer, Btu/hr	238,000	
Radioactive Pipe Trench Exhaust Fan		
Type	Vaneaxial	
Quantity	1 at 100 percent	
Flowrate, ft^3/min	2,300	
Static pressure, in. WG	0.5	
Drive	Direct	
MG Set Rooms Supply Fan		
Type	Vaneaxial	
Quantity	1 at 100 percent	
Flow rate, ft^3/min	12,600	10
Static pressure, in. WG	1.0	
Cooling capacity, Btu/hr	504,630	
Chilled water flow rate, gal/min	90	
Drive	Direct	
MG Set Exhaust Fan		
Type	Vaneaxail	
Quantity	1 at 100 percent	
Flowrate, ea, ft^3/min	12,600	
Static pressure, in. WG	1.0	
Drive	Direct	
Smoke Removal Fan		
Type	Vaneaxial	
Quantity	1 at 100 percent	
Flowrate, ea, ft^3/min	11,000	
Static pressure, in. WG	1.3	
Drive	Direct	
Main Steam Support Structure Supply Fan		
Type	Vaneaxial	
Quantity	2 at 100 percent capacity ea	
Flowrate, ea, ft^3/min	12,000	
Static pressure, in. WG	0.75	
Drive	V-belt	

Table 9.4-3

AUXILIARY BUILDING HVAC SYSTEM DESIGN DATA (Sheet 8 of 8)

HVAC Equipment Room Exhaust Fan	
Drive	Direct
Type	Vaneaxial
Quantity	2 at 50 percent
Flowrate, ft^3/min, ea	10,740
Static pressure, in. WG	0.75
HVAC Equipment Room Unit Heater	
Type	Electric
Quantity	4 at 25 percent
Capacity, kW, ea	20
Nuclear Sample Room Supply Fan	
Type	Vaneaxial
Quantity	1 at 100 percent
Flowrate, ft/min	2,200
Drive	Direct
Static pressure, in. WG	0.25
Nuclear Sample Room Duct Heater	
Type	Electric
Quantity	1
Capacity, kW	30

MSIV & MFIV Supply Air Handling Unit	
Quantity	1 at 100 percent
Fan	2 at 100 percent
Flowrate, ft^3/min, ea	9,000
Static pressure, in. WG	Later
Cooling capacity, Btu/hr, each	693,700
Moderate efficiency filter, each	1 bank
Type	Dry, disposable
Filter media	Glass fiber
Pressure drop, clean, in. WG	0.55
Efficiency, percent	80~89
MSIV & MFIV Room Unit Heater	
Type	Electric
Quantity	2
Capacity, kW, ea	25
Aux. F.W Pump Room Supply and Exhaust Fan	
Drive	Direct
Type	Vaneaxial
Quantity	1 at 100 percent
Flowrate, ft^3/min, ea	4,000
Static pressure, in WG	0.6
Aux. F.W Pump Area Exhaust Fan	
Drive	Direct
Type	Vaneaxial
Quantity	1 at 100 percent
Flowrate, ft^3/min, ea	2,000
Static pressure, in WG	1.8
Aux. F.W Pump Area Unit Heater	
Type	Electric
Quantity	2
Capacity, kW, ea	15

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Table 9.4-4

AUXILIARY BUILDING HVAC
SINGLE ACTIVE FAILURE ANALYSIS
(Sheet 1 of 3)

Component	Failure	Comments
1. Charging Pump Room HVAC AHU	Unit fails	Four air handling units are provided. There are three charging pump rooms. One room has "A" train unit, one room has "B" train unit and one room has one "A" and one "B" unit. At least two pumps will remain operable.
2. RHR Pump Room HVAC AHU	Unit fails	One unit per pump room is provided. One pump provides 100 percent capacity. One AHU is sufficient to meet the requirement.
3. Containment Spray Pump Room HVAC AHU	Unit fails	One unit per pump room is provided. One pump provides 100 percent capacity. One AHU is sufficient to meet the requirement.
4. CCW Pump Room HVAC AHU	Unit fails	One AHU is always available. Each is supplying 100 percent requirement of the pump room.

Table 9.4-4

AUXILIARY BUILDING HVAC
SINGLE ACTIVE FAILURE ANALYSIS
(Sheet 2 of 3)

Component	Failure	Comments
5. Auxiliary Feedwater Pump Room (Motor-Driven Pump) AHU	Unit fails	One AHU per motor pump room. If one fails, the turbine-driven pump AHU and the other motor-driven pump room AHU are still available.
6. Auxiliary Feedwater Pump Room (Turbine-Driven Pump) AHU	Unit fails	A and B AHU for the turbine-driven pump room; if one fails, the other one is still available.
7. ESF SWGR and MCC Rooms AHU	Unit fails	A and B AHU units. If one fails, the other one is available to provide 100 percent of the requirements.
8. Electrical Penetration Room AHU	Unit fails	Two independent and physically separated electrical penetration rooms, each with one 100 percent capacity AHU. If one unit fails, the other penetration room is not affected.

Table 9.4-4

AUXILIARY BUILDING HVAC
SINGLE ACTIVE FAILURE ANALYSIS
(Sheet 3 of 3)

Component	Failure	Comments
9. Power Supply	Failure of both normal and preferred power supplies	All Class 1E components automatically switch over to diesel generator power supply.
10. Power Supply	Failure of power supply bus to one train	Two independent and physically separated bus bars; 100 percent capacity each.
11. Essential Chilled Water System	One train fails	Two independent trains are provided.

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Table 9.4-5

RADWASTE BUILDING AND HOT MACHINE SHOP
VENTILATION SYSTEMS MAJOR COMPONENTS DESIGN DATA
(Sheet 1 of 5)

Radwaste Building Environmental Conditions		
Temperature, @F	Maximum	Minimum
Normally occupied areas	78	68
Pipe chase and tank rooms	120	50
All other areas	104	50
1. Radwaste Building Supply Air Handling Units		
Quantity	2 at 100 percent	
Airflow, ft^3/min, each	11,800	
Static pressure, in. WG	4.9	
Cooling capacity, Btu/hr, each	867,000	
Chilled water flowrate, gal/min, each	125	
Heating coil capacity, kW, each	180	
Moderate efficiency filter, each	1 bank	
Type	Dry, disposable	
Filter media	Glass fiber	
Pressure drop, clean, in. WG	0.30	
Efficiency rating, percent	45	
2. Local Air Handling Units		
A. Electrical Equipment Room		
Quantity	1	
Airflow, ft^3/min	2,300	
Static pressure, in. WG	1.3	
Cooling capacity, each, Btu/hr	111,000	
Chilled water flow, each, gal/min	16	
B. Boron Recycle System (BRS) Evaporator Room		
Quantity	1	
Airflow, ft^3/min	3,350	
Static pressure, in. WG	1.75	
Cooling capacity, Btu/hr	158,000	
Chilled water flowrate, gal/min	23	

Table 9.4-5

RADWASTE BUILDING AND HOT MACHINE SHOP
VENTILATION SYSTEMS MAJOR COMPONENTS DESIGN DATA
(Sheet 2 of 5) 1

C. Liquid Radwaste System (LRS) Evaporator Room	
Quantity	2
Airflow, ft^3/min	5,000
Static pressure, in. WG	1.64
Cooling capacity, Btu/hr	237,600
Chilled water flowrate, gal/min	34
D. LRS Pump Room	
Quantity	1
Airflow, ft^3/min	900
Static pressure, in. WG	1.4
Cooling capacity, Btu/hr	41,000
Chilled water flowrate, gal/min	6
E. BRS Recycle Evaporator Feed Pump	
Quantity	1
Airflow, ft^3/min	800
Static pressure, in. WG	1.0
Cooling capacity, Btu/hr	38,000
Chilled water flowrate, gal/min	5.5
3. Radwaste Control Room Supply Air Handling Unit	
Quantity	1
Airflow, ft^3/min	4,800
Static pressure, in. WG	3.8
Cooling capacity, Btu/hr	252,500
Chilled water flowrate, gal/min	42
Heating coil capacity, kW	30
4. Radwaste Building Exhaust Filtration Trains	
Number of Trains	2 at 100 percent
Flowrate, ft^3/min	13,800

1 Table 9.4-5

RADWASTE BUILDING AND HOT MACHINE SHOP
VENTILATION SYSTEMS MAJOR COMPONENTS DESIGN DATA
(Sheet 3 of 5)

A. Moderate Efficiency Filter	
Quantity	1 bank
Type	Dry, disposable
Filter media	Glass fiber
Capacity, ft^3/min	13,800
Pressure drop, clean, in. WG	0.30
Efficiency, percent	45
B. HEPA Filters	
Type	Dry, high efficiency
Filter media	Glass fiber
Capacity each filter, ft^3/min	1,000
Pressure drop, clean, in. WG	1.0
Efficiency	99.97
C. Fans	
Drive	Belt
Quantity	2 at 100 percent
Type	Centrifugal
Airflow, each, ft^3/min	13,800
Static pressure, in. WG	8.0
5. Radwaste Building Smoke Removal Fan	
Drive	Direct
Quantity	1
Type	Vaneaxial
Airflow, ft^3/min	5,800
Static pressure, in. WG	1.1
6. Radwaste Utility Exhaust Fan	
Drive	Direct
Quantity	1
Type	Vaneaxial
Airflow, ft^3/min	500
Static pressure, in. WG	0.75

Table 9.4-5

RADWASTE BUILDING AND HOT MACHINE SHOP
VENTILATION SYSTEMS MAJOR COMPONENTS DESIGN DATA
(Sheet 4 of 5) 1

7. Recycle Holdup Tank Air Handling Unit	
Quantity Type Airflow, ft^3/min Static pressure, in. WG	1 Centrifugal 1,350 2.1
8. Control Room Duct Heater	
Quantity Airflow, cfm Heating capacity, Btu/hr Electric duct heater, kW	1 4,800 102,500 30
9. Radwaste Building Duct Heater	
Quantity Airflow, cfm Heating capacity, Btu/hr Electric duct heater, kW	1 7,300 614,500 90
10. Radwaste Building Duct Heater	
Quantity Airflow, cfm Heating capacity, Btu/hr Electric duct heater, kW	1 1,700 136,500 20
11. Radwaste Building Duct Heater	
Quantity Airflow, cfm Heating capacity, Btu/hr Electric duct heater, kW	1 6,500 512,100 75

Table 9.4-5

RADWASTE BUILDING AND HOT MACHINE SHOP
VENTILATION SYSTEMS MAJOR COMPONENTS DESIGN DATA
(Sheet 5 of 5)

Hot Machine Shop Environmental Conditions		
Temperature, @F	Maximum	Minimum
All areas	104	50
1. Hot Machine Shop Supply Air Handling Units		
Quantity Static pressure, in W.G. Airflow, ft^3/min, each 1 Heating coil capacity, kW, each Moderate efficiency filter, each Type Filter media Pressure drop, in. W.G. Efficiency rating, percent	Two (2) at 100 percent 2.6" 5,200 40 1 bank Dry, disposable Glass fiber 1.2 90	
2. Hot Machine Shop Exhaust Fans		
Quantity Type Airflow, ft^3/min., each Static pressure, in. W.G.	Two (2) at 100 percent Centrifugal 5700 1.5	
3. Hot Machine Shop Unit Heaters		
Quantity Heating capacity, kW	Four (4) Two (2) x 30 Two (2) x 25	

Table 9.4-6

TURBINE AND SWITCHGEAR BUILDINGS VENTILATION
SYSTEM DESIGN DATA (Sheet 1 of 3)

Turbine and Switchgear Buildings Environmental Conditions		
Temperature, °F	Maximum	Minimum
Turbine building overhead	104	50
Normally occupied areas	104	50
Switchgear building battery room	104	77

Turbine Building Supply Fans	
Type	Propeller
Quantity	16 and 1
Flowrate, each, ft^3/min	41,000 and 38,000
Static pressure, in. WG	0.75
Drive	Direct

Turbine Building Operating Floor Exhaust Fans	
Type	Axial flow
Quantity	22 at 5 percent capacity ea
Flowrate, each, ft^3/min	66,000
Static pressure, in. WG	0.75
Drive	V-belt

Turbine Building Lube Oil Reservoir Room Exhaust Fan	
Type	Centrifugal
Quantity	1 at 100 percent
Flowrate, ft^3/min	18,700
Static pressure, in. WG	1.9
Drive	Direct

Turbine Building Unit Heaters	
Type	Electric
Quantity	20 and 10
Heating capacity, kW	40 kW and 10 kW

Table 9.4-6

TURBINE AND SWITCHGEAR BUILDINGS VENTILATION
SYSTEM DESIGN DATA (Sheet 2 of 3)

Switchgear Building Supply Air Handling Unit	
Type	Centrifugal
Quantity	2 at 50 capacity each
Flowrate, each, ft^3/min	61,000
Static pressure, in. WG	3.5
Drive	V-belt
Switchgear Building Supply Air Handling Unit Air Filter	
Type	Dry
Quantity, per supply air handling unit	1 bank
Filter media	Glass fiber
Capacity, ft^3/min	61,000
Pressure drop, clean, in. WG	0.1
Efficiency, percent	45
Switchgear Building Supply Air Duct Heaters	
Type	Electric
Quantity	2
Heating capacity, each kW	50
Switchgear Building Exhaust Fans	
Type	Centrifugal
Quantity	2 at 50 percent capacity each
Flowrate, each, ft^3/min	66,000
Static pressure, in. WG	2.0
Drive	V-belt

Table 9.4-6

TURBINE AND SWITCHGEAR BUILDINGS VENTILATION
SYSTEM DESIGN DATA (Sheet 3 of 3)

Battery Room Exhaust Fans	
Type	Centrifugal
Quantity	2 at 100 percent capacity each
Flowrate, each, ft^3/min	2,500
Static pressure, in. WG	1.2
Drive	V-belt
Storage Area Exhaust Fan	
Type	Centrifugal
Quantity	1 at 100 percent
Flowrate, ft^3/min	500
Static pressure, in. WG	1.25
Drive	V-belt
Toilet Exhaust Fan	
Type	Centrifugal
Quantity	1 at 100 percent
Flowrate, ft^3/min	300
Demineralizer Area Fan	
Type	Propeller
Quantity	2 at 100 percent capacity each
Flowrate, each, ft^3/min	4,000

Table 9.4-7

ACCESS CONTROL BUILDING HVAC SYSTEM
DESIGN DATA PER UNIT (Sheet 1 of 3)

Access Control Building Environmental Conditions		
Temperature, °F	Maximum	Minimum
Personnel Area	78	68
Equipment Area	104	50
Access Control Building Supply Air Handling Unit		
Quantity	1	
Flowrate, standard ft^3/min	26,400	
Access Control Building Supply Air Handling Unit Filter		
Type	Dry, disposable	
Quantity	1	
Filter media	Glass fiber	
Capacity, actual ft^3/min	26,400	
Pressure drop, clean, in. WG	0.50	
Efficiency	45	
Access Control Building Supply Air Handling Unit Heating Coils		
Type	Electric	
Quantity	1	
Heating capacity, kW	350	
Access Control Building Supply Air Handling Unit Cooling Coil		
Type	Chilled water fin-tube	
Quantity	1	
Heat transfer, Btu/hr, total	2,444,000	
Chilled water flowrate, gal/min	407	

Table 9.4-7

ACCESS CONTROL BUILDING HVAC SYSTEM
DESIGN DATA PER UNIT (Sheet 2 of 3)

Access Control Building Supply Air Handling Unit Fan	
Type	Centrifugal
Quantity	1
Flowrate, standard ft^3/min	26,400
Static pressure, in. WG	5.6
Drive	V-belt
Duct Heaters	
Type	Electric
Quantity	11
Heating capacity, kW/each	20
Electrical and Instrument Repair Room Air Handling Unit	
Quantity	1 at 100 percent
Flowrate, ft^3/min	10,900
Electrical and Instrument Repair Room AHU Filter	
Type	Dry, disposable
Quantity	1
Filter media	Glass fiber
Capacity, ft^3/min	10,900
Pressure drop, clean, in. WG	0.5
Efficiency, percent	45
Electric and Instrument Repair Room AHU Heating Coil	
Type	Electric
Quantity	1
Capacity, kW	50 1

Table 9.4-7

ACCESS CONTROL BUILDING HVAC SYSTEM
DESIGN DATA PER UNIT (Sheet 3 of 3)

	Electric and Instrument Repair Room AHU Cooling Coil	
	Type	DX
	Quantity	1
	Heat transfer, Btu/hr, total	180,000
	Electric and Instrument Repair Room Condenser	
	Type	Air cooled
	Quantity	1
	Access Control Building Exhaust Fan	
1	Type	Roof exhauster
	Quantity	1
1	Flowrate, standard ft^3/min	18,100
	Static pressure, in. WG	3.6
	Drive	V-belt
	Laundry Room Exhaust Fan	
1	Type	Vaneaxial
	Quantity	1
	Flowrate, standard ft^3/min	6,800
	Static pressure, in. WG	1.0
1	Drive	Direct
	Access Control Building Fume Hood Exhaust Fan	
	Type	Centrifugal
	Quantity	1
	Flowrate, standard ft^3/min	3,400
	Static pressure, in. WG	1.0
	Drive	V-belt

Table 9.4-8

FUEL BUILDING HVAC SYSTEM
DESIGN DATA (Sheet 1 of 3)

Fuel Building Environmental Conditions		
Temperature, °F	Maximum	Minimum
Normal	104	50
Emergency	120	50
Normal Ventilation Supply Air Handling Units		
Quantity	2 at 100 percent each	
Flowrate, each, ft^3/min	19,100	
Normal Ventilation Supply Unit Air Filter		
Type	Dry	
Quantity	1 bank	
Filter media	Glass fiber	
Capacity, ft^3/min	19,100	
Pressure drop, clean, in. WG	0.5	
Efficiency, percent	45	
Normal Ventilation Supply Air Handling Unit Fans		
Type	Centrifugal	
Quantity, per unit	1	
Flowrate, each, ft^3/min	19,100	
Static pressure, in. WG	6.54	
Drive	V-belt	
Normal Ventilation Supply Unit Cooling Coils		
Type	Fin-tube	
Quantity, per unit	1	
Heat transfer, each, Btu/hr	1,275,000	
Chilled water flowrate, gpm	185	
Normal Ventilation Supply Unit Heating Coils		
Type	Electric	
Quantity per unit	1	
Capacity, kW	450	

Table 9.4-8

FUEL BUILDING HVAC SYSTEM
DESIGN DATA (Sheet 2 of 3)

Normal Exhaust Fans	
Type	Centrifugal
Quantity	2 at 100 percent each
Flowrate, each, ft^3/min	21,000
Static pressure, in. WG	2.45
Drive	V-belt
Emergency Exhaust Trains	
Quantity	2 at 100 percent each
Airflow, each, cfm	5,000
Emergency Exhaust Train Fans	
Type	Centrifugal
Quantity per train	1
Airflow, each, ft^3/min	5,000
Static pressure, in. WG	13.9
Drive	Direct
Emergency Exhaust Train Moderate Efficiency Filter	
Type	Dry, disposable
Quantity per train	1 bank
Filter media	Glass fiber
Capacity, each filter, ft^3/min	1,000
Pressure drop, clean, in. WG	0.5
Efficiency, percent	45
Emergency Exhaust Train HEPA Filters	
Type	Dry, high efficiency
Filter media	Glass fiber
Capacity, each filter, ft^3/min	1,000
Pressure drop, clean, in. WG	1.0
Efficiency, percent	99.97
Quantity per train	2 banks

Table 9.4-8

FUEL BUILDING HVAC SYSTEM
DESIGN DATA (Sheet 3 of 3)

Emergency Exhaust Train Carbon Adsorbers	
Type	Deep bed
Media	Activated carbon
Bed depth, in.	2
Minimum gas stream residence time, seconds	0.25
Pressure drop, in. WG (new)	1.3
Efficiency, percent	
Elemental iodine	95 at 70 percent relative humidity
Organic iodide	95 at 70 percent relative humidity
Emergency Exhaust Train Electric Heating Coil	
Type	Electric
Quantity per train	1
Heat transfer, Btu/hr	130,000
Airflow	5,000 cfm
Fuel Pool Pump Room Cooling Units	
Quantity	2
Flowrate each, ft^3/min	2,700
Fuel Pool Pump Room Cooling Unit Fans	
Type	Centrifugal
Quantity per cooling unit	1
Airflow, each, ft^3/min	2,700
Static pressure, in. WG	1.74
Drive	Direct
Fuel Pool Pump Room Cooling Unit Cooling Coil	
Type	Fin-tube
Quantity per cooling unit	1
Heat transfer, each, Btu/hr	116,200
Water flowrate, each, gpm	20

Table 9.4-9

SINGLE FAILURE ANALYSIS - EMERGENCY EXHAUST SYSTEM, FUEL POOL PUMP ROOM COOLERS, AND FUEL BUILDING HVAC ISOLATION

Component	Malfunction	Consequences
Particulate filters	Excess dust loading	Train continues to operate at reduced airflow. Other train is unaffected.
Emergency exhaust train fan	Fails to start	One emergency exhaust train is out of service; redundant train is capable of providing cleanup.
Emergency exhaust train discharge damper	Fails to open; flow path is not available.	One emergency exhaust train is out of service; redundant train is capable of providing cleanup.
Fuel building normal exhaust system isolation dampers	Damper fails to close; flow path is not isolated	One damper is out of service; redundant damper is capable of providing required closure.
Fuel building supply system ductwork isolation dampers	Damper fails to close; flow path is not isolated	One damper is out of service; redundant A and B dampers are in service, one is capable of providing required closure.
Fuel pool pump room cooler unit fan	Fan fails to start	One unit is out of service; the other unit is capable of providing cooling requirements for the alternate fuel pool cooling train.

Table 9.4-10

CONTAINMENT HVAC SYSTEM DESIGN DATA (Sheet 1 of 5)

Containment Environmental Conditions		
Temperature, °F	Maximum	Minimum
Normal operation	120	60
Shutdown	120	60
Emergency	300	
Reactor Cavity Cooling Unit Fans		
Type	Centrifugal	
Quantity	2 at 100 percent capacity ea	
Flowrate, each, ft^3/min	20,500	
Total static pressure, in. WG	5.5	
Drive	Direct	
Reactor Cavity Cooling Unit Cooling Coils		
Type	Fin-tube	
Quantity	2 at 100 percent capacity ea	
Heat transfer, each, Btu/hr	470,000	
Chilled water flowrate, gal/min	70	
CRDM Cooling Fans		
Type	Centrifugal	
Quantity	4 at 50 percent capacity ea	
Flowrate, each, ft^3/min	26,300	
Total static pressure, in. WG	9.0	
Drive	Direct	
Recirculation Fans		
Steam Generator Compartment		
Type	Vaneaxial	
Quantity	4 (two at 100 percent capacity for each of two steam generator compartments)	
Flowrate, each, ft^3/min	18,350	
Static pressure, in. WG	1.4	
Drive	Direct	

Table 9.4-10

CONTAINMENT HVAC SYSTEM DESIGN DATA (Sheet 2 of 5)

Recirculation Fans (Cont)	
Pressurizer and Steam Generator Compartment	
Type	Vaneaxial
Quantity	2 at 100 percent capacity ea
1 Flowrate, each, ft^3/min	28,500
Static pressure, in. WG	1.1
Drive	Direct
Tendon Gallery Fans	
Supply Fan	
Type	Vaneaxial
Quantity	1 at 100 percent capacity
Flowrate, each, ft^3/min	5,000
Static pressure, in. WG	0.8
Drive	Direct
Exhaust Fan	
Type	Vaneaxial
Quantity	1 at 100 percent capacity
Flowrate, each, ft^3/min	5,500
Static pressure, in. WG	0.8
Drive	Direct
High Volume Purge System	
Supply Unit Moderate Efficiency Filter	
Type	Dry disposable
Quantity	1 bank
Filter media	Glass fiber
Capacity, ft^3/min	38,000
Pressure drop, clean, in. WG	0.3
Supply Unit Cooling Coil	
Type	Fin-tube
Quantity	1
Heat transfer, Btu/hr	3,604,000
Chilled water flow, gal/min	600
Supply Unit Heating Coil	
Type	Electric
Quantity	1
Heating capacity, kW	780

Table 9.4-10

CONTAINMENT HVAC SYSTEM DESIGN DATA (Sheet 3 of 5)

High Volume Purge System (Cont)	
Supply Unit Fan	
Type	Centrifugal
Quantity	1 at 100 percent capacity
Flowrate, ft^3/min	38,000
Static pressure, in. WG	3.5
Drive	V-belt
Exhaust Unit Fan	
Type	Centrifugal
Quantity	1 at 100 percent capacity
Flowrate, ft^3/min	40,000
Static pressure, in. WG	3.5
Drive	Direct
Low Volume Purge System	
Supply Unit Moderate Efficiency Filter	
Type	Dry disposable
Quantity	1 bank
Filter media	Glass fiber
Capacity, ft^3/min	3,600
Pressure drop, clean, in. WG	0.5
Supply Unit Cooling Coil	
Type	Fin-tube
Quantity	1
Heat transfer, Btu/hr	342,000
Chilled water flow, gal/min	57
Supply Unit Fan	
Type	Centrifugal
Quantity	1
Flowrate, ft^3/min	3,600
Static pressure, in. WG	4.5
Drive	V-belt
Exhaust Unit (Filter Train) Moderate Efficiency Filter	
Type	Dry disposable
Quantity	1 Bank
Filter media	Glass fiber
Capacity, ft^3/min	4,000
Pressure drop, clean, in. WG	0.5
Efficiency, percent	45

Table 9.4-10

CONTAINMENT HVAC SYSTEM DESIGN DATA (Sheet 4 of 5)

Low Volume Purge System (Cont)	
Exhaust Unit (Filter Train) Heating Coil	
Type	Electric
Quantity	1
Airflow, ft^3/min	4,000
Heat transfer, Btu/hr	56,300
Exhaust Unit (Filter Train) HEPA Filter	
Type	Dry, high efficiency
Quantity, upstream/downstream	4/4
Filter media	Glass fiber
Capacity, each, ft^3/min	1,000
Efficiency, percent	99.97
28 Pressure drop, clean, in. WG	1.0
Exhaust Unit (Filter Train) Carbon Adsorber	
Type	Deep bed
Media	Activated carbon
Pressure drop, clean, in. WG	1.3
Efficiency, percent	
Elemental iodine	99.9 at 70 percent relative humidity
Methyl iodide	99.5 at 70 percent relative humidity
28 Minimum gas stream residence time, Sec	0.75
Exhaust Unit (Filter Train) Fan	
Type	Centrifugal with variable inlet vane control
Quantity	1 at 100 percent capacity
Flowrate, ft^3/min	4,000
Static pressure, in. WG	13.0
Drive	V-belt
Containment Hydrogen Recombiner System	
Type	Thermal
Quantity	2 at 100 percent capacity ea
Flowrate, each, ft^3/min	70

Table 9.4-10

CONTAINMENT HVAC SYSTEM DESIGN DATA (Sheet 5 of 5)

Post-Accident Hydrogen Purge System	
Exhaust Unit Moisture Separator	
Exhaust Unit (Filter Train) Heating Coil	
Type	Electric
Quantity	1
Heat transfer, Btu/hr	1,700
Exhaust Unit (Filter Train) HEPA Filter	
Type	Dry, high efficiency
Quantity, upstream/downstream	One/one
Filter media	Glass fiber
Capacity, each, ft^3/min	50
Pressure drop, clean, in. WG	1.0
Efficiency, percent	99.97
Exhaust Unit (Filter Train) Carbon Adsorber	
Type Deep bed	Deep bed
Media	Activated carbon
Pressure drop, clean, in. WG	2.0
Efficiency, percent	
Elemental iodine	99.9 at 70 percent relative humidity
Methyl iodine	99.5 at 70 percent relative humidity
Minimum gas stream residence time, Sec	0.25
Containment Fan Coolers	
Type	Draw-through
Quantity	4 at 33.3 percent capacity ea
Flowrate, each, ft^3/min	
Normal	66,000
Accident	33,000
Cooling coil capacity, each, Btu/hr	
Duty: Normal	760,000
Post-LOCA	5.0×10^6
Steam line break	5.0×10^6
Chilled water flowrate, gal/min	660

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Table 9.4-11

DIESEL GENERATOR BUILDING HVAC SYSTEM
DESIGN DATA

Diesel Generator Building Environmental Data		
Temperature, °F	Maximum	Minimum
Normal (diesels not operating) Post-LOCA (diesels operating)	110 120	50
ESF Exhaust Fans		
Type Quantity, per generator room Flowrate, each, ft^3/min Static pressure, in. WG Drive	Vaneaxial 2 at 50 percent capacity 75,000 1.0 Direct	
Normal Exhaust Fan		
Type Quantity, per generator room Flowrate, ft^3/min Static pressure, in. WG Drive	Vaneaxial 1 at 100 percent capacity 6,300 1.5 Direct	
Day Tank Room Exhaust Fan		
Type Quantity Flowrate, ft^3/min Static pressure, in. WG Drive	Vaneaxial 1 at 100 percent capacity 1,500 1.0 Direct	
Normal Unit Heaters		
Type Quantity, per room Heating capacity, each, kW	Electric 5 15	

Table 9.4-12

NUCLEAR SERVICE COOLING WATER PUMP HOUSE
AND ELECTRICAL CONTROL BUILDING HVAC SYSTEM 1
DESIGN DATA

Nuclear Service Cooling Water Pump House Environmental Data		
Temperature, °F	Maximum	Minimum
Pump Operating	104	50
NSCW Pump House Supply Fans		
Type Quantity, per train Flowrate, ft^3/min Static pressure, in. WG Drive	Vaneaxial 2 at 100 percent 17,500 3.0 Direct	
NSCW Pump House Ventilation Supply Train Filters		
Type Quantity, per train Filter media Capacity, each bank, ft^3/min Pressure drop, clean, in. WG Efficiency, percent	Dry 2 banks Glass fiber 17,500 0.5 50	
NSCW Pump House Unit Heaters		
Type Quantity, per room Heating capacity, each, kW	Electrical 2 20	
Electrical Control Building Exhaust Fan		
Type Quantity, per room Flowrate, ft^3/min	Vaneaxial 1 2200	
Electrical Control Building Unit Heaters		
Type Quantity, per room Heating capacity, each, kW	Electrical 1 8	

Table 9.4-13

AUXILIARY BOILER AND WATER TREATMENT BUILDING AND FIRE WATER PUMP HOUSE HVAC SYSTEMS DESIGN DATA
(Sheet 1 of 3)

	Auxiliary Boiler and Water Treatment Building and Fire Water Pump House Environmental Data		
	Temperature, °F	Maximum	Minimum
		104	50
	Auxiliary Boiler Building Supply Fans		
	Type	Propeller	
	Quantity	2	
	Flowrate, ea, ft^3/min	47,500	
1	Static pressure, in. WG	0.5 (external)	
	Drive	Direct	
	Auxiliary Boiler Building Unit Heaters		
	Type	Electric	
	Quantity	2	
	Heating capacity, each, kW	20	
	Auxiliary Boiler Building Toilet Exhaust Fan		
	Type	Propeller	
	Quantity	1	
	Flowrate, ft^3/min	275	
	Static pressure, in. WG	0.5 (external)	
	Drive	Direct	
	Water Treatment Building Supply Fans		
	Type	Propeller	
	Quantity	2	
1	Flowrate, ea, ft^3/min	13,600	
	Static pressure, in. WG	0.5 (external)	
	Drive	Direct	

Table 9.4-13

AUXILIARY BOILER AND WATER TREATMENT BUILDING AND FIRE WATER PUMP HOUSE HVAC SYSTEMS DESIGN DATA (Sheet 2 of 3)

Electrical Room Supply Fans		
Type	Propeller	
Quantity	1	
Flowrate, ea, ft^3/min	13,000	
Static pressure, in. WG	0.5 (external)	1
Drive	Direct	
Water Treatment Building Unit Heaters		
Type	Electric	
Quantity	3	
Heating capacity, each, kW	20	
Electrical Room Unit Heater		
Type	Electric	
Quantity	1	
Heating capacity, kW	15	
Fire Pump Room Supply Fans		
Type	Propeller	
Quantity	1	
Flowrate, ea, ft^3/min	6,700	1
Static pressure, in. WG	0.5 (external)	
Drive	Direct	
Fire Pump Room Exhaust Fans		
Type	Propeller	
Quantity	2	
Capacity, each, ft^3/min	4,000	1
Pressure drop, clean, in. WG	0.5 (external)	
Drive	Direct	

Table 9.4-13

AUXILIARY BOILER AND WATER TREATMENT BUILDING AND
FIRE WATER PUMP HOUSE HVAC SYSTEM
DESIGN DATA
(Sheet 3 of 3)

Fire Pump House Unit Heaters	
Type	Electric
Quantity	3
Heating capacity, each, kW	5

Table 9.4-14

MISCELLANEOUS BUILDINGS HVAC SYSTEMS
DESIGN DATA

Steam Generator Blowdown Heat Exchanger Building Supply Fan	
Type	Propeller
Quantity	1
Flowrate, ft^3/min	8000
Static pressure, in. WG	0.75
Drive	Direct
Steam Generator Blowdown Heat Exchanger Building Exhaust Fan	
Type	Propeller
Quantity	1
Flowrate, ft^3/min	8000
Static pressure, in. WG	0.75
Drive	Direct
Steam Generator Blowdown Heat Exchanger Building Unit Heaters	
Type	Electric
Quantity	2
Heating capacity, each, kW	20
Chlorination Building Exhaust Fan	
Type	Propeller
Quantity	3
Flowrate, ft^3/min	25,000
Static pressure, in. WG	0.75
Drive	Direct
Chlorination Building Toilet Exhaust Fan	
Type	Propeller
Quantity	1
Flowrate, ft^3/min	280
Static pressure, in. WG	0.5
Drive	Direct

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KOREA HYDRO & NUCLEAR POWER COMPANY KORI 3 & 4 FSAR

CONTROL BUILDING HVAC SYSTEM

(SHEET 1 OF 3)

Figure 9.4-1

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P & I DIAGRAM
CONTROL BUILDING HVAC SYSTEM
(SHEET 2 OF 3)
Figure 9.4-1

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P & I DIAGRAM
CONTROL BUILDING HVAC SYSTEM
(SHEET 3 OF 3)
Figure 9.4-1

KOREA HYDRO & NUCLEAR POWER COMPANY KORI 3&4 FSAR

AUXILIARY BUILDING HVAC SYSTEM
(SHEET 1 OF 4)

Figure 9.4-2

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AUXILIARY BUILDING HVAC SYSTEM
(SHEET 2 OF 4)

Figure 9.4-2

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AUXILIARY BUILDING HVAC SYSTEM
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Figure 9.4-2

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AUXILIARY BUILDING HVAC SYSTEM
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Figure 9.4-2

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KOREA ELECTRIC POWER CORPORATION
KRN 3 & 4 FSAR

P & I DIAGRAM
RADWASTE BUILDING HVAC SYSTEM
(Sheet 1 of 4)
FIGURE 9.4-3

KOREA ELECTRIC POWER CORPORATION
KOREA NUCLEAR UNITS 5 & 6
FSAR

P&I DIAGRAM RADWASTE BLDG HVAC SYSTEM
(Sheet 2 of 4) 1

Figure 9.4-3

KOREA ELECTRIC POWER CORPORATION
KOREA NUCLEAR UNITS 5 & 6
FSAR

P&I DIAGRAM RADWASTE BLDG HVAC SYSTEM
(Sheet 3 of 4) 1

Figure 9.4-3

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KOREA ELECTRIC POWER CORPORATION
KOREA NUCLEAR UNITS 5 & 6
FSAR

P&I DIAGRAM
RADWASTE BUILDING HVAC SYSTEM
(Sheet 4 of 4)

Figure 9.4-3

KOREA ELECTRIC POWER CORPORATION
KOREA NUCLEAR UNITS 5 & 6
FSAR

P&I DIAGRAM
TURBINE BUILDING HVAC SYSTEM
(Sheet 1 of 2)

Figure 9.4-4

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KOREA HYDRO & NUCLEAR POWER COMPANY KORI 3&4 FSAR

TURBINE BLDG HVAC SYSTEM

(Sheet 2 of 2)

Figure 9.4-4

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P & I DIAGRAM
ACCESS CONTROL BUILDING HVAC SYSTEM
Figure 9.4-5

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P&I DIAGRAM
FUEL HANDLING BLDG HVAC SYSTEM

Figure 9.4-6

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CONTAINMENT HEAT REMOVAL SYSTEM

(SHEET 1 OF 2)

Figure 9.4-7

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CONTAINMENT HEAT REMOVAL SYSTEM

(SHEET 2 OF 2)

Figure 9.4-7

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CONTAINMENT AIR PURIFICATION

(Sheet 1 OF 2)

Figure 9.4-8

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CONTAINMENT AIR PURIFICATION
& COMBUSTIBLE GAS CONTROL
(SHEET 2 OF 2)
Figure 9.4-8

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P&I DIAGRAM
DIESEL GENERATOR BUILDING
HVAC SYSTEM

Figure 9.4-9

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P&I DIAGRAM
NUCLEAR SERVICE COOLING WATER
PUMP HOUSE HVAC

Figure 9.4-10

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P&I DIAGRAM
AUXILIARY BOILER & WATER TREATMENT
BUILDING HVAC SYSTEM

Figure 9.4-11

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P&I DIAGRAM
FIRE WATER PUMP HOUSE
HVAC SYSTEM

Figure 9.4-12

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KOREA NUCLEAR UNITS 5 & 6
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P&I DIAGRAM
STEAM GENERATOR BLOWDOWN
HEAT EXCHANGER HVAC SYSTEM

Figure 9.4-13

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KOREA NUCLEAR UNITS 5 & 6
FSAR

P&I DIAGRAM
CHLORINATION BUILDING HVAC

Figure 9.4-14

9.5 OTHER AUXILIARY SYSTEMS

9.5.1 FIRE PROTECTION SYSTEM

The fire protection system (FPS) is designed to detect fires, protect the plant against damage from fire, minimize hazards to personnel, and reduce property loss due to fire. The overall fire protection system assures, through a defense-in-depth design approach, that safety-related systems maintain the ability to perform their safe shutdown functions; and minimizes the possibility of radioactive releases to the environment in the event of fires.

Refer to table 9.5-1 for the design comparison to Regulatory Positions of Regulatory Guide 1.120, Revision 1, dated November 1977, Fire Protection Guidelines for Nuclear Power Plants. The basis for compliance to Regulatory Guide 1.120 is the implementation of Appendix A of NRC Branch Technical Position (BTP), Auxiliary Systems Branch 9.5-1. Table 9.5-1 provides a summary of the compliance with ASB 9.5-1.

Fire protection is provided in accordance with the requirements of 10 CFR 50, General Design Criteria 3 and 5. The fire protection program consists of fire detection and suppression systems, administrative control and procedures, and trained personnel.

Plant-specific Fire Hazard Analysis for Kori Units 3&4 was published in October 2005. In this report , Fire Hazard Analysis including safe shutdown analysis was performed in accordance with Regulatory Guide 1.189, Fire Protection for Operating Nuclear Power Plants. 561

9.5.1.1 Design Bases

Structures, systems, and components important to safety are designed and located to minimize the fire hazard consistent with other safety requirements. Noncombustible and heat-resistant materials are used wherever practical throughout the unit to minimize the fire intensity in any combustion zone. This requirement is in compliance with 10 CFR 50, General Design Criterion 3, Fire Protection.

The basic fire protection for safety-related items is achieved by fire inception avoidance and through remote separation of systems serving the same safety function, or by fire barriers between such installations. In addition, a Seismic Category I firewater system is provided for post Safe Shutdown Earthquake (SSE) manual fire fighting for safety-related equipment areas with water supply from a Seismic Category I tank. The fire protection system is not a safety related system.

9.5.1.1.1 Safety Design Bases

9.5.1.1.1.1 Safety Design Basis One (Fire Protection). The containment isolation valves in the FPS are selected, tested, and located in accordance with the requirements of 10 CFR 50, Appendix A, General Design Criteria 54 and 56, and 10 CFR 50, Appendix J, Type C testing.

9.5.1.1.1.2 Safety Design Basis Two (Fire Protection). Non-Seismic Category I fire protection system components are designed so that an SSE will not cause failures that could result in unacceptable damage that could cause loss of function of plant structures, systems, or components important to safety, in compliance with 10 CFR 50, Appendix A, General Design Criterion 3, Fire Protection.

9.5.1.1.1.3 Safety Design Basis Three (Fire Protection). Seismic Category I fire protection system components are designed for SSE loading so that the system remains operable post SSE in compliance with NRC Branch Technical Position ASB 9.5.1.

9.5.1.1.2 Power Generation Design Bases

The design bases indicated below address either fire protection or fire inception avoidance and are so identified. The FPS is not a safety-related system.

The FPS is designed to minimize the effects of fire on the power plant. It is designed to provide the capability to fight fires in all plant areas. Areas that are protected by manual fire protection are accessible with respect to heat, smoke, toxic combustion products, and radiation. Areas are protected with one, or a combination of more than one, of the following systems: manual fire fighting water, automatic water sprinkler, portable fire extinguishing, and early warning detection.

9.5.1.1.2.1 Power Generation Design Basis One (Fire Protection). The plant fire protection water supply system is capable of supplying rated flow with any two of the three 1500 gal/min fire pumps. The two diesel-driven pumps are capable of supplying rated flow. The fire protection water supply system is rated to supply simultaneously the maximum flow of 2000 gal/min for any automatic sprinkler or water spray system and 1000 gal/min for fire hoses, assuming the shortest fire main flow path is valved out of service.

9.5.1.1.2.2 Power Generation Design Basis Two (Fire Protection). The fire protection water supply yard main is so arranged that each branch line from the main may be supplied with water from the pumps by alternate flow paths. Two-way hydrants with hose houses are installed at about 250-foot intervals along the main.

9.5.1.1.2.3 Power Generation Design Basis Three (Fire Protection). Hydraulically balanced automatic sprinkler systems ordinary or extra hazard, and hydraulically designed automatic water spray systems are installed in all areas with a high fire potential. Criteria for determining the need for these systems is in general compliance with the ANI Guide, Basic Fire Protection for Nuclear Power Plants.

9.5.1.1.2.4 Power Generation Design Basis Four (Fire Protection). Standpipes, inside hose connections, and hose reels are provided in areas adjacent to and within stair towers and other points not greater than one hundred feet apart in all normally accessible areas.

9.5.1.1.2.5 Power Generation Design Basis Five (Fire Protection). Portable fire extinguishers are provided throughout normally accessible areas of the plant in accordance with applicable National Fire Protection Association (NFPA), and American Nuclear Insurers (ANI) regulations and recommendations. A wheeled dry chemical extinguisher is also provided in the turbine building basement.

9.5.1.1.2.6 Power Generation Design Basis Six (Fire Protection). Alarms are provided in the control room to indicate activation of the FPS. Fire and smoke monitoring and detection systems are installed in areas where a potential for fire exists. Analog photo-electric detectors are used for detecting fire in long cable trays. These systems alarm in the control room and locally. 451

9.5.1.1.2.7 Power Generation Design Basis Seven (Fire Protection). A fire protection water supply system jockey pump is provided to minimize cycling of the main fire pumps.

9.5.1.1.2.8 Power Generation Design Basis Eight (Fire Protection). The Seismic Category I fire protection consists of two 100 percent Seismic Category I electric motor-driven pumps in parallel, connected to redundant Class 1E emergency power buses. Each pump takes suction from the Seismic Category I condensate storage tank and discharges to a common Seismic Category I distribution piping network.

9.5.1.1.2.9 Power Generation Design Basis Nine (Fire Protection). Fire protection system components are designed so that their inadvertent operation does not result in loss of function of plant structures, systems, or components important to safety, in compliance with 10 CFR 50, Appendix A, General Design Criterion 3, Fire Protection. The condensate storage tank is capable of providing the required flow for 2 hours in compliance with NRC Branch Technical Position ASB 9.5-1.

9.5.1.1.2.10 Power Generation Design Basis Ten (Fire Protection). The Seismic Category I FPS pumps are sized to supply flow to at least two hose stations, at 75 gpm each.

9.5.1.1.2.11 Power Generation Design Basis Eleven (Fire Protection). The piping is Seismic Category I, ANSI B31.1 and stand pipes discharging lines shall be completely dry when not in use.

9.5.1.1.2.12 Power Generation Design Basis Twelve (Fire Protection). Seismic Category I standpipes and hose connections equipped with caps are provided in areas containing equipment required for safe plant shutdown in the event of an SSE.

9.5.1.1.2.13 Power Generation Design Basis Thirteen (Fire Inception Avoidance). Special precautions, taken to reduce fire hazards and potentials incident to construction of multiple unit plants, are provided in accordance with ANI recommendations when one unit is in operation.

9.5.1.1.2.14 Power Generation Design Basis Fourteen A flooding analysis assures that the failure of the fire suppression systems will not prevent the safe shutdown of the plant.

9.5.1.1.2.15 Power Generation Design Basis Fifteen (Fire Protection). The Seismic Category I FPS is designed to supply water to dry standpipes and hose connections for manual fire fighting in areas containing equipment required for safe plant shutdown in the event of a SSE, in compliance with NRC Branch Technical Position ASB 9.5-1.

9.5.1.1.2.16 Power Generation Design Basis Sixteen (Fire Protection). Piping serving hose stations is analyzed for SSE loading, and is provided with supports to ensure system pressure integrity, in compliance with NRC Branch Technical Position ASB 9.5-1.

9.5.1.1.2.17 Power Generation Design Basis Seventeen (Fire Protection). The Seismic Category I FPS is designed to remain operable following an SSE, even though it is not a safety-related system.

Class 1E power is provided through an isolation device for the Seismic Category I fire protection pumps, in compliance with NRC Branch Technical Position ASB 9.5-1.

9.5.1.1.2.18 Power Generation Basis Eighteen. A 3-hour separation fire barrier is provided as per NRC Branch Technical Position ASB 9.5-1. Where a 3-hour separation barrier is not established, a 20-foot separation between redundant trains is provided. As a last resort, a one hour rated thermal barrier is placed around redundant cable trays used in those areas where the 20-foot separation is not possible.

9.5.1.1.2.19 Power Generation Basis Nineteen. The possibility of carbonization and breakdown of cable insulation is remote and problems arising from the use of water on such deteriorated insulation is an unlikely event because of the following test programs and fire detection systems:

A. A long-term moisture absorption test has been conducted. Class 1E cables were submerged for 26 weeks in water maintained at 90℃ in accordance with definition of Section 6.9 of ICEA Standard S-19-81 and cable insulation was not damaged. | 462

B. All Class 1E cables have passed flame test qualifications. The multiple conductor cables were subjected to vertical tray flame test using the gas burners flame source as stipulated in Section 2-5 of IEEE 383-1974. Also, a specimen of single conductor cable and a single conductor of a multiple conductor cable subjected to a flame test in accordance with Section 6.19.6 of ICEA Standard S-19-81 vertical flame-resistant test. The cables successfully passed.

C. Early fire protection system with analog photo-electric detectors is provided in cable tray areas. | 451

9.5.1.1.3 Codes and Standards

Codes and standards applicable to the FPS are listed in table 3.2-1. The FPS is designed in general compliance with

the requirements of ANI, National Fire Codes of NFPA, applicable codes and regulations of the Republic of Korea, and 10 CFR 50, Appendix A, General Design Criterion 3, Fire Protection, and applicable sections of Title 29, Chapter XVIII, Part 1910 (Occupational Safety and Health Standards) of the Code of Federal Regulations.
Code and standard applied to the Fire Hazard Analysis of Kori Units 3&4 are Regulatory Guide 1.189. MEST Regulatory Guide for Fire protection program and Fire Hazard Analysis. 561

9.5.1.2 System Description

9.5.1.2.1 General Description

The plant fire suppression systems are shown schematically in figure 9.5-1 (sheets 1 through sheet 6). The fire area boundaries are indicated in figure 9.5-2 (sheets 1 through sheet 12). A comparison of KNU 5 & 6 design with requirements of Appendix A of NRC Branch Technical Position, Paper 9.5-1, is included in table 9.5-1 (sheets 1 through 40). The plant FPS is comprised of diversified monitoring, detection, alarm, and suppression facilities particularly selected to protect the area or equipment from damage by fire and includes, among other things, the following major features:

A. Fire protection water supplies, fire pumps, yard mains, hydrants and valves

B. Automatic wet-pipe sprinkler systems

C. Automatic water spray systems

D. Automatic preaction sprinkler systems

E. Wet standpipes and hose racks

F. Seismic Category I standpipes

G. Portable fire extinguishers

H. Fire and smoke detection and alarm system

I. Fire barriers

J. Smoke and heat vents

K. Fire resistant and noncombustible materials

314 L. Low Pressure Carbon Dioxide System

M. Clean Agent Suppression System

Accessibility is provided for the safety-related equipment areas that rely on manual fire protection.

Egress is provided through the power block in accordance with 29 CFR 1910, Subpart E, Means of Egress.

In the unlikely event that the fire cannot be immediately extinguished, fire barriers or physical separation of redundant components will prevent the fire from causing the failure of redundant components and systems required for safe shutdown. For redundant systems that cannot physically be located in separate fire areas, protection is provided by separation distance, a combination of fire rated thermal barrier, and fire detection and suppression systems.

Noncombustible construction materials are employed throughout all the buildings to minimize fire potential. Employment of heat- and flame-resistant materials of construction and fire-resistant coatings reduces the potential for fire, particularly in areas that contain or may interact with safety-related equipment, or rely solely on manual fire protection. Figure 9.5-2 shows FPS design throughout the plant.

Smoke, heat, flame, and combustible gas control is maintained by minimizing the amounts of combustibles in all areas including safety-related areas, and by storing combustibles required for the operation of the plant in a manner conforming with applicable NFPA Standards. Storage of flammable liquids meets the requirements of NFPA No. 30. Fire barriers restrict the spread of fire, heat, and flame. Fire dampers, which automatically close upon high temperature, are provided in all ductwork penetrating a fire-rated wall to prevent the spread of heat and flames. Normal building mechanical ventilation exhaust paths or separate purge systems provide a means to remove smoke and heat. Fire suppression systems, either manual or automatic, are used for limiting smoke and heat.

The fire suppression systems are designed so that in the event of the failure of the primary suppression system in a given area, a backup suppression system will be available. In areas of high fire loading, the primary suppression system is a fixed automatic water system with secondary protection from portable extinguishers and hose stations. In areas of low fire loading, the primary method of fire extinguishment is by hose stations. All hose stations are located so that if a fire occurs at a hose station, preventing access to the hose, the fire may be extinguished by the hose stream from an adjacent hose station.

The FPS components in safety-related equipment areas utilize proven components and have been selected to minimize the risks of inadvertent operation. Drip-proof Seismic Category I pump motors and electrical equipment are used, when feasible, to minimize the possibility of damage should fire fighting operations be required. Wet-pipe sprinkler systems are not used in electric motor-driven safety-related pump rooms and electrical equipment rooms. Extinguishing materials used in the FPS are compatible with the equipment in the areas served to avoid damage to the equipment in the event of a break in the system. Adequate drainage is provided in the areas where sprinkler or waterspray systems are used.

The basic fire protection for a safety-related area is achieved through separation or by fire barriers. The FPS, designed to detect, control, and extinguish any fire rapidly and effectively, is not a safety-related system. KNU 5 & 6 has a Seismic Category I manual firefighting capability to provide two 75 gal/min hose streams from a Seismic Category I water supply system in all safety-related areas. This system contains two 100 percent capacity electric motor-driven horizontal fire pumps. This system is operated by manual actuation of valves and hand switches when the normal FPS system is not available, after a SSE. Vents and drain lines are provided in discharge lines to keep the pipe system dry when not operated. Normal fire protection hoses shall be used for Seismic Category I fire protection standpipes after removing caps. The FPS is designed so that inadvertent actuation will not prevent a safe shutdown of the plant. In most cases, fixed fire suppression systems are required for safety-related equipment. Actuation of any system will alarm in the control room.

Standpipes that service safety-related equipment are located outside the equipment room, where possible, so that pipe failure will not cause unacceptable flooding condition in the vicinity of the safety-related equipment. Manual valves are provided to isolate the failed standpipe. The ESF pump rooms located in the basement of the auxiliary building are enclosed by watertight doors and walls to prevent flooding within the pump rooms. Standpipes in the control building are routed in the stairwells, where possible, to preclude pipe failures, creating a flooding condition in the vicinity of the safety-related equipment. Floor drains have been provided throughout the control building to preclude flooding at any elevation due to a failure of the FPS, or if fire water is required to extinguish a postulated fire. Refer to section 3.4 for a description of flood protection.

Fire detection circuits are continuously supervised for circuit continuity, and open circuit failures is annunciated by the circuits' supervisory alarm, locally and in the control room.

The FPS supply piping to the containment is designed to protect the integrity of the containment boundary from component failures. The inside containment isolation valve is a check valve. A fire inside the containment will not disable the operability or impair the access to the outside isolation valve, which may be operated either automatically or manually.

9.5.1.2.2 Component Description

9.5.1.2.2.1 Fire Protection Water Supplies, Yard Mains, Hydrants, and Valves. The fire protection water supplies are shared between the two plants. Water for fire protection service is supplied at 150 psig to the 12-inch cast iron, cement-lined yard main encircling the plant. One 1500-gal/min automatic motor-driven fire pump and two 1500-gal/min automatic diesel engine-driven fire pumps draw suction from two 435,000-gallon suction tanks to provide a total reserved supply of 720,000 gallons of water for fire protection. A jockey pump automatically maintains yard main pressure at 125 psig. The yard main is provided with post-indicator valves for sectional control. Two-way hydrants with individual curb box valves are provided at 250- to 300-foot intervals. Hose houses and equipment, in accordance with NFPA No. 24, are provided at each hydrant.

9.5.1.2.2.2 Automatic Wet-Pipe Sprinkler Systems. Automatic wet-pipe sprinklers are provided in accordance with NFPA No. 13 to protect the area and equipment shown on figure 9.5-1. Each system consists of a network of piping which distributes water to closed head sprinklers. Systems are provided with an alarm check valve equipped to alarm locally and in the main control room when any flow from the system is equal to or greater than that from a single sprinkler. The alarm check valve consists of a check valve, a standard trim including auxiliary valves and gauges, and a self-draining retarding chamber in the alarm line to prevent false alarms.

9.5.1.2.2.3 Automatic Water Spray System. Automatic water spray systems, hydraulically designed in accordance with NFPA No. 15, are provided to protect the equipment as shown on figure 9.5-1. Each system utilizes directional solid-cone nozzles and provides a spray density of 0.25-0.30 gal/min/ft^2. Automatic spray systems are provided with deluge valves. The deluge valve consists of a diaphragm-type valve with standard trim including auxiliary valves, gauges, and a manual control station for local manual actuation.

The deluge valves are tripped by solenoid valves. It is possible to periodically test the alarm line circuit without tripping the deluge valve. Each automatic spray system has a local control panel that performs the following functions:

A. On detection of a fire, transmits a fire alarm to the control room and to a local alarm.

B. Initiates operation of the deluge valve.

C. Supervises deluge valve actuation device circuits and transmits a trouble alarm signal to the main control room in the event of a malfunction or power failure.

Failure of the detection system will not trip the deluge valve but will register a trouble alarm in the control room.

9.5.1.2.2.4 Automatic Preaction Sprinkler System. Automatic preaction sprinklers are provided in accordance with NFPA No. 13 to protect the areas and equipment as shown on figure 9.5-1. Each preaction system includes a diaphragm-type deluge valve, a check valve, and a network of distribution piping with closed head sprinklers. The piping downstream of the deluge valve is normally dry and pressurized with instrument air. A pressure switch is installed to alarm in the control room on loss of air pressure (indicating a sprinkler head or pipe failure).

Refer to subparagraph 9.5.1.2.2.3 for a description of the deluge valve and related trim and the local control panel.

9.5.1.2.2.5 Seismic Category I Fire Protection System. The Seismic Category I fire protection water supply is from the condensate storage tank provided for each unit. The reserve volume in condensate tank is 18,000 gallons, based upon 150 gal/min for 2 hours. Water for fire protection service is supplied at 125 psig to the 4-inch carbon steel pipe. Two 100 percent capacity manual-operated electric motor driven fire pumps draw suction from the condensate storage tank. Vents and drain lines are provided to keep the piping dry when the system is not operating. Each hose connection is equipped with a cap and chain. Fire hoses from the normal fire protection system are used when hoses are needed.

9.5.1.2.2.6 Standpipes and Hose Stations

The standpipe system is designed in accordance with the requirements for Class 11 service of NFPA No. 14.

Hose stations are provided for areas of the plant containing equipment needed for safe shutdown. Hose stations will be supplied water from wet standpipes located throughout the plant. Hose stations are provided for use by the plant personnel, and are located adjacent to stairways and at interior columns so that no more than 100 feet separates adjacent hose stations. 561
Four-inch standpipes are provided for multiple hose stations, and 2-1/2-inch standpipes are provided for single-hose stations.
Each standpipe hose station is equipped with a 1-1/2-inch angle

hose valve with the hose station assembly for use by the plant personnel.

Each hose station is provided with 75 feet or 100 feet of 1-1/2-inch woven polyester-jacketed , neoprene-lined hose and adjustable nozzle. see figure9.5-1, for hose and nozzle details. 561

Isolation valves will be provided in the wet standpipe main supply headers.

9.5.1.2.2.7 Portable Fire Extinguishers. Portable fire extinguishers for manual extinguishment of fires are provided throughout normally accessible areas of the plant, In accordance with NFPA NO.10

Where possible, the hand extinguishers are located conveniently throughout normally accessible areas of the plant. Portable extinguishers of the multi-purpose type for use on class A, B and C fires have a capacity of approximately 14 pounds of dry chemical. They are rated to an equivalent underwriters Laboratory (UL) rating for type 20, 5A,10B, and 10C. Portable extinguishers for Class B and C fires have a capacity of approximately 20 pounds of carbon dioxide, have a minimum UL rating of 10-B:C, and are UL labeled.

9.5.1.2.2.8 Wheeled Dry Chemical Extinguisher. The portable dry chemical extinguishing system consists of two-wheeled multi-purpose dry chemical extinguishers per unit. Each extinguishers consists of a 99-pound dry chemical powder tank and gas cylinder mounted on a mobile chassis. Each extinguisher is equipped with a hose and nozzle designed for local application of dry chemical powder. Normally, these extinguishers are stationed in the turbine building ready for immediate use

9.5.1.2.2.9 Fire and Smoke Detection and Alarm System
Automatic fire and smoke-detection and alarm systems are provided in accordance with NFPA Nos. 72. 451
See figure 9.5-2.

Fire and smoke detector sensitivities are established in accordance with UL Standard 268 "Smoke Detectors for Fire Protective signaling Systems," June 9, 1981 ANSI/UL 268-1981.

The fire and smoke detection and alarm system includes a supervisory circuit that indicates the failure of individual circuits and detectors. Both monitoring and supervisory alarm signals register Local Fire Control Panel(LFCP). 451

LFCPs connect to Main Fire Control Panel(MFCP) through networked communication cables. Main Fire Control Panel(MFCP) connects to Graphic Display System Panel(GDSP) in main control room to monitor the respective smoke detector. GDSP can control, operate and monitor both MFCP and LFCP. Also MFCP can control, operate and monitor LFCP 451
The fire annunciation control panel in the main control room indicates the alarm status of each water suppression system. Individual valves associated with the water suppression system will be supervised for position and alarm on the fire annunciation control panel.

9.5.1.2.2.10 Fire Barriers. Fire barrier walls, floors, and ceilings are provided based on an evaluation of the potential fire hazard to safe shutdown system the fire barrier ratings and locations are indicated in figure 9.5-2, sheets 1 through12, and 9.5-3, sheets 1 through 21. 561

All penetrations through the fire barrier are fitted with fire stops having, as a minimum, the same rating of the barrier.
Fire dampers in HVAC ducting penetrating the fire barriers equal the fire resistance rating of the barrier and are fusible link operated. personnel doors have the underwriter laboratory (UL) rating except as noted below:

A. Elevator doors are rated at 1-1/2 hours.

B. Pressure, missile-resistant, and watertignt doors; equipment hatches have no rating. but they will be controlled and managed as a fire door when they are located in the boundary of fire areas. 561

The design, construction, test method, and acceptance criteria for the fire barriers and related items are as follows:

A. Fire Rated Barriers
Per applicable sections (determined by construction type) of ASTM E-119, and UL standards, and applicable sections of the uniform building code.

B. Fire Barrier Penetration Seals (piping, cable trays and ductwork)

All penetration seals will meet the rating of the fire barrier ASTM E-119 and/or IEEE Standard 634 and tested in accordance with ANI/MAERP standard test method.

C. Metal Deck Roof

Construction of the metal deck roof assemblies conforms to Factory Mutual (FM) Category I or UL Class A. The test method and acceptance criteria are as specified in UL- or FM-approved guide.

Areas in which combustible oil-filled equipment is located are designed to minimize the spread of the combustible oil from the immediate area of the equipment. An enclosed gravel-filled pit is located beneath the yard transformers.

The pit is sized to contain oil and there is a drainage system to take care of water spray system operation for 30 minutes in addition to oil and water spillage. The oil and water drains to an oil/water underground separation holding tank. Barrier walls are provided between all oil-filled transformers located in the yard area.

All transformers inside the building are the dry type.

9.5.1.2.2.11 Smoke, Heat, Flame, and Combustible Gas Control. Smoke, heat, flame, and combustible gas control is maintained by minimizing the amounts of combustibles in all areas including safety-related areas, and by storing combustibles required for the operation of the plant in a manner conforming with applicable NFPA Standards. For example, storage of flammable liquids meets the requirements of NFPA No. 30. Fire barriers restrict the spread of fire, heat, and flame, and fire dampers that automatically close upon high temperature are provided in all ductwork penetrating a fire-rated wall to prevent the spread of heat and flames. Normal building mechanical ventilation exhaust paths or separate smoke removal systems provide a means to remove smoke and heat.

Bulk hydrogen storage is out-of-doors and away from building structures. The preferred method of fire control is by cutting off the source of the burning gas.

The battery rooms ventilation systems dilute and exhaust hydrogen gas that may be generated by the batteries.

The rooms containing oil storage containers are ventilated directly outdoors at a sufficient exhaust rate for the removal of flammable oil vapors.

Toxic gases and smoke containment control is by the normal ventilation exhaust or smoke removal systems. The control building normal HVAC system is of the recirculating type:

A. Closing return air duct prevents spreading of the smoke.

B. The smoke removal fan starts and exhausts from the fire floor. This capacity is greater than the supply air, so the air infiltrates to this floor from the surrounding areas.

C. Makeup air that is exhausted would come from outside the air intake and from open doors. The auxiliary building and radwaste building are "once through" systems, and the normal exhaust system ductwork is used for smoke removal as follows:

   A. The smoke removal fan starts

   B. Normal exhaust filtration unit stops

   C. Normal supply system continues running.

In the turbine and fuel buildings, ventilation systems are "once through" systems, where the normal exhaust system is used for smoke removal.

For the auxiliary building, radwaste building, and the fuel building, the spread of smoke is prevented by the same ventilation that prevents the spread of potential airborne radioactivity.

Stairwells are designed to minimize smoke infiltration during a fire and serve as access and egress routes during a fire. Fire exit wells outside the containment are enclosed with 2-hour fire rating walls with 1-1/2-hour rated automatic self-closing doors. Elevators are similarly designed except they are not to be used during fires. Inside the containment a 1-1/2-hour fire rating is used for elevator doors.

9.5.1.2.2.12 Fire Resistant and Noncombustible Materials. Construction materials are noncombustible to the maximum extent practical. Fire resistant materials are those that have a maximum rating of 25 for smoke contribution, fuel contribution, and flame spread as defined per ASTM E-84. Insulation over metal roof decking and the vapor barrier will be securely attached by approved noncombustible adhesive and perimeter fastening.

Suspended acoustical ceilings and their supports are of UL listed, noncombustible construction. Insulation for pipes and ducts and their adhesives are noncombustible and UL listed, where practical. Concealed spaces are devoid of combustibles, as practical. Materials that give off toxic fumes when exposed to fire are prohibited. Excluding charcoal adsorbers, all ventilation filters are UL Class 1.

9.5.1.2.2.13 Low Pressure Carbon Dioxide System

Low pressure carbon dioxide shall be supplied for fire protection of the AAC D/G Building Cable Spreading Room, D/G Fuel Oil Transfer Pump Room, Diesel Fuel Oil Storage Tank Room, Diesel Fuel Oil Day Tank Room and Diesel Generator Room.

Total flooding carbon dioxide protection shall be provided in accordance with NFPA 12. Visual and audible local pre-discharge alarms, with adjustable timing, shall be provided to allow personnel to leave the fire area before the carbon dioxide is discharged. 314

9.5.1.2.2.14 Clean Agent Suppression System

Automatic and remotely actuated clean agent fire suppression system is provided for the AAC D/G Building Control Room and MV SWGR Room. The system is designed in accordance with NFPA 2001. An odorizer shall be utilized in the system to allow detection of the clean agent in stagnant areas of applications and to provide an early warning to personnel of system activation.

9.5.1.2.2.15 Reactor Coolant Pump Oil Collection

RCP lube oil collection system designed to withstand the safe shutdown earthquake is provided in the containment. Separate oil collection system per RCP is installed and it is composed of piping, oil tank with flame arrestor, and supports. Each tank is sufficient to collect the lube oil inventory of RCP.

9.5.1.2.2.16 Foam-Water Spray system 561

Foam-Water Spray system is provided for Auxiliary Boiler Fuel Oil Tank. Foam tank and control panel are located in Auxiliary Boiler room and foam fire hydrants are located next to Auxiliary Boiler Fuel Oil Tank.

9.5.1.2.3 System Operation

Automatic wet-pipe sprinkler system operation is initiated on a rise in the ambient temperature to the melting point of fusible links on sealed sprinkler heads, thus permitting the heads to open. Flow of water through alarm check valves energizes local alarms, and registers an alarm condition on the audiovisual fire protection control panel in the main control room. Once initiated, wet-pipe sprinkler system operation is terminated manually by shutting an isolation gate valve. Closure of this valve is electrically supervised in the main control room.

Water spray system actuation is automatic, depending upon the hazard. Automatic operation is initiated by electric thermostat-type heat-responsive devices. These heat-responsive devices detect either a rapid rise in ambient temperature or the attainment of a high fixed temperature, and release a tripping device that opens the deluge valve and thus supplies water under pressure to the open spray nozzles. Actuation of the heat-responsive device also initiates a local alarm and registers an alarm condition on the audio-visual fire protection control panel in the main control room. System operation is terminated by shutting an isolation gate valve manually. Closure of this valve is supervised in the fire protection control panel in the control room.

Charcoal filter units have fire protection systems that are manually operated from normally closed UL-approved valves. Safety-related charcoal filter units are provided with Seismic Category I Class 1E powered valves, which may be opened locally or from the main control room.

Preaction sprinkler system operation is initiated by an automatic heat detector, as appropriate for the hazard. These sensors detect heat and release a tripping device to open the deluge valve, thus supplying water under pressure to fill and pressurize the system. Actuation of a detection device also initiates a local alarm, and registers the alarm condition on the audio-visual fire protection control panel in the main control room. Preaction sprinkler system operation is continued on rise in ambient temperature to the melting point of fusible links on sealed sprinkler heads, thus permitting the heads to open. Once initiated, system operation is terminated by manually shutting an isolation gate valve. Closure of this valve is supervised in the control room. The piping downstream of the deluge valve is pressurized with air. Low air pressure in this piping will give an audible and visual alarm in the main control room, thus loss of air pressure is indicative of failure of piping or sprinkler heads.

Hose racks are operated manually by plant personnel. Each rack is controlled by a normally-closed hose valve. Hose nozzles are fully adjustable from complete shutoff to a straight stream, except in areas where high voltage electrical equipment presents a shock hazard. In such areas, hose nozzles without the straight stream capability are provided.

The fire and smoke monitoring, detection, and alarm devices are activated by the several stages of fire. Photo-electric detectors alarm at the presence of invisible combustion particles during the incipient stage of fire. Flame detectors respond directly to the infrared radiation emanating from a flickering flame sustained for at least 3 seconds in areas where fire develops rapidly with a minimum or absent incipient stage. Smoke detectors respond directly to visible smoke concentrations of not less than 0.6 percent/ft of light obscuration caused by smoke for at least 5 seconds (reference 1). Thermal detectors react to the attainment of a high fixed temperature, or rapid rise in ambient temperature (in excess of 15F per minute), and provide alarm service as well as release service for certain automatic systems as discussed above. 451

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Failure of a single fire detection device is annunciated by the circuit's supervisory alarm. Indication of a circuit failure prompts inspection and replacement or repair of the failed component. During the period when the failed fire detector is out of service, a detection capability continues to exist since more than one detector is installed in each area (refer to table 9.5-2).

The automatic carbon dioxide extinguishing system is initiated by a heat or smoke detector and also, initiated by manual actuation of the pushbutton station. Upon detection of a fire, an alarm sounds to warn personnel of the impending discharge.

The discharge is started by opening both of the main and extended discharge valves for deep seated fire and by opening the main discharge valves for surface fire. The flow through the main discharge line provides rapid total flooding for fast extinguishment. An interlock signal from CO_2 transponder cabinet automatically closes the associated HVAC dampers to shut off the major ventilation openings at the beginning of the discharge. 314

The clean agent suppression system initiated by detectors or manually by actuation of a handswitch. Actuation of a detector in one zone activates an alarm to warn personnel of the impending discharge.
The discharge from the storage cylinders is started by a manual actuation lever mounted on top of the cylinder valve or automatically by actuation of a detector.

9.5.1.3 Safety Evaluation

The KNU 5&6 powerblock has been designed to provide protection
for safety-related equipment from hazards and events that could
reasonably be expected to occur. This protection is provided to
ensure that recovery from the event is possible, to ensure the
integrity of the reactor coolant pressure boundary, to minimize 314
the release of radioactivity, and to enable the plant to be
placed in a safe shutdown condition. The containment isolation
system is described in subsection 6.2.4

Portions of the FPS that pass through areas containing safety-related equipment are seismically supported to prevent unacceptable damage resulting from an SSE.

9.5.1.4 Tests and Inspections

9.5.1.4.1 Preoperational Testing

Each fire pump is subjected to a factory hydrostatic test to not less than 250 psig, performance certified, and accepted after installation and field testing to 150 percent of rated capacity. Underground piping is hydrostatically tested at a pressure of 200 psig, and leakage at this pressure does not exceed 2 qt/h per 100 joints. Wet standpipe, wet sprinkler, and water spray piping is hydrostatically tested at a pressure of 200 psig with no visible leakage. Alarm valves, deluge valves, strainers, and all components are tested for operative condition, and drainage facilities for each system are tested by opening drain valves with control valve wide open.

9.5.1.5 Personnel Qualification and Training

The fire protection engineer of the architectural engineering contractor is qualified by training and experience to design and select equipment for the fire protection system.

The existing Kori fire protection program covers KNU 1, under operation, and KNU 2 and KNU 5 & 6, which is under construction. This program is updated every year and will be modified to keep up with the transition from construction to operational phase.

The manager of the plant security division is responsible for updating the fire protection program, control of the firefighting crew, training and drills, and maintaining and inspecting the fire protection equipment.

Fire protection training will be conducted twice a year for all plant personnel and drills will be performed monthly as part of a civil defense drill.

Fire drills for the firefighting crew will be carried out twice a month and will include activation, firefighting against a simulated fire, and life safeguard and first aid activities.

Key members of the firefighting crew and fire protection organization have taken a three-day training course for fire protection administered by the provincial government.

For the operation period of plant, personnel training will comply with the Fire Protection Program of Kori Units 3&4 561

9.5.2 COMMUNICATION SYSTEMS

The communication systems are designed to provide reliable and effective communications between essential locations of the plant and the control room, and to locations remote from the plant during normal operations or under emergency conditions. The communication systems are designed so that a failure of one system will not impair the operation or the reliability of the other systems.

9.5.2.1 Design Basis

A. Diverse and redundant communication systems are provided to ensure a reliable means of intraunit communication.

B. A telephone system, direct wire system, and a public address system are provided to employ diverse systems to ensure maximum flexibility in onsite and offsite communications during emergency conditions.

C. An evacuation alarm system is provided.

D. A private automatic branch exchange (PABX) telephone system provides intraplant, interplant, and plant-to-offsite communication on a continuous basis.

E. A system is provided for direct communication between the control room and offsite locations.

F. The plant has communication links to its dispatching center and system control center via microwave system.

G. Each individual communication system is provided with a separate and independent power source. The main equipment cabinets and power supplies for each system are located in separate areas, to minimize the probability that a local fire will disable more than one system.

9.5.2.1.1 Codes and Standards

The communication systems conform with applicable codes and standards.

9.5.2.2 System Description

9.5.2.2.1 In-plant Communication System

9.5.2.2.1.1 Public Address System. For operating purposes, a public address (PA) system is provided which consists of handset stations and loudspeaker assemblies, each including its own amplifier.

The system provides two independent communication modes: page and party line. The party line consists of five circuits. Intraplant communication can be established by using the page channel to call a particular party and then communicating through one of the five party lines available, thus leaving the page channel open for others.

This page-and-party system is available for use during an emergency shutdown operation outside the control room for communication between the remote shutdown area, control room, and other areas that may require operator action during this period. Figure 9.5-4 (sheet 1 of 4) shows the system block diagram for the public address system.

9.5.2.2.1.2 Evacuation Alarm System. An evacuation alarm system is provided by means of multitone generator whose output is broadcast throughout the plant via the main amplifiers. The audible alarm system is supplemented by visual alarms in high noise areas. The tone generator is manually activated from the main control board. Figure 9.5-4 (sheet 2 of 4) shows the system block diagram for the evacuation alarm including backup evacuation alarm system.

9.5.2.2.1.3 Backup Evacuation Alarm System. A backup evacuation alarm system is provided by means of multitone generator whose output is broadcast throughout the plant via the PA system.

9.5.2.2.1.4 Telephone System

A. A sound-powered telephone system shall be located throughout the plant at designated control points for plant maintenance and test and to serve as a backup communication system.

B. A sound-powered telephone system shall be located throughout the refueling areas and the control room for each unit. Figure 9.5-4 (sheet 3 of 4) shows the system block diagram for the sound-powered telephone system.

9.5.2.2.1.5 Direct Wire System.

A. This system consists of desk-type telephones and bells located throughout the plant and at the switchboard in the control room.

B. This system operates as backup public address system by means of PA circuits when the PA system fails. Figure 9.5-4 (sheet 4 of 4) shows the system block diagram for the direct wire system.

9.5.2.2.2 Public Offsite Communication System

9.5.2.2.2.1 Commercial Telephone. Plant-to-offsite communication during normal operations is accomplished through a commercial dial-type telephone system, with extensions installed at a limited number of locations throughout the plant. The system provides direct dialing to locations outside the plant, both local and long distance, and also between extensions within the plant.

9.5.2.2.3 Private Offsite Communication System

The private offsite communication system provides communication between the plant and offsite locations, including the security forces and remote points in the power system.

9.5.2.2.3.1 <u>Security Force Communications.</u> Two communication channels to offsite security forces are required. The public offsite communication system described in subparagraph 9.5.2.2.2 is used as one communication channel. The second channel may consist of a second, private telephone line using a separate route of departure from the site, or a radio.

9.5.2.2.3.2 <u>Power System Communications.</u> Communication with offsite locations in the power system is provided by means of a private communications network. This consists of a microwave telephone/radio system as described below:

9.5.2.2.3.3 <u>Radio.</u> A radio is provided for both normal and emergency communications. The normal power source is ac, with automatic transfer to battery power supply when required. A control unit located in the plant control room provides a means of emergency communication from the control room to offsite.

9.5.2.2.3.4 <u>Microwave Telephone.</u> For normal system communications, a microwave telephone channel connects the control room to the control center and the system load dispatcher.

9.5.2.3 Safety Evaluation

Inasmuch as the communication systems have no safety design basis, no safety evaluation is provided.

9.5.2.4 Inspection and Testing

Systems of the types described above are conventional and have a history of successful operation at existing plants. Most of these systems are in routine use, and this will assure their availability. Systems not frequently used are tested at periodic intervals to assure operability when required.

9.5.3 LIGHTING SYSTEMS

9.5.3.1 Design Bases

The components of the lighting system associated with safety-related equipment are protected from winds, floods, missiles, and pipe ruptures only to the extent that protection provided for specific engineered safety features (ESF) equipment may also protect components of other systems physically within that protected area. Protection from wind and tornado effects is discussed in section 3.3, flood design in section 3.4, missiles in section 3.5. dynamic effects associated with the postulated rupture of piping in section 3.6. Seismic qualification of Seismic Category I equipment is discussed in section 3.10.

9.5.3.1.1 Safety Design Bases

9.5.3.1.1.1 Safety Design Basis One. Structures supporting the essential lighting and emergency lighting system components, which serve the main control room, access and egress routes and the auxiliary shutdown panel area, shall be designed to prevent their collapse during and after a safe shutdown earthquake (SSE). The light fixtures for the essential lighting and the battery pack powered fluorescent emergency lights for the operating area of the control room are not designed to be functionally operational after a seismic event.

The backup incandescent emergency light units including the battery packs and the seal beam lamps which are used in areas occupied during a reactor shutdown or emergency, and the access and egress pathways for a reactor shutdown or emergency are seismically qualified. 462

9.5.3.1.1.2 Safety Design Basis Two. The lighting system is designed so that a single failure of any electrical component, assuming loss of offsite power, cannot terminate the system's ability to illuminate areas occupied during a reactor shutdown or emergency, or the access and egress pathways for a reactor shutdown or emergency.

9.5.3.1.1.3 Safety Design Basis Three. Lighting fixtures containing mercury and mercury switches are not used inside the reactor containment building or the fuel pool area, including the fuel transfer crane.

9.5.3.1.2 Power Generation Design Bases

9.5.3.1.2.1 Power Generation Design Basis One. Area lighting intensities provide the illumination required for comfort and worker efficiency in the performance of the visual activities required in that area.

9.5.3.1.3 Codes and Standards

Codes and standards applicable to the lighting system are listed in table 3.2-1. Generally, design of the plant lighting system follows the guidance provided by the Handbook of the illuminating Engineering Society and the National Electrical Code (NFPA No. 70-1978/ANSI CI-75). 462

9.5.3.2 System Description

9.5.3.2.1 General Description

Plant lighting is divided into three categories: normal, essential, and emergency. The normal system is powered from normal ac buses, whereas the essential system is connected to ESF ac buses. The emergency lighting system consists of battery pack units(self-contained battery pack, distribution panel for emergency lighting in MCR) with integral charger dc units, and inverters in those packs powering emergency fluorescent lamps. 585

9.5.3.2.2 Component Description

9.5.3.2.2.1 Normal Lighting. The normal lighting system is that portion that provides illumination for the entire plant. The lighting load is distributed among the non-Class 1E distribution systems.

9.5.3.2.2.2 Essential Lighting. The essential lighting system is designed to provide illumination to all areas required to shut down and maintain the unit in a cold shutdown condition, whether in the control room or from outside the control room (see table 9.5-3) The essential lighting system supplements the normal lighting, and provides a minimum level of illumination in the event of a failure of the normal lighting system. The ac essential lighting system is normally energized. The ac essential lighting system is supplied power from redundant Class 1E MCCs, through Class 1E isolating transformers, and is not tripped on safety injection signal (SIS). The system is deenergized, however, upon loss of voltage (LOV) to the Class 1E 4.16 kV switchgear. In that event, the essential lighting system will be restored by the second step of the diesel generator sequencer.

9.5.3.2.2.3 Emergency Lighting. The dc-powered emergency lighting system is provided at locations required to shut down and maintain the unit in a cold shutdown condition from outside the control room. These areas are identified in table 9.5-3. In addition, the emergency lighting system is provided in remote areas, exit aisles, and corridors throughout the plant to permit an orderly personnel evacuation. In the event of the loss of essential and/or normal lighting sources, the dc emergency lighting system is energized automatically. The dc emergency sealed beam lighting units consist of fixtures that have battery pack units(self-contained battery pack, distribution panel for emergency lighting in MCR), battery charger, and switches that automatically energize the fixtures from their batteries in the event of the loss of the ac source for their battery chargers. 585

The emergency lighting fixtures are designed to provide lighting for a minimum continuous period of 8 hours. Spare battery pack units(self-contained battery pack, distribution panel for emergency lighting in MCR) will be readily acvailable to areas as required should there be a need for dc lighting in excess of 8 hours. 585

9.5.3.3 Safety Evaluation

The safety evaluations are numbered to correspond to the safety design bases.

9.5.3.3.1 Safety Evaluation One

All lighting systems that serve the main control room are designed in accordance with Industrial Standard Quality Class requirements. The supporting steel elements are designed and installed to Quality Class T requirements.

9.5.3.3.2 Safety Evaluation Two

Reliable lighting is provided to permit the operators to shut down the plant safely and maintain it in a cold shutdown condition at any time. The lighting system is designed to provide illumination in those areas used during reactor shutdown or emergency, and which provide access or egress to those areas.

The essential and emergency lighting in the control room and the local stations is arranged so that alternate rows of fixtures are fed by redundant Class 1E buses to provide uniform distribution of adequate lighting in the event of loss of one of the Class 1E buses.

Each Class 1E bus can be energized by a diesel generator. If the normal source to a Class 1E bus fails, the diesel generator is automatically started. During this period, illumination 462

is provided by the emergency lighting. The essential lighting that was affected is restored automatically after the diesel generator has started and its circuit breaker is closed. In the event that all ac power is lost, illumination in the control room and other areas where it is required will be provided by the self-contained emergency lighting fixtures and distribution panel for emergency lighting in MCR. 585
These units are energized upon loss of normal or essential power.

In those areas that are not required to be occupied during shutdown or emergency, normal area lighting is supplied by the non-Class 1E distribution systems. Should one of these distribution systems become unavailable or power to its circuit be lost, a portion of the normal lighting fixtures will be deenergized.

Refer to table 9.5-4 for a single failure analysis of lighting systems.

9.5.3.3.3 Safety Evaluation Three

Lighting fixtures containing mercury are prohibited inside the containment building and fuel building, including the fuel transfer crane, because of potential amalgamation of mercury with many metals used in reactor systems and the degrading of those metals.

9.5.3.4 Tests and Inspections

The normal and essential ac lighting circuits are normally energized and require no periodic testing. The emergency lighting units(self-contained lighting units, emergency lighting with distribution panel in MCR) are inspected and tested periodically to ensure the operability of the components in the system. 585

9.5.4 DIESEL GENERATOR FUEL OIL STORAGE AND TRANSFER SYSTEM

9.5.4.1 Design Bases

Criteria for selection of design bases are stated in paragraph 1.1.2.2.

Protection of the diesel generator fuel oil storage and transfer system from wind and typhoon effects is discussed in section 3.3; flood design in section 3.4; missile protection in section 3.5; protection against dynamic effects associated with the postulated rupture of piping in section 3.6; and environmental design in section 3.11.

9.5.4.1.1 Safety Design Bases

9.5.4.1.1.1 Safety Design Basis One. The diesel generator fuel oil storage and transfer system provides onsite storage and delivery of fuel oil for at least 7 days of operation to all diesel generators assigned to the unit at the largest actual operating load of section 8.3, Onsite Power Systems, for a design basis accident assuming a loss of all offsite power sources, plus 15 percent additional storage of fuel required to test the engines periodically.

9.5.4.1.1.2 Safety Design Basis Two. The diesel generator fuel oil storage and transfer system is designed so that a single failure of any active component cannot cause loss of the system's ability to mitigate the consequences of an accident, or to safely shut down the reactor.

9.5.4.1.1.3 Safety Design Basis Three. The diesel generator fuel oil storage and transfer system is designed to remain functional during and after a safe shutdown earthquake (SSE).

9.5.4.1.2 Power Generation Design Bases

The diesel generator fuel oil storage and transfer system has no power generation design basis.

9.5.4.1.3 Codes and Standards

Codes and standards applicable to the diesel generator fuel oil storage and transfer system are listed in table 3.2-1. The system is designed and constructed in accordance with Quality Group C specifications.

9.5.4.2 System Description

9.5.4.2.1 General Description

The diesel generator fuel oil storage and transfer system is shown schematically in figure 9.5-5. The system consists of two fuel oil bulk storage tanks, four fuel oil transfer pumps, two fuel oil day tanks, and associated piping and instrumentation.

9.5.4.2.2 Component Description

9.5.4.2.2.1 Fuel Oil Bulk Storage Tanks. Two fuel oil bulk storage tanks, one for each diesel engine, are provided. Both tanks are below ground and located near the diesel generator building. Each tank is sized to provide sufficient fuel to operate its associated diesel generator at 100 percent rated output for 7 days with sufficient additional storage capacity to permit periodic testing of the associated diesel generator and to allow replenishment of the fuel oil supply on approximately 6-month intervals. Each tank has a capacity of 100,000 gallons. Appropriate connections for level instruments, sounding, sampling and water removal are provided. Each tank has a truck connection and appropriate isolation capabilities for emptying its contents. The type of fuel stored is No. 2 diesel oil. The fuel oil bulk storage tank is vented to atmosphere and is provided with a flame arrestor.

9.5.4.2.2.2 Diesel Fuel Oil Transfer Pumps. Four diesel fuel oil transfer pumps, two for each diesel generator (one operating, one standby) are provided. Each pump motor is powered from the Class IE bus to which the diesel generator it serves is connected. Each pump is capable of a flow capacity of 25 gal/min at 92 feet of head. Each pump has a capacity equal to approximately three times the full load fuel consumption rate. The pumps are of the submerged horizontal centrifugal type and are mounted in the fuel oil bulk storage tanks. Each fuel oil train is physically and operationally independent of the other train. However, cross-connected piping with locked closed valves are provided to permit pumping from the storage tank of one train to the day tank or the bulk storage tank of the other train when the transfer operation is under local manual control. A twin basket strainer is provided on the pump discharge line to remove debris from the system. The strainer is provided with high differential-pressure alarms, both locally and in the control room, which alert operators to a clogged strainer condition. Twin basket strainers are provided for rapid change of strainer system should one basket become clogged. As an additional backup, a manual bypass is provided across the twin basket strainer.

9.5.4.2.2.3 Fuel Oil Day Tanks. Each day tank, one for each diesel generator, has a capacity of 2260 gallons which is equivalent to approximately 4 hours of operation for the associated diesel generator at nameplate rating. The day tank is located above its respective diesel engine within the diesel generator building to provide a positive feed of fuel oil to the suction side of the engine-driven fuel oil pump. Each tank is provided with sample and drain connections. The day tank has provisions for draining to the oily waste system.

Overflow from the day tanks flows back to the fuel oil bulk storage tank. The day tanks are enclosed by 3-hour fire walls to comply with the requirements of NFPA 37. The day tank is vented to the outside with a flame arrestor. The engine-driven fuel oil booster pump supplies fuel oil to the injection pump and the excess fuel oil flows back to the day tank.

9.5.4.2.2.4 Piping and Fittings. Piping and fittings which are underground are located within piping tunnels. Aboveground components are located inside Seismic Category I structures which protect these components from detrimental environmental effects.

9.5.4.2.3 System Operation

Each diesel generator has its own independent fuel pumping train from the fuel oil bulk storage tank to the fuel oil day tank, with suitable normally isolated tie lines between the two flow paths. Level switches, on the day tanks, initiate a signal for the operation of the corresponding diesel fuel oil transfer pumps to replenish the day tank. Bulk storage tanks are replenished by outside delivery trucks.

The day tank contains approximately 4 hours of fuel oil inventory. A low level switch initiates the fuel oil transfer system after approximately 2 hours of operation. The diesel fuel oil transfer pump restores the fuel level within approximately 1 hour with the diesel operating. The pump is stopped by a high-level switch. The diesel fuel oil transfer pump cycles at these intervals while the diesel is operating.

Low level in the day tank is alarmed in the control room should the level drop below the 700 gallons inventory allowing more than 1 hour for an operator to investigate and rectify any malfunction, such as a clogged strainer.

Automatic pumps and valves may be controlled manually from the control room or the diesel generator room.

In the event that the diesel oil degenerates during storage, it can be discarded by using the transfer pump to pump out to disposal through a manually operated valve connection on the discharge pipe.

9.5.4.3 Safety Evaluation

9.5.4.3.1 Safety Evaluation One

The total capacity of the underground fuel oil bulk storage tanks and fuel oil day tanks is sufficient for 7 days of operation of all diesel generators assigned to the unit at the largest operating load indicated in section 8.3, Onsite Power Systems, for a design basis accident. Within this period, additional fuel could be delivered to the plant site by truck, rail, or helicopter.

9.5.4.3.2 Safety Evaluation Two

There is complete physical redundancy of active components in the diesel generator fuel oil system. Two diesel fuel oil transfer pumps are provided for each diesel generator. Each pump is powered from the Class IE bus on which the diesel generator it serves is connected. Failure of any pump or diesel generator would not affect the operability of any component in another train.

9.5.4.3.3 Safety Evaluation Three

The diesel generator fuel oil storage and transfer system is designed in accordance with Seismic Category I requirements as specified in section 3.2. The components (and supporting structures) of any system, equipment, or structure which is not Seismic Category I and whose failure could result in loss of a required function of the diesel generator fuel oil system through either impact or flooding are analytically checked to determine that they will not fail when subjected to seismic loading resulting from the SSE.

9.5.4.4 Tests and Inspections

The diesel generator fuel oil storage and transfer system receives an NDT examination in accordance with the ASME B&PV Code, Section III, Class 3. A discussion of preoperational testing requirements is given in chapter 14.

The diesel generator fuel oil storage and transfer system operability can be demonstrated during regularly scheduled tests of the diesel generator. Fuel oil samples are tested upon delivery for water & sediment, distillation temperature,
23 flash point, sulfur, ash, cloud point, ramsbottom carbon residue, kinematic viscosity, copper strip corrosion rating, and cetane number. Fuel reserve for testing is supplied by sizing the fuel oil bulk storage tank to contain 15 percent more fuel than required as cited in safety design basis one.

Fuel sample from the bulk fuel storage tanks is to be analyzed, on a monthly basis, for particulate Contaminant in accordance with ASTM D2276. If the given limits are exceeded, the diesel engine supplied from that tank will be considered inoperable and the fuel must be replaced within 7 days according to ITS Chapter 1 3.8.3. 23 357 358

In order for the diesel fuel oil transfer pump to be tested independently of the diesel generator, the day tank is manually drained to the setting which will automatically start the diesel fuel oil transfer pump. The day tank is drained to the bulk storage tank. The overflow line from the day tank is also routed to the bulk storage tank.

9.5.4.5 Instrumentation Applications

Diesel fuel oil transfer pumps and valves with actuators can be operated from either the control room or the diesel control panel. Alarms and indications of tank levels and diesel fuel oil transfer pump (running) status are displayed in the control room and at the diesel control panel. Day tank level switches start and stop the diesel fuel oil transfer pumps and activate a day tank low and high level alarms. The following alarms, belonging to the fuel oil storage and transfer subsystem of each diesel generator unit, are located on a local control panel provided with each diesel generator:

A. Low fuel oil level in day tank

B. High fuel oil level in day tank

C. High fuel oil twin basket strainer differential pressure

D. Fuel oil day tank room exhaust fan off

E. Low fuel oil level in bulk storage tank

F. High fuel oil level in bulk storage tank.

9.5.5 DIESEL GENERATOR COOLING WATER SYSTEM

This subsection discusses the mechanical features of the diesel generator cooling water system (DGCWS). Diesel generator cooling water interlocks are discussed in section 7.6. The standby power supply, i.e., the diesel generator system, is discussed in subsection 8.3.1.

9.5.5.1 Design Bases

Criteria for the selection of design bases are stated in paragraph 1.1.2.2.

Protection of the diesel generator cooling water system from wind and typhoon effects is discussed in section 3.3, flood design in section 3.4, missile protection in section 3.5, protection against dynamic effects associated with postulated rupture of piping in section 3.6, and environmental design in section 3.11.

9.5.5.1.1 Safety Design Bases

9.5.5.1.1.1 Safety Design Basis One. The DGCWS is capable of removing sufficient heat to permit continuous operation of the diesel engine at maximum load.

9.5.5.1.1.2 Safety Design Basis Two. The DGCWS is designed to remain functional during and after a safe shutdown earthquake.

9.5.5.1.1.3 Safety Design Basis Three. The DGCWS is designed so that a single failure of any active component, assuming a loss of offsite power, cannot result in complete loss of the diesel generation function.

9.5.5.1.1.4 Safety Design Basis Four. In normal standby status, DGCWS is maintained in a warmed condition to promote starting.

9.5.5.1.1.5 Safety Design Basis Five. Active components of the DGCWS are capable of being tested during plant operation in accordance with 10 CFR 50, General Design Criteria 45 and 46.

9.5.5.1.2 Power Generation Design Bases

The diesel generator cooling water system has no power design basis.

9.5.5.1.3 Codes and Standards

Codes and standards applicable to the DGCWS are listed in table 3.2-1. The system is designed and constructed in accordance with Quality Group C specifications.

9.5.5.2 System Description

9.5.5.2.1 General Description

The DGCWS provides cooling water to the diesel engine and its critical parts and is an integral part of the diesel generator package. The DGCWS is shown schematically in figure 9.5-6. Each engine has its own cooling system. Each system consists of the jacket water cooler, standpipe, engine jacket water pump, two air coolers, a governor cooler, two turbo coolers, two exhaust jackets, a keep-warm pump, immersion heater, and a lube oil cooler.

The DGCWS heat is rejected to the nuclear service cooling water system. The DGCWS is filled from the condensate storage system.

9.5.5.2.2 Component Description

9.5.5.2.2.1 Jacket Cooling Water Pump. The diesel generator jacket cooling water pump is a centrifugal type powered by direct drive from the diesel engine. The pump circulates cooling water through the diesel generator coolant loop during periods of diesel engine operation. A failure of this pump constitutes an engine failure.

9.5.5.2.2.2 Heat Exchanger. The diesel generator cooling water heat exchanger is a shell and tube heat exchanger which provides the means for removing heat from the diesel generator coolant loop. Diesel generator cooling water (1800 gal/min) flows through the shell side, and nuclear service cooling water (2000 gal/min) flows through the tube side. Inlet valves which permit nuclear service cooling water to flow through the diesel generator heat exchanger are locked open.

9.5.5.2.2.3 Thermostatic Valve. A three-way thermostatic valve is installed in the diesel generator coolant loop at the inlet to the diesel generator coolant heat exchanger, providing the capability to bypass diesel generator cooling water around the heat exchanger for fast engine warmup. The valve is designed so that there is always some flow through the heat exchanger. Remote manual control of the valve (overriding the automatic function) is possible.

9.5.5.2.2.4 Turbocharger Air Cooler. The turbocharger air coolers are located between stages of the turbocharger on the diesel engine. Turbocharger air passes through the shell side of the cooler, and diesel generator cooling water flows through finned tubes.

9.5.5.2.2.5 Lube Oil Cooler. Diesel generator lube oil passes through the shell side of the lube oil cooler, and diesel generator coolant flows through the tube side of the heat exchanger. The diesel generator lubrication system is discussed in subsection 9.5.7.

9.5.5.2.2.6 Standpipe. The standpipe connected to the diesel generator coolant loop allows for coolant volumetric changes due to temperature variations, provides makeup water, and absorbs pump pressure variations. The surge line runs from the discharge of the diesel engine water jacket to the standpipe; a return line runs from the standpipe to the inlet of the diesel generator jacket coolant water pump which serves to provide adequate suction head.

9.5.5.2.2.7 Warming Water Pump and Heater. The electric driven warming water pump and heater provide warm water to the engine's cooling system when the standby generator is not running. The purpose is to guarantee quick starting.

9.5.5.2.3 System Operation

When the diesel generator is not in operation, the unit is maintained at the optimum temperature to assure quick starting and fast loading. The warming water pump and heater run continuously to maintain the engine at this temperature by circulating warmed water through the engine water jackets. A thermostat on the heater maintains the circulating water at the proper temperature. The warming water pump and heater are automatically deenergized when the diesel engine is started.

The DGCWS provides a sufficient heat sink to permit the diesel engine to start and operate for 3 minutes without nuclear service cooling water flow through the diesel generator coolant heat exchanger. This margin is provided since the flow of nuclear service cooling water to the diesel generator heat exchanger will be interrupted after a loss of offsite power until the nuclear service cooling water pumps are restarted by the diesel generator.

During operation of the diesel engine, temperature regulation of the diesel generator coolant is accomplished through action of the automatic three-way thermostatic valve, which modulates coolant flow between the diesel generator coolant heat exchanger and its associated bypass line. In this manner, the engine cooling water is maintained at the proper temperature for maximum engine efficiency.

Active components in the DGCWS include the diesel generator coolant pump, the warming water pump, and the three-way thermostatic valve.

Failure of the direct-driven coolant pump, indicated by a low pump differential pressure alarm, requires shutdown of its diesel generator; the other redundant train of engineered safety features equipment continues to be powered by its associated diesel generator.

Failure of the warming unit while the diesel engine is in standby status would be indicated by the water jacket low temperature alarm; this annunciation would prompt operators to replace the failed unit or start the engine to prevent DGCWS low temperatures. The pump may be readily replaced and the large mass of the diesel engine will retain heat for lengthy periods. Moreover, reduction to room temperature does not seriously lengthen the time required to start the engine (the diesel generator room minimum air temperature is 50°F). 462
The three-way thermostatic valve is designed to fail in the position directing full coolant flow to the diesel generator heat exchanger, to provide maximum cooling.

However, should the three-way valve become stuck in some other position, some portion of the diesel generator cooling water flow would be bypassed around the heat exchanger. If sufficient flow is bypassed, the engine temperature begins to increase. High temperature alarms indicate the malfunction, and prompt manual control of the valve's position may be taken; high temperatures do not, however, automatically initiate diesel generator shutdown.

Initial filling and makeup water for the diesel generator cooling water system is supplied from the condensate storage system.

For the control of long term corrosion and to prevent the formation of scale deposits, boron nitrite will be used 131
as corrosion inhibitor as recommended by the diesel generator manufacturer. Weekly test must ensure that the water pH value is maintained within the range of 8.25 to 9.75.

9.5.5.3 Safety Evaluation

9.5.5.3.1 Safety Evaluation One

Each diesel generator's coolant pumps, pipes, heat exchangers, and valves are sized to allow a flow of cooling water sufficient to remove 22.3×10^6 Btu/hr to prevent engine overheating. Calculations are based upon the warmest expected temperatures of service water and diesel generator room air.

9.5.5.3.2 Safety Evaluation Two

The DGCWS, as a supporting component of the diesel generator system, is designed to Seismic Category I requirements as defined in section 3.2. The components and supporting structures of any system, component, or structure which is not seismic category I and whose failure could result in loss of a required function of the diesel generator cooling water system through either impact or flooding are supported to ensure that they will not fail when subjected to seismic loading resulting from a SSE.

9.5.5.3.3 Safety Evaluation Three

The cooling water supply to each diesel generator is sized to provide adequate diesel generator cooling as discussed in safety evalution one above. The cooling water subsystem for each generator is capable of supplying this cooling water without augmentation from other sources. The cooling water pump is driven by the diesel engine with which it is associated. Because of these arrangements and the redundance of emergency diesel generator design and installation, a failure of any single active component of a diesel generator cooling water system cannot result in a complete loss of more than one diesel generator.

The most severe single failure would result in failure of the diesel generator with which it is associated. In such a circumstance, cold shutdown can be attained and maintained by the redundant diesel generator.

9.5.5.3.4 Safety Evaluation Four

The diesel generator warming water system warms and circulates water through the diesel engine cooling water jacket to promote the engine's starting capability. Failure of the system is annunciated by a jacket cooling water low temperature alarm.

9.5.5.3.5 Safety Evaluation Five

The entire diesel generator system, including the cooling water system, may be tested during all normal modes of power plant operation. During these tests, coolant flow rates and temperatures are monitored to ensure that the heat exchangers, coolant pump, and three-way thermostatic valve are functioning properly. In standby status, operability of the heater and electric circulating pump is evident by inspection.

9.5.5.4 Tests and Inspections

Testing of the diesel generator system is discussed generally in section 8.3 Visual inspections, pressure and leak testing, in accordance with the governing ASME code and operational checks of the cooling system components, are performed as the unit is installed. The DGCWS is operationally checked during the periodic testing of the diesel generator system. The warming water system is operationally checked during diesel generator shutdown periods.

9.5.5.5 Instrumentation Applications

Indications of system temperatures and jacket water pressure are provided in the diesel generator room. High and low temperature, jacket water low pressure, and low level jacket water alarms are provided locally, and to the main control room. Warming water pump running status is displayed at the diesel generator engine control board. Diesel generator cooling water interlocks are discussed in section 7.6.

9.5.6 DIESEL GENERATOR STARTING SYSTEM

This subsection discusses the mechanical features of the diesel generator starting system (DGSS). Control and instrumentation for starting the diesel generator system is discussed in section 7.3. The standby power supply, i.e., the diesel generator system, is discussed in detail in subsection 8.3.1.

9.5.6.1 Design Bases

Criteria for selection of design bases are stated in paragraph 1.1.2.2.

Protection of the DGSS from wind and typhoon effects is discussed in section 3.3; flood design in section 3.4; missile protection in section 3.5; protection against dynamic effects associated with postulated rupture of piping in section 3.6; and environmental design in section 3.11.

9.5.6.1.1 Safety Design Bases

9.5.6.1.1.1. Safety Design Basis One. The DGSS initiates an engine start such that within 10 seconds after receipt of the start signal, the diesel generator is operating at rated speed and is ready to begin load sequencing.

9.5.6.1.1.2 Safety Design Basis Two. No single active failure in the DGSS will impair the capability of the system to comply with safety design basis one.

9.5.6.1.1.3 Safety Design Basis Three. Portions of the DGSS which are required in order to start the diesel upon receipt of an engineered safety features actuation signal (ESFAS) are designed to remain functional during and after a safe shutdown earthquake.

9.5.6.1.1.4 Safety Design Basis Four. Active components of the system can be tested during plant operation in accordance with 10 CFR 50, General Design Criterion 18.

9.5.6.1.2 Power Generation Design Bases

The DGSS has no power generation design basis.

9.5.6.1.3 Codes and Standards

Codes and standards applicable to the DGSS are listed in table 3.2-1. All equipment necessary to start the diesel generator including the air receiver tanks, valves, and piping, with the exception of that equipment located on the engine, are made of carbon steel, meet the requirements of ASME Section III and are designed and constructed in accordance with Quality Group C specifications; the remainder is Quality Group D.

9.5.6.2 System Description

9.5.6.2.1 General Description

Each diesel generator is equipped with two independent and redundant air starting trains. The starting air system piping schematic is shown in figure 9.5-7. Each starting train consists of an air compressor, air dryer, air receiver, strainer, injection lines, and two redundant admission valves. The standby power supply, i.e., the diesel generator system, is discussed in detail in subsection 8.3.1.

9.5.6.2.2 Component Description

9.5.6.2.2.1 Air Compressor. A motor-driven, two-stage, air-cooled air compressor rated at 88 standard ft^3/min is provided for each starting train. The compressor is sized to completely charge, within 30 minutes, its respective air receiver from minimum starting air pressure of 150 psig to the normal operating pressure of 250 psig. The air compressor is automatically started when receiver pressure drops below 235 psig.

9.5.6.2.2.2 Air Receiver. A 305-cubic-foot carbon steel compressed air storage tank is provided in each starting train. The receiver is sized to provide a minimum of five engine starts without being recharged; a low pressure alarm annunciates at 215 psig, indicating the air compressor has failed to start.

9.5.6.2.2.3 Air Dryer. A desiccant type, heatless regeneration air dryer is provided in each starting air train to maintain the effluent dewpoint temperature at -40°F. 462

9.5.6.2.3 System Operation

The air receivers for each diesel engine are maintained under pressure by its respective compressor. The compressors start when air receiver pressure drops below 235 psig and stop when pressure increases to 250 psig. Two compressors are provided for each diesel generator. Each compressor keeps its respective receiver pressurized. Check valves in the air receiver charging lines ensure that a line failure in the charging system will not rapidly depressurize the receiver tanks and affect the ability of the air starting system to start the diesel. An alarm activates when receiver pressure drops below 215 psig.

Starting signals for the emergency diesel generators are produced by coincidence of two out of four trips of bus undervoltage monitors, or by receipt of a BOP ESFAS (loss of voltage) signal. Control of the automatic starting system is discussed in detail in subsection 8.3.1.

The starting signal causes the redundant start air admission valves in each train to open, admitting receiver air at high pressure to turn and start the engine. Starting air flow is stopped when the engine is running under its own power. Should one air solenoid fail to operate, the redundant air solenoid in the same train will function and not compromise the safety of the system.

9.5.6.3 Safety Evaluation

Safety evaluations are numbered to correspond to the safety design bases.

9.5.6.3.1 Safety Evaluation One

Compressed air for each diesel is stored in two individual starting trains. Each train holds sufficient air to start the diesel five times under a no-load condition without compressor assistance. The continuous availability of the air starting system will keep the diesel engine in constant readiness.

9.5.6.3.2 Safety Evaluation Two

Each diesel generator air starting system consists of two redundant receivers and associated redundant solenoid valves. Each air receiver, when fully charged, contains sufficient air to start its associated diesel engine at least five times. Should an air solenoid valve on one train fail to open, the redundant air solenoid valve will function and start the diesel. A failure of the compressor is indicated by an air receiver low pressure alarm; this alarm prompts the operator to take corrective action. A single active failure in either starting system will not compromise the ability of the systems to accomplish their function (refer to table 9.5-5).

9.5.6.3.3 Safety Evaluation Three

The diesel engine starting system, exclusive of the air compressors and air dryers, is designed in accordance with Seismic Category I requirements as specified in section 3.2. Any system, equipment, or structure which is not Seismic Category I and whose collapse could result in loss of a required function of the DGSS through either impact or flooding, is supported to ensure that it will not collapse when subjected to seismic loading.

9.5.6.3.4 Safety Evaluation Four

All active components of the system can be separately tested during plant power generation operation, as discussed in paragraph 9.5.6.4 below.

9.5.6.4 Tests and Inspections

The air compressor for each diesel engine is test-started periodically to assure continued operability. Compressor suction air filters are periodically checked for cleanliness. During the preoperational testing of the diesel generator, the entire compressed air starting system is operated to ensure 100 percent capability.

The air starting system can be tested during normal plant operation as described in subsection 8.3.1.

9.5.6.5 Instrumentation Applications

Each compressor and air receiver is furnished with instrumentation consisting of locally mounted pressure switches, pressure indicators, and automatic protection devices. The temperature and pressure switches support the automatic control modes of compressor and receiver operation.

Low starting air pressure and diesel start failure are annunciated locally and in the main control room.

Instrumentation and control for automatic diesel generator starting is discussed in section 7.3.

9.5.7 DIESEL GENERATOR LUBRICATION SYSTEM

This subsection discusses the diesel generator lubrication system (DGLS). The standby power supply, i.e., the diesel generator system, is discussed in detail in subsection 8.3.1.

9.5.7.1 Design Bases

Criteria for the selection of design bases are stated in paragraph 1.1.2.2.

Protection of the DGLS from wind and typhoon effects is discussed in section 3.3, flood design in section 3.4, missile protection in section 3.5, protection against the dynamic effects associated with postulated rupture of piping in section 3.6, and environmental design in section 3.11.

9.5.7.1.1 Safety Design Bases

9.5.7.1.1.1 Safety Design Basis One. The DGLS provides lubricating oil to all turbocharger and engine bearings during diesel generator operation and shutdown.

9.5.7.1.1.2 Safety Design Basis Two. The DGLS is designed to remain functional during and after a safety shutdown earthquake.

9.5.7.1.1.3 Safety Design Basis Three. The DGLS is designed so that a single failure of any active component, assuming loss of offsite power, cannot result in complete loss of the diesel generation function.

9.5.7.1.1.4 Safety Design Basis Four. In normal standby status, the DGLS is maintained in a warmed condition to promote starting and prevent extreme lub oil viscosities.

9.5.7.1.1.5 Safety Design Basis Five. The DGLS is capable of being tested during plant power generation operation in accordance with 10 CFR 50, General Design Criterion 18.

9.5.7.1.2 Power Generation Design Bases

The DGLS has no power generation design basis.

9.5.7.1.3 Codes and Standards

Codes and standards applicable to the DGLS are listed in table 3.2-1. The system is designed and constructed in accordance with Quality Group C specifications with the exception of that equipment located on the engine.

9.5.7.2 System Description

9.5.7.2.1 General Description

Each of the two diesel generators is provided with an oil lubrication system. The lube oil system piping schematic is shown in figure 9.5-8. Major components of the system include an engine-driven pump, a lube oil collection sump, a pressure regulating valve, a full-flow duplex filter, a pressure strainer, a lube oil cooler, an electric immersion heater and electric-driven keep-warm circulating pump, and associated piping and valves. The standby power supply system is discussed in detail in subsection 8.3.1.

9.5.7.2.2 Component Description

9.5.7.2.2.1 Engine Lubricating Oil Pump. An engine-driven constant displacement, rotary-screw-type lubricating pump is provided. The pump circulates lube oil through the system during periods of diesel engine operation. Failure of this pump constitutes an engine failure.

9.5.7.2.2.2 Lubricating Oil Cooler. The diesel generator lube oil cooler is a shell and tube heat exchanger which provides the means for maintaining the lube oil temperature within limits. Diesel generator cooling water (900 gal/min) flows through the tube side while lube oil (500 gal/min) flows through the shell side.

9.5.7.2.2.3 Pressure Regulating Valve. Lubricating oil header pressure is regulated by the pressure regulating valve. Set at 50 psig, it senses header pressure and regulates the bypass volume to maintain the set header pressure.

9.5.7.2.2.4 Lubricating Oil Sump. A sump tank with a 450 gallon capacity allows for lube oil volumetric changes and provides makeup lube oil to the system.

9.5.7.2.2.5 Lubricating Oil Filter and Strainer. A 20-micron, nominal size, filter and an 80-micron, nominal size, removable basket type strainer are provided to maintain the system free of debris and other foreign matter. Both filter and strainer are duplex and full flow type, and are equipped with differential pressure indicators.

9.5.7.2.2.6 Lubricating Oil Warmup Pump and Heater. A motor-driven warmup pump and an immersion heater keep the engine warm and lubricated during standby to assure a quick start. The warmup pump is supplied with separate filter and strainer.

9.5.7.2.3 System Operation

When the engine is operating, circulation is accomplished by the lubricating pump which draws oil from the sump tank and discharges it to the lube oil cooler. From the cooler, oil flows through the duplex filter and then through the pressure strainer before distribution to bearings. Oil returns to the sump by gravity from the engine base and turbocharger. During this process, the lube oil cools internal components such as pistons by splashing against hot surfaces. All heat transferred to the lube oil is given up to the engine closed loop cooling water system, which in turn gives its heat to the nuclear service cooling water system; a three-way thermostatic valve maintains a sufficient flow through the cooler to keep the oil at a constant temperature.

The duplex filters are valved for full flow through one side only, thus it is possible to transfer flow through the parallel filter for filter replacement for inspection during engine operation.

There are also two strainers in parallel, each sized for full flow, thus permitting strainer bypass during engine operation to allow the strainer to be cleaned.

The complete lubrication system is thoroughly flushed before initial startup to make sure that there is no foreign matter in the system. Strainers are cleaned and filters replaced before the engine is put into initial operation, and again every 20 operating hours of the engine.

During standby periods, the lube oil is circulated through the immersion heater and then through the entire engine by an electric motor-driven pump. By keeping the engine warm and lubricated in this way, quick starting is assured. This keep-warm pump runs continuously during standby only and is rated for such use. Heating of the oil is automatically controlled by a thermostat. Failure of the heating unit will not adversely affect the diesel generator system since the unit may be readily replaced and the large mass of the diesel generator and lube oil retains heat for lengthy periods. Moreover, reduction to room temperature does not affect the time required to start the engine (the diesel generator building heating and ventilating system maintains the room air temperature at a minimum of 50°F). Finally, failure of 462 the immersion heating unit would be indicated by the lube oil low temperature alarm; this annunciation would prompt operators to replace the failed unit or start the engine to prevent the extreme lube oil viscosities which accompany low lube oil temperatures.

During starting or operation of the diesel generator, failure of the lube oil pump, pressure regulating valve, or three-way thermostatic valve could result in unsatisfactorily low lube oil pressure. Receipt of a low lube oil pressure signal will shut down the diesel engine during either routine or post accident operation. Since each load group is powered by an associated diesel generator, a low lube oil pressure trip of one diesel generator will not impact safety because the second diesel generator functions as a backup.

9.5.7.3 Safety Evaluation

Safety evaluations are numbered to correspond to the safety design bases.

9.5.7.3.1 Safety Evaluation One

The main diesel engine-driven pump provides oil to the engine bearings during engine operational periods. Oil is kept at a constant pressure and temperature by use of regulating valves, recirculation lines, and a lube oil cooler. After engine shut-down or during periods of standby status, the motor-driven pump and electric heater keep the bearings lubricated and warmed to 150°F. 462

9.5.7.3.2 Safety Evaluation Two

The DGLS is designed in accordance with Seismic Category I requirements as specified in section 3.2. The components (and supporting structures) of any system, equipment, or structure which are not Seismic Category I and whose failure could result in loss of a required function of the DGLS through either impact or flooding are supported to ensure that they will not fail when subjected to seismic loading.

9.5.7.3.3 Safety Evaluation Three

The lubricating oil supply to each diesel generator is sized to provide adequate diesel generator lubrication as discussed in safety evaluation one above. The lubrication subsystem for each diesel generator is capable of supplying lube oil without augmentation from other sources. The lube oil pump is driven by the diesel engine with which it is associated. Because of these arrangements and the redundancy of emergency diesel generator design and installation, a failure of any single active component of the diesel generator lubrication system cannot result in a complete loss of any diesel generator system function. Alternately considered, a single failure may be assessed as a failure of the diesel generator with which it is associated; in such a circumstance safety shutdown is attained and maintained by the redundant diesel generator installation.

9.5.7.3.4 Safety Evaluation Four

The DGLS is provided with and electric pump and immersion heater unit which circulates warmed lube oil through the engine during standby status. Extreme lube oil viscosities which accompany low lube oil temperatures are thus prevented, and quick starting of the diesel engine is assured. Failure of the unit is annunciated by a lube oil low temperature alarm set at 140°F. 462

9.5.7.3.5 Safety Evaluation Five

All active components are capable of being tested during power generation operation to ensure proper functioning of the system, as discussed in paragraph 9.5.7.4 below.

9.5.7.4 Tests and Inspections

Testing of the diesel generator system is discussed generally in subparagraph 8.3.1.1.3. The DGLS is operationally tested during the regular startup and checkout of the diesel generator.

Lube oil pressure and temperature are monitored to insure operability of the engine-driven pump and the recirculation lines. Operation of the electric pump and heater are evidence of their operability. Inspection and testing of the system can be performed without disturbing normal plant operations. The oil itself is checked at regular intervals to determine that the pH, ash content, and fuel dilution are all within the engine manufacturer's specifications.

9.5.7.5 Instrumentation Applications

Instrumentation provided for the DGLS includes pressure and temperature switches, indicators, and automatic protection devices. The temperature and pressure switches support the automatic control modes of lubrication operation. Remote control and indication are provided on the plant auxiliaries panel in the control room, as well as at the standby diesel control panel in the diesel generator building. Low lube oil pressure, high and low lube oil temperatures and high diesel generator bearing temperatures are alarmed in the control room and in the diesel generator room.

A start-failure relay, discussed in subparagraph 8.3.1.1.3, functions to interrupt starting of the diesel generator if lube oil pressure is not established within a predetermined time interval following the start initiation. A low lube oil pressure signal during operation of the engine initiates a diesel generator trip. To prevent spurious trips, three pressure switches are provided and two-out-of-three logic is employed to initiate a diesel generator trip.

9.5.8 DIESEL ENGINE COMBUSTION AIR INTAKE AND EXHAUST SYSTEM

The diesel engine combustion air intake and exhaust system (DECAIES) supplies combustion air of suitable quality to the diesel engines and exhausts the combustion products from the diesel engine to the atmosphere.

9.5.8.1 Design Bases

Criteria for the selection of design bases are stated in paragraph 1.1.2.2.

Protection of the DECAIES from wind and typhoon effects is discussed in section 3.3, flood design in section 3.4, missiles in section 3.5, dynamic effects associated with postulated rupture of piping in section 3.6, and environmental design in section 3.11.

9.5.8.1.1 Safety Design Bases

9.5.8.1.1.1 Safety Design Basis One. The DECAIES is designed and physically arranged to supply combustion air to the diesel engines and to exhaust to the atmosphere the products of combustion so that the diesel generator can be operated continuously at nameplate rating.

9.5.8.1.1.2 Safety Design Basis Two. The DECAIES is designed to remain functional during and after a safe shutdown earthquake.

9.5.8.1.1.3 Safety Design Basis Three. The DECAIES is designed so that a single failure of any active component, assuming loss of offsite power, will not impair the capability of the system to comply with safety design basis one.

9.5.8.1.1.4 Safety Design Basis Four. Provisions are made to allow for inservice inspection of components at appropriate times.

9.5.8.1.2 Power Generation Design Bases

The DECAIES has no power generation design basis.

9.5.8.1.3 Codes and Standards

Applicable codes and standards for the diesel engine combustion air intake and exhaust system are listed in table 3.2-1.

9.5.8.2 System Description

9.5.8.2.1 General Description

The DECAIES is shown in figures 9.5-5, sheet 2 and 9.5-9. Each emergency diesel engine has its own combustion air intake and exhaust system. The combustion air intake system for each engine consists of intake openings, intake filters, intake silencers, and piping. Separate combustion air intake manifolds are provided for the right and left banks of the cylinders.

The exhaust system for each engine consists of an exhaust silencer, fittings and piping.

The standby power supply; i.e., the diesel generator system, is discussed in detail in subsection 8.3.1.

9.5.8.2.2 Component Description

Component parameters for the DECAIES are presented in table 9.5-6.

9.5.8.2.2.1 Intake Filter. Oil-bath type air filters are used in the combustion air intake system. These filters are installed in the air intake filter room next to the engine they serve. Two filter pads are installed within the filters to remove dirt particles and any oil mist from the filtered air. A rain shield is provided over the air inlet to each filter to minimize water carryover in the event the preaction sprinkler system installed for diesel building fire protection is activated. Water carryover into the filter does not reduce the filter efficiency. The entrapped water tends to settle and can be drawn off.

9.5.8.2.2.2 Intake and Exhaust Silencers. Silencers are installed in the intake system to minimize the noise level within the diesel generator room. A silencer is installed in the exhaust system to reduce the noise level outside the diesel generator room. The silencers are inline type, constructed of carbon steel, and utilize internal baffle arrangements to reduce the level of noise emitted from the DECAIES.

9.5.8.2.2.3 Piping. The piping in the DECAIES is carbon steel. Expansion joints are strategically located to accommodate the thermal growth of the exhaust piping. The piping is sized adequately so that the total pressure drop when the engine is operating at nameplate continuous rating is within the diesel engine manufacturer's recommendations.

9.5.8.2.2.4 Missile Protected Air Intake. A double wall configuration with staggered openings is provided for each diesel engine. The outer openings are provided with louvers and covered with wire mesh to prevent undesirable objects from being drawn into the diesel engine intake filters.

9.5.8.2.3 System Operation

Combustion air is supplied to each manifold through an intake filter and silencer. The intake system uses the air in the air intake filter room for combustion. The air intake system, by design, is not subject to adverse weather conditions which could potentially block the air supply.

The products of combustion are exhausted outside the diesel building as shown in figure 9.5-9. Each engine has an independent and separate exhaust stack. The stacks discharge the exhaust gases approximately 40 feet above the diesel building roof. The exhaust gases are released to atmosphere 65 feet above the diesel engine room air intake louvers which are located approximately 90 feet horizontally from the exhaust stacks. The distances between the combustion air intake and exhaust release, the high exhaust discharge velocity, and the buoyancy of the heated exhaust gases are sufficient to minimize the possibilities of diluting the combustion air with exhaust.

To preclude blockage of exhaust flow from the diesel engines due to a seismic event, the design of the stack meets Seismic Category I criteria. The two exhaust stacks are designed to prevent damage from external missiles.

Rain which enters the diesel exhaust stack accumulates in the low points of the diesel exhaust piping system. This piping is provided with drain lines which continuously remove water to prevent its passage to the diesel engine.

The typhoon missile protection for the diesel engine combustion air intake is provided by having two staggered openings, inner and outer, of which the outer one is provided with louvers.

9.5.8.3 Safety Evaluation

9.5.8.3.1 Safety Evaluation One

The DECAIES components are designed and arranged to provide combustion air of required quality and quantity and to exhaust the combustion products when the diesel engine is operating continuously at nameplate rating. The intake is located such that no accidental release of gases can enter and adversely affect the operation of the diesel engine.

9.5.8.3.2 Safety Evaluation Two

The DECAIES is designed to remain functional during and after a safe shutdown earthquake. The components (and supporting structures) of any system, equipment, or structure which are not Seismic Category I and whose failure could result in loss of required function of the DECAIES through either impact or flooding are supported to ensure that they will not fail when subjected to seismic loading.

9.5.8.4 Tests and Inspections

The DECAIES is initially tested as described in chapter 14. The DECAIES is tested periodically, along with the complete diesel generator system. This test will demonstrate the performance, structural, and leaktight integrity of all system components.

The DECAIES is designed and located (to the extent practicable) to permit preservice and inservice inspection.

9.5.8.5 Instrumentation Applications

The DECAIES instrumentation is designed to provide continuous indication of the system parameters. Temperature indicators are installed on the local control panel for monitoring each cylinder exhaust temperature and stack exhaust temperatures.

9.5.9 SERVICE GAS SYSTEM

9.5.9.1 Design Bases

Criteria for the selection of design basis are noted in section 1.1.

9.5.9.1.1 Safety Design Bases

The service gas system serves no safety function and no safety design bases are provided.

9.5.9.1.2 Power Generation Design Bases

9.5.9.1.2.1 Power Generation Design Basis One. The service gas system is designed to supply hydrogen in sufficient quantity to meet both the main generator cooling and the chemical and volume control system volume control tank requirements for both units during normal operation.

9.5.9.1.1.2 Power Generation Design Basis Two. The service gas system is designed to supply nitrogen in sufficient quanitities to meet purging, pressurization, and blanketing requirements.

9.5.9.1.2.3 Power Generation Design Basis Three. The service gas sytem is designed to provide carbon dioxide to meet the main generator purging requirements.

9.5.9.1.3 Codes and Standards

Gas cylinders are designed to the requirements of U.S. Department of Transportation. Piping and valves are designed to ANSI B31.1. The liquid nitrogen storage tank, vaporizers, and high pressure nitrogen gas storage vessels are designed to the requirements of ASME B&PV Code, Section VIII. 1

9.5.9.2 System Description

9.5.9.2.1 General Description

The service gas system, shown on figure 9.5-10, consists of storage cylinders, bottles and vessels, a liquid nitrogen pump, manifolds, regulators, pressure relief valves, and piping which supply nitrogen, hydrogen, and carbon dioxide from their respective storage areas to the systems identified in table 9.5-7 at each unit. 510

The hydrogen subsystem is shared by both units, and the subsystem consists of three banks of high pressure (2,000 psig or 140.6 kg/cm^2) cylinders feeding 100 psig (nominal) header which transport the gas to its respective users. Excess flow switches and excess flow check valves are provided in the hydrogen lines entering the auxiliary and turbine buildings to isolate the line in the event of a downstream line break. 510

The nitrogen gas subsystem is shared by both units. The subsystem has one storage tank which contains liquid nitrogen at a pressure of approximately 150 psig. Liquid nitrogen is normally withdrawn from the storage tank, vaporized by the ambient vaporizer and passes through the pressure reducing valve where the pressure drops to 100 psig (nominal) for its respective users. 1

The nitrogen subsystem also has one liquid nitrogen pump, one high-pressure ambient vaporizer and three high-pressure storage vessels. The high-pressure storage vessels are sized to supply a makeup for the safety injection accumulators and to reserve nitrogen which can be used for low-pressure users when the low-pressure supply system is temporarily out of service. The low-pressure liquid nitrogen is withdrawn from the storage tank to the pump by which nitrogen pressure is boosted. The high-pressure liquid is then vaporized by the high-pressure electric vaporizer and stored into the high-pressure storage vessels.

The carbon dioxide subsystem per unit consists of two banks of high pressure (850 psig or 60 Kg/cm^2) bottles.

The hydrogen storage cylinders and carbon dioxide storage bottles are manifolded such that one bank of manifolds of a particular gas is connected to the other bank of manifolds to assure a continuous gas supply. One bank of each gas is in service while the other is on standby. 510

9.5.9.2.2 Component Description

9.5.9.2.2.1 Liquid Nitrogen Storage Tank (For Two Units). One liquid nitrogen storage tank is provided. The tank has an approximately 1500-gallon net capacity and a normal operating pressure of 150 psig. The purity is 99.9 percent with an oxygen concentration not exceeding 1000 ppm.

9.5.9.2.2.2 Liquid Nitrogen Pump (For Two Units). One liquid nitrogen pump takes suction from the liquid nitrogen storage tank and discharges nitrogen at approximately 2400 psig to the high-pressure electrical vaporizer and high-pressure storage tanks.

9.5.9.2.2.3 High-Pressure Electrical Vaporizer (For Two Units). One high-pressure vaporizer which is electrically powered, is provided. The vaporizer vaporizes liquid nitrogen discharged from the pump.

9.5.9.2.2.4 High-Pressure Nitrogen Storage Vessels (For Two Units). Three storage vessels are supplied. Each tank is to provide 4750 standard cubic feet between 900 psig and 2200 psig.

9.5.9.2.2.5 Low-Pressure Ambient Vaporizer (For Two Units). There is one ambient vaporizer which vaporizes liquid nitrogen from the liquid nitrogen storage tank.

9.5.9.2.2.6 Hydrogen Storage Cylinders (For Two Units). There are thirty nine(39) hydrogen storage cylinders each at 2,000 psig with a nominal capacity of 6,779 standard cubic feet. The purity is 99.95 percent with an oxygen concentration not exceeding 500 ppm. 510

9.5.9.2.2.7 Carbon Dioxide Storage Bottles. There are 150 carbon dioxide storage bottles for each unit. Each bottle contains 50 pounds of carbon dioxide at a pressure of 850 psig.

9.5.9.2.3 System Operation

During normal operation, service gas received from the site storage facility is maintained at the required pressure through pressure regulators. Service gas flow to the serviced systems is controlled by those systems.

During plant startup and shutdown, service gas for filling and purging will be manually controlled. During these periods, large volumes of hydrogen or nitrogen gas may be required; therefore, the site storage facility for hydrogen and nitrogen gas is equipped with truck connections to supplement the gas supply requirements.

9.5.9.3 Safety Evaluation

Inasmuch as the service gas system has no safety design basis, no safety evaluation is provided.

9.5.9.4 Tests and Inspections

Before and during operation of the service gas system, the system's instruments are tested and inspected on a regular basis.

9.5.9.5 Instrument Application

All instrumentation is shown in figure 9.5-10.

9.5.10 NUCLEAR SERVICE COOLING WATER TRAVELING SCREEN SYSTEM

The nuclear service cooling water (NSCW) traveling screens are designed to remove debris from the influent NSCW to prevent fouling of the NSCW pump and auxiliary heat exchanger tubes. The screens are washed and debris is collected for ready disposal.

9.5.10.1 Design Bases

9.5.10.1.1 Safety Design Bases

9.5.10.1.1.1 Safety Design Basis One. Two independent trains of the screen wash systems, including the associated screens, are physically separated and capable of withstanding the effects of typhoon, wind, and other natural phenomena. Power supply to the redundant screen wash systems is available from redundant Class IE buses. 1

1 After a postulated accident, the traveling screens are required to move continuously for satisfactory operation of the NSCW pumps.

9.5.10.1.1.2 Safety Design Basis Two. The screens and screen wash system are designed to remain operable following a safe shutdown earthquake (SSE).

9.5.10.1.1.3 Safety Design Basis Three. The active components of the system can be inspected and tested during plant operation. Provisions are made for suitable inspection of important components at appropriate times in accordance with ASME Section XI.

9.5.10.1.1.4 Safety Design Basis Four. The screens and screen wash systems are so designed that the single failure of any component, assuming loss of offsite power, cannot impair the system's ability to provide intended services.

9.5.10.1.2 Power Generation Bases

9.5.10.1.2.1 Power Generation Basis One. The traveling screens are designed to remove debris entrained by the incoming water to the NSCW.

9.5.10.1.2.2 Power Generation Basis Two. The traveling screens system is comprised of a series of wide interconnected panels extending across the full width of the openings into the respective intake structures.

9.5.10.1.2.3 Power Generation Basis Three. The traveling screens are designed for a water velocity not exceeding 1 f/s.

9.5.10.1.2.4 Power Generation Basis Four. Debris collected from the screens is sluiced away in troughs to a suitable collection point for subsequent disposal.

9.5.10.1.2.5 Power Generation Basis Five. Screens are designed to withstand a maximum differential head of 8 feet of water. During normal operation, maximum differential water pressure head across the screens is expected to be 0 to 9 inches.

9.5.10.1.2.6 Power Generation Basis Six. During normal conditions, the traveling water screen and the screen wash spray systems are required to operate if the differential head across the traveling screens exceeds 0.5 inch and if it will operate intermittently for 15 minutes one to four times each 24 hours, controlled by a Class 1E timer. While under emergency conditions, the screen and spray wash systems will operate continuously upon receipt of the safety injection signal. The normal travel speed of the screens shall be approximately 10 ft/min. 1

9.5.10.1.3 Codes and Standards

Codes and standards applicable to the traveling water screens are listed as the following:

A. United States Nuclear Regulatory Commission (USNRC)

- 10 CFR 50, Appendix B, Quality Assurance Criteria

B. American National Standards Institute (ANSI)

- B31.1 Power Piping
- B16.5 Steel Pipe Flanges and Flange Fittings
- B16.9 Wrought Steel, Butt-Welding Fittings 1
- B16.11 Forged Steel Fittings
- N45.2.2 Packing, Shipping, Receiving, Storage and Handling of Items for Nuclear Power Plants

C. American Gear Manufacturer's Association (AGMA) Standards

- 221.02A Rating for the Strength of Helical and Herringbone Gears for Enclosed Drives
- 211-02A Rating for the Durability of Helical and Herringbone Gears for Enclosed Drives

D. American Society of Mechanical Engineers (ASME)

- Boiler and Pressure Vessel Code, Section IX, Welding Qualifications

- Boiler and Pressure Vessel Code, Section III, Class 3

E. American Society for Testing and Materials (ASTM) Standards

F. Institute of Electrical and Electronic Engineers (IEEE) Standards

- 323-1974 — Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations
- 344-1974 — Recommended Practices for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations
- 334-1974 — Type Tests of Continuous Duty Class 1E Motors for Nuclear Power Generating Stations

1 G. National Electrical Manufacturers Association (NEMA)

- MG-1 — Motors and Generators

H. Hydraulic Institute (HI).

9.5.10.2 System Description

9.5.10.2.1 General Description

The traveling screens and screen wash system is capable of continuous operation during normal and abnormal plant operation and hot and cold shutdown, and also capable of intermittent operation during startup. Sluice gates and sliding fine screens are provided to permit pump or traveling screen servicing. Trash racks are installed upstream of the traveling water screen in the intake structure. The function of the trash rack is to prohibit passage of large-size debris which may cause clogging or structural damage to the traveling water screens. The screen wash pumps supply high-pressure seawater for washing the traveling screens.

9.5.10.2.2 Component Description

A. Screen Data	Nuclear Service Cooling Water
Number of screens per unit	2

Flow per screen, gal/min	20,000
Velocity through screen, ft/sec	1
Square opening between wires	3/8 in.
Speed of screen travel, ft/min	10
Width of trays	10 feet - 0 in.
Screen centers (℄ to ℄ of shafts)	33 feet - 0 in.
Width of screen well	11 feet - 2 in.
Depth of screen well	32 feet - 0 in.
Low water Level El.	66 feet - 4 in.
High water Level El.	71 feet - 9 in.

B. Drive Motor Data

Horsepower rating, hp	3
Phase	3
Voltage, volts	460
Rated speed, rpm	3,600
Full load current, amp	4.7

9.5.10.3 Tsunami Protection

The NSCW traveling screens are located in the NSCW intake structure on the seashore. The impact of tsunami to the traveling screens will be minimized by the intake breakwaters and the trash racks. During the tsunami condition, the water surge may rise to about 1 foot below the operating floor [redacted] of the intake structure which houses the traveling screens. Therefore, all the water passages, including the refuse trough and other openings in the operating floor, will not be flooded by the tsunami and will remain in operable condition.

9.5.10.4 Tests and Inspections

Preoperational inspection and testing are performed to:

A. Verify that the system is installed in accordance with the applicable plans, drawings, and specifications.

B. Verify the proper operation of the traveling screen system.

9.5.11 AUXILIARY STEAM SYSTEM

The auxiliary steam system is designed to provide process steam during plant startup, shutdown, and normal operation to equipment located in the turbine, auxiliary, and radwaste buildings. It also provides steam for decontamination of equipment located in the containment, auxiliary, radwaste, and fuel buildings. The auxiliary steam boiler supplies steam to the system during cold shutdown and startup (see figure 9.5-11).

9.5.11.1 Design Basis

Criteria for the selection of design bases are stated in paragraph 1.1.2.2.

9.5.11.1.1 Safety Design Basis One

The containment isolation valves for the auxiliary steam containment penetrations are provided in accordance with General Design Criteria 54 and 56 and Appendix J of 10 CFR 50.

9.5.11.1.2 Power Generation Design Basis

9.5.11.1.2.1 Power Generation Design Basis One. The auxiliary steam system provides the steam required for the following services:

A. Boric acid batching tank

B. Boron recycle evaporator

C. Turbine steam seal system

D. Auxiliary feedwater pump turbine (preoperational and postmaintenance testing)

E. Steam generator feedpump turbines (preoperational and postmaintenance testing)

F. Decontamination of equipment

G. Liquid radwaste evaporator

H. Feedwater heaters

I. Turbine moisture separator reheaters

J. Various utility stations throughout the plant

K. Condenser hotwell spargers.

9.5.11.1.3 Codes and Standards

Codes and standards applicable to the auxiliary steam system are listed in table 3.2-1.

9.5.11.2 System Description

9.5.11.2.1 General Description

The auxiliary steam boiler supplies steam to the system at 150 psia with a moisture content not to exceed 0.5 percent, during plant cold shutdown and startup. Feedwater is passed through a deaerating heater before injection to the steam generator.

The main steam system (NSSS) supplies steam to the auxiliary steam system during normal operation and hot shutdown. A pressure reducing station is used to reduce main steam pressure. During this mode of operation, the condensate from the auxiliary steam services is returned to the main condenser hotwell.

9.5.11.2.2 Component Description

The auxiliary steam system consists of the following equipment:

A. One auxiliary steam boiler

B. Two auxiliary steam boiler feedwater pumps

C. Two auxiliary steam condensate transfer pumps

D. One auxiliary steam deaerator

E. One auxiliary steam condensate recovery tank

F. One auxiliary steam continuous blowdown tank

G. One auxiliary steam forced draft fan

H. One auxiliary steam ammonia tank

I. One auxiliary steam hydrazine tank

J. Three auxiliary steam chemical feed pumps

K. Associated controls, piping and valves.

Refer to table 9.5-8 for system major component data.

9.5.11.3 System Operation

9.5.11.3.1 Startup

During plant startup and starts from cold shutdown, the auxiliary steam boiler provides steam to the following equipment:

A. Boric acid batching tank (heating of boric acid solution)

B. Boron recycle evaporator (boric acid concentration)

C. Turbine steam seals (shaft-sealing main turbine and feedwater pump turbines, and condenser evacuation)

D. Auxiliary feedwater pump turbine (preoperational and postmaintenance testing)

E. Steam generator feedwater pump turbines (preoperation and postmaintenance testing)

F. Decontamination stations (decontamination of fuel cask and refueling equipment)

G. Liquid radwaste evaporator (waste concentration)

H. Feedwater heaters 5A and 5B (condensate and feedwater warmup to aid hydrazine in the suppression of iron oxide formation)

I. Turbine moisture separator reheater (tube side blanketing steam for corrosion prevention).

J. Utility stations (steam for use in water/steam/air utility stations throughout the plant).

The auxiliary steam boiler operates automatically from 12.5 to 100 percent load. The auxiliary steam boiler feedwater is deaerated and treated with hydrazine and ammonia.

9.5.11.3.2 Normal Operation

During normal plant operation the auxiliary steam system provides steam to the equipment listed in subparagraph 9.5.11.3.1 except items C, D, E and H. During this mode, steam is supplied by the main steam system through a pressure reducing station. Condensate from the equipment in the auxiliary, access control, and radwaste buildings is routed to the recovery tank and then pumped to the deaerating heater, where it is deaerated and treated with ammonia and hydrazine, if required, before pumping to the main condenser hotwell.

Condensate from the decontamination stations is routed to the liquid radwaste system through the radioactive waste drains.

9.5.11.3.3 Shutdown

During plant hot shutdown the auxiliary steam system, using main steam, provides steam to the equipment listed in subparagraph 9.5.11.3.1 excepting items D, E and H. During plant cold shutdown the auxiliary steam boiler is placed in operation to provide steam to the equipment listed in subparagraph 9.5.11.3.1.

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9.5.12 Alternate AC (AAC) Diesel Generator System

9.5.12.1 Design Bases

The AAC diesel generator system provides an alternate acpower source according to the requirements of 10 CFR 50.63 and Reg. Guide 1.155.

9.5.12.2 System Description

One AAC diesel generator set is provided for four KN 1,2,3&4 units. The AAC DG consists of one Non-Class 1E generator and one diesel engine with the following auxiliary systems:

A. diesel fuel oil system,
B. cooling water system,
C. starting-air system,
D. lubrication system, and
E. air intake and exhaust system.

The diesel fuel oil system, consisting of two 100% capacity fuel oil transfer pumps, a fuel oil storage tank, an aux. fuel oil storage tank and a day tank provided for supplying fuel oil to the diesel generator set. The fuel oil transfer pumps take suction from the fuel oil storage tank and the aux. fuel oil storage tank through a strainer. The fuel oil storage tank is sized to hold enough fuel oil to operate the diesel engine at full load for 4 hours plus a margin to allow periodic testing and subsequent refill of the day tank. The aux. fuel oil storage tank is provided for additional fuel oil to operate the diesel engine at full load for 20 hours plus margin, in accordance with action item 3-2 of KHNP's Special Safety Inspection taken after Fukushima Daiichi Accident. The day tank has capacity equivalent to at 60 minutes of operation) plus 10% margin for the diesel engine at its rating of 5,500 kW. The day tank is located so that fuel oil is fed to the diesel engine fuel injectors through the motor-driven fuel oil pump by gravity. The fuel oil transfer pumps are operated continuously during operation of the diesel generator set. Overflow from the day tank flows back to the fuel oil storage tank.

518 518 518 314

A separate and complete closed-loop cooling watersystem is provided for the diesel engine, receiving makeup water from the demineralized water system. The heat sink for the cooling water system consists of six radiators with fans. The expansion tank provides positive suction pressure for the preheatingwater circulation pump, and allows free expansion of water. The preheating water circulation pump, which is electric motor-driven, operates continuously during engine standby to ensure that the system is completely preheated and filled with water. When the diesel engine starts, the cooling water pump, which is engine-mounted and engine-driven, would operate to circulate cooling water through the closed loop system.

Each diesel engine is provided with two independent starting-air systems. Each starting-air system consists of a compressor and cooler, a filter/ dryer unit, an air receiver, air supply lines and valves, and devices to crank the engine. Air is compressed, cooled, filtered, dried, and then stored in the air receivers until needed. The starting-air storage capacity for the diesel engine is sufficient for a minimum of five successful engine starts without recharging the receiver.

The lubrication system is provided to deliver clean lubricating oil to the diesel engine, its bearings and crank shaft, and other moving parts. By means of the lube oil/pre-heating water heat exchanger and the prelube oil pump, the oil is heated and delivered to the engine during standby to ensure its fast-starting and load accepting capability.

The air intake and exhaust system is provided to supply clean
314 air to the diesel engine and to exhaust the engine exhaust gas. Combustion air is drawn in through the intake air filter located in the combustion air intake penthouse prior to entering the turbocharger. The exhaust gas is discharged to the engine-mounted turbochargers. After the turbochargers, the exhaust gas flows to the silencer through the exhaust pipes and is discharged to atmosphere through the exhaust stack.

9.5.12.3 Safety Evaluation

All components of the AAC DG are housed in a separated Seismic Category III structure.

The fuel oil storage tank capacity is based on continuous operation of the diesel engine at its rated load for 4 hours plus margin
518 for periodic testing. The aux. fuel oil storage tank is provided for additional fuel oil to operate the diesel engine at full load for 20 hours plus margin, in accordance with action item 3-2 of KHNP's Special Safety Inspection taken after Fukushima Daiichi Accident.
Two 100% capacity fuel oil transfer pumps are provided to supply fuel oil. If one transfer pump fails to start or trips, the other pump is automatically started.

The engine and engine-mounted components, the radiator, and other equipment are classified as Seismic Category III, Quality Group D, and non-Class 1E.

Refer to Subsection 8.3.1.1 for a discussion of the AAC DG following a station blackout.

9.5.12.4 Tests and Inspections

518 A fuel oil storage tank, an aux. fuel oil storage tank, a day tank, and air receivers receive NDE in accordance with the ASME Boiler and Pressure Vessel Code, Section VIIIrequirements incidental to routine construction tests and inspections. Fuel oil samples, as specified by ASTM D975, are tested upon delivery for deterioration products. System components and piping are tested at the pressures designated by the appropriate codes. In-service inspection and testing is performed regularly to verify the operability and reliability of the AAC power source at interval not longer than three month.

9.5.12.5 Instrumentation Application

Pressure instruments installed on the transfer pump discharge line initiate an alarm on the AAC diesel generator local control panel when the discharge line pumping pressure is low. The alarm indicates that fuel oil is not being pumped to the day tank. The level instruments on the fuel oil storage tank and the aux. fuel oil storage tank are provided to initiate low-low, low, and high alarms at the AAC diesel generator local control panel. 518 314 The instrumentation for the diesel generator set, cooling water system, starting-air system, lubrication system, and air intake and exhaust system is designed to provide continuous indication of the system parameters by the diesel generator vendor. The parameters are displayed and annunciated on a local diesel generator control panel. Any alarm annunciated on the local control panel initiates a common trouble alarm in Units 1, 2, 3&4 main control rooms to warn the operator of any abnormal condition in the AAC DG. Also, certain alarms are initiated individually in four main control rooms.

9.5.13 REFERENCE

1. Underwriter's Laboratories Standard for Safety, Smoke Detectors for Fire Protective Signaling Systems, U.L. 268, June 9, 1981.

Table 9.5-1
COMPARISON OF KRN 3&4 WITH REQUIREMENTS OF APPENDIX A OF NRC BRANCH TECHNICAL POSITION ASB 9.5-1 561
(Sheet 1 of 40)

APPLICATION DOCKETED BUT CONSTRUCTION PERMIT NOT RECEIVED AS OF 7/1/76	KNU 5 & 6 POSITION	METHOD OF COMPLIANCE
Positions		
A. Overall Requirement of Nuclear Plant Fire Protection Program.		A. Overall Requirement of Nuclear Plant Fire Protection Program.
1. Personnel Responsibility for the overall fire protection program should be assigned to a designated person in the upper level of management. This person should retain ultimate responsibility even though formulation and assurance of program implementation is delegated. Such delegation prepared by training and experience in fire protection, and nuclear plant safety to provide a balanced approach in directing the fire protection programs for nuclear power plants. The qualification requirements for the fire protection engineer or consultant who will assist in the design and selection of equipment, inspect and test the completed physical aspects of the system, develop the fire protection program, and assist in the fire fighting training for the operating plant should be stated.* (Subsequently, the FSAR should discuss the training and the updating provisions such as fire drills provided for maintaining and operating crew, including personnel resonsible for maintaining and inspecting the fire protection equipment). The fire protection staff should be resonsible for : (a) Coordination of building layout and systems design with fire area requirements, including consideration of potential hazards associated with postulated design basis fires (b) Design and maintenance of fire detection, suppression, and extinguishing systems. (c) Fire prevention activities.	Comply Comply Comply	1. Personnel One of the vice superintendents takes full responsibility for fire protection program of the plant. Program implementation is delegated to the chief of safety and engineering support team. 561 The fire protection staff should be resonsible for : (a) Coordination of building layout and systems design with fire area requirements, including consideration of potential hazards associated with postulated design basis fires (b) Design and maintenance of fire detection, suppression, and extinguishing systems. (c) Fire prevention activities.

NOTE : Refer to Appendix 1.3(Comparison of Method of compliance to Reg Guide 1.189 requirement) to Fire Hazard Analysis for Kori Units 3&4, October 2005. 561

Table 9.5-1

COMPARISON OF KNU 5 & 6 WITH REQUIREMENTS OF APPENDIX A
OF NRC BRANCH TECHNICAL POSITION ASB 9.5-1
(Sheet 2 of 40)

APPLICATION DOCKETED BUT CONSTRUCTION PERMIT NOT RECEIVED AS OF 7/1/76	KNU 5 & 6 POSITION	METHOD OF COMPLIANCE OR BASIS FOR NONCOMPLIANCE
(d) Training and manual firefighting activities of plant personnel and the fire brigade. NOTE NFPA 6 - Recommendations for Organization of Industrial Fire Loss Prevention Contains useful guidance for organization and operation of the entire fire loss prevention program.	Comply	(d) Training and manual firefighting activities of plant personnel and the fire brigade.
2. Design Bases The overall fire protection program should be based upon evaluation of potential fire hazards throughout the plant and effect of postulated design basis fires relative to maintaining ability to perform safety shutdown functions and minimize radioactive releases to the environment.	Comply	2. Design Bases The overall fire protection program is based upon evaluation of potential fire hazards throughout the plant, and the effect of postulated design basis fires relative to maintaining ability to perform safety shutdown functions and minimize radioactive releases to the environment.
3. Backup Total reliance should not be placed on a single automatic fire suppression system. Appropriate backup fire suppression capability should be provided.	Comply	3. Backup Total reliance is not placed on a single automatic fire suppression system. Appropriate backup fire suppression capability is provided.
4. Single Failure Criterion A single failure in the fire suppression system should not impair both the primary and backup fire suppression capability. For example, redundant fire water pumps with independent power supplies and controls should be provided. Postulated fires or fire protection system failures need not be considered concurrent with other plant accidents or the most severe natural phenomena. However, in the event of the most severe earthquake, i.e., the safe shutdown earthquake (SSE), the fire suppression system should be capable of delivering water to manual hose stations located within hose reach of areas containing equipment required for safe plant shutdown. The fire protection systems should, however, retain their original design capability for	Comply	4. Single Failure Criterion A single failure in the fire suppression system will not impair both the primary and backup fire suppression capability. For example, redundant fire pumps with independent power supplies and controls are provided. Postulated fires or fire protection system failures are not considered concurrent with other plant accidents or the most severe natural phenomena. The effects of lightning strikes are included in the overall plant fire protection program, see Elec. Des. Crit. 5.6. In the event of a SSE, the Seismic Category I fire protection system does have the capability of water hose protection for equipment required for safe plant shutdown and is located in the

Table 9.5-1

COMPARISON OF KNU 5 & 6 WITH REQUIREMENTS OF APPENDIX A
OF NRC BRANCH TECHNICAL POSITION ASB 9.5-1
(Sheet 3 of 40)

APPLICATION DOCKETED BUT CONSTRUCTION PERMIT NOT RECEIVED AS OF 7/1/76	KNU 5 & 6 POSITION	METHOD OF COMPLIANCE OR BASIS FOR NONCOMPLIANCE
(1) natural phenomena of less severity and greater frequency (approximately once in 10 years) such as tornadoes, hurricanes, floods, ice storms, or small intensity earthquakes which are characteristic of the site geographic region and (2) for potential man-created site related events such as oil barge collisions, aircraft crashes which have a reasonable probability of occurring at a specific plant site. The effects of lightning strikes should be included in the overall plant fire protection program.		diesel generator, control, auxiliary, component cooling water, and fuel handling buildings. Seismic Category I components of the fire protection system are protected from natural phenomena and man-created hazard to the same extent as other safety related equipment. For additional discussion on the design of safety related system with respect to natural phenomena and man-created hazard see Chapter 2.
5. <u>Fire Suppression Systems</u> Failure or inadvertent operation of the fire suppression system should not incapacitate safety related systems or components. Fire suppression systems that are pressurized during normal plant operation should meet the guidelines specified in APCSB Branch Technical Position 3-1. "Protection Against Postulated Piping Failures in Fluid Systems Outside Containment."	Comply	5. <u>Fire Suppression Systems</u> Failure or inadvertent operation of the fire suppression system will not incapacitate safety related systems or components. All fire suppression sprinkler systems located in areas containing safety-related equipment are normally dry. In addition, the fire suppression systems piping is designed and analyzed to withstand an SSE to the extent that it will not fall and damage other equipment. Refer to section 3.4 for additional information.
6. <u>Fuel Storage Areas</u> The fire protection program (plans, personnel, and equipment) for buildings storing new reactor fuel and for adjacent fire zones which could affect the fuel storage zone should be fully operational before fuel is received at the site.	Comply	6. <u>Fuel Storage Areas</u> The fire protection program (plans, personnel, and equipment) for the fuel building will be fully operational before fuel is received.
7. <u>Fuel Loading</u> The fire protection program for an entire reactor unit should be fully operational prior to initial fuel loading in that reactor unit.	Comply	7. <u>Fuel Loading</u> The fire protection program for the entire reactor unit will be fully operational prior to initial fuel loading in that reactor unit.
8. <u>Multiple Reactor Sites</u> On multiple reactor sites where there are operating reactors and construction of remaining units is being completed, the fire	Comply	8. <u>Multiple Reactor Sites</u> Each unit complex is separated from the other unit complex by a minimum of 100 feet. The operating plant manager will have the lead

Table 9.5-1

COMPARISON OF KNU 5 & 6 WITH REQUIREMENTS OF APPENDIX A OF NRC BRANCH TECHNICAL POSITION ASB 9.5-1
(Sheet 4 of 40)

APPLICATION DOCKETED BUT CONSTRUCTION PERMIT NOT RECEIVED AS OF 7/1/76	KNU 5 & 6 POSITION	METHOD OF COMPLIANCE OR BASIS FOR NONCOMPLIANCE
protection program should provide continuing evaluation and include additional fire barriers, fire protection capability, and administative controls necessary to protect the operating units from construction fire hazards. The superintendent of the operating plant should have the lead responsibility for site fire protection.		responsibility for site fire protection.
9. Simultaneous Fires Simultaneous fires in more than one reactor need not be postulated where separation requirements are met. A fire involving more than one reactor unit need not be postulated except for facilities shared between units.	Comply	9. Simultaneous Fires Simultaneous fires in more than one reactor are not postulated. A fire involving more than one reactor unit is not postulated except for facilities shared between units.
B. Administrative Procedures, Controls, and Fire Brigade		B. Administrative Procedures, Controls and Fire Brigade
1. Administrative procedures consistent with the need for maintaining the performance of the fire protection system and personnel in nuclear power plants should be provided. Guidance is contained in the following publications: NFPA 4 - Organization for Fire Services NFPA 4A - Organization for Fire Department NFPA 6 - Industrial Fire Loss Prevention NFPA 7 - Management of Fire Emergencies NFPA 8 - Management Responsibility for Effects of Fire on Operations NFPA 27 - Private Fire Brigades	Comply	1. Administrative procedures will be provided to assure the need for maintaining the performance of the fire protection system and personnel in the plant Guidance is contained in Fire Protection Principle for Korea Hydro & Nuclear Power Co. and applicable plant emergency plan. 451
2. Effective administrative measures should be implemented to prohibit bulk storage of combustible materials inside or adjacent to safety related buildings or systems during operation or maintenance periods. Regulatory	Comply	2. Effective administrative measures will be implemented to prohibit bulk storage of combustible materials inside or adjacent to safety related buildings or systems during operation or maintenance periods.

Table 9.5-1

COMPARISON OF KNU 5 & 6 WITH REQUIREMENTS OF APPENDIX A
OF NRC BRANCH TECHNICAL POSITION ASB 9.5-1
(Sheet 5 of 40)

APPLICATION DOCKETED BUT CONSTRUCTION PERMIT NOT RECEIVED AS OF 7/1/76	KNU 5 & 6 POSITION	METHOD OF COMPLIANCE OR BASIS FOR NONCOMPLIANCE
Guide 1.39, "Housekeeping Requirements for Water-Cooled Nuclear Power Plants," provides guidance on housekeeping, including the disposal of combustible materials.		
3. Normal and abnormal conditions or other anticipated operations such as modifications (e.g., breaking fire stops, impairment of fire detection and suppression systems) and refueling activities should be reviewed by appropriate levels of management and appropriate special actions and procedures such as fire watches or temporary fire barriers implemented to assure adequate fire protection and reactor safety. In particular:	Comply	3. Normal and abnormal conditions or other anticipated operation and refueling activities will be reviewed by appropriate levels of management and appropriate special actions and procedures will be implemented to assure adequate fire protection and reactor safety.
(a) Work involving ignition sources such as welding and flame cutting should be done under closely controlled conditions. Procedures governing such work should be reviewed and approved by persons trained and experienced in fire protection. Persons performing and directly assisting in such work should be trained and equipped to prevent and combat fires. If this is not possible, a person qualified in fire protection should directly monitor the work and function as a fire watch.	Comply	
(b) Leak testing and similar procedures such as air flow determination should use one of the commercially available aerosol techniques. Open flames or combustion-generated smoke should not be permitted.	Comply	
(c) Use of combustible material, e.g., HEPA and charcoal filters, dry ion exchange resins or other combustible supplies, in safety-related areas should be controlled. Use of wood inside buildings containing safety related systems or equipment should be permitted only when suitable noncombustible substitutes are not available. If wood must be used, only fire retardant treated wood (scaffolding, lay down blocks) should be permitted. Such materials should be allowed into safety-	Comply	

Table 9.5-1

COMPARISON OF KNU 5 & 6 WITH REQUIREMENTS OF APPENDIX A OF NRC BRANCH TECHNICAL POSITION ASB 9.5-1
(Sheet 6 of 40)

APPLICATION DOCKETED BUT CONSTRUCTION PERMIT NOT RECEIVED AS OF 7/1/76	KNU 5 & 6 POSITION	METHOD OF COMPLIANCE OR BASIS FOR NONCOMPLIANCE
related areas only when they are to be used immediately. Their possible and probable use should be considered in the fire hazard analysis to determine the adequacy of the installed fire protection systems.		
4. Nuclear power plants are frequently located in remote areas, at some distance from public fire departments. Also, first-response fire departments are often volunteer. Public fire department response should be considered in the overall fire protection program. However, the plant should be designed to be self-sufficient with respect to fire fighting activities and rely on the public response only for supplemental or backup capability.	Comply	4. Public fire department response is considered in the overal fire protection program. However, the plant is desigend to be self-sufficient with respect to fire fighting activities, and to rely on the public response only for supplemental or backup capacity.
5. The need for good organization, training, and equipping of fire brigades at nuclear power plant sites requires effective measures be implemented to assure proper discharge of these functions. The guidance in Regulatory Guide 1.101, "Emergency Planning for Nuclear Power Plants," should be followed as applicable.	Comply	
(a) Successful fire fighting requires testing and maintenance of the fire protection equipment, emergency lighting and communication, as well as practice as brigades for the people who must utilize the equipment. A test plan that lists the individuals and their responsibilities in connection with routine tests and inspections of the fire detection and protection systems should be developed. The test plan should contain the types, frequency, and detailed procedures for testing. Procedures should also contain instructions on maintaining fire protection during those periods when the fire protection system is impaired, or during periods of plant maintenance, e.g., fire watches or temporary hose connections to water systems.	Comply	(a) A test plan containing individuals, responsibilities, type of tests, frequency, and detailed procedures for testing will be developed. Procedures will also provide instruction during those periods when the fire protection system is impaired or during plant maintenance.

Table 9.5-1

COMPARISON OF KNU 5 & 6 WITH REQUIREMENTS OF APPENDIX A
OF NRC BRANCH TECHNICAL POSITION ASB 9.5-1
(Sheet 7 of 40)

APPLICATION DOCKETED BUT CONSTRUCTION PERMIT NOT RECEIVED AS OF 7/1/76	KNU 5 & 6 POSITION	METHOD OF COMPLIANCE OR BASIS FOR NONCOMPLIANCE
(b) Basic training is a necessary element in effective fire fighting operation. In order for a fire brigade to operate effectively it must operate as a team. All members must know what their individual duties are. They must be familiar with the layout of the plant, equipment location, and operation in order to permit effective firefighting operations during times when a particular area is filled with smoke or is insufficiently lighted. Such training can only be accomplished by conducting drills several times a year (at least quarterly) so that all members of the fire brigade have had the opportunity to train as a team, testing itself in the major areas of the plant. The drills should include the simulated use of equipment in each area, and should be preplanned and post-critiqued to establish the training objective of the drills and determine how well these objectives have been met. These drills should periodically (at least annually) include local fire department participation where possible. Such drills also permit supervising personnel to evaluate the effectiveness of communications within the fire brigade and with the on-scene fire team leader, the reactor operator in the control room, and the offsite command post.	Comply	(b) Basic training and firefighting drills will be held periodically. Plant supervising personnel will evaluate the effectiveness of the communication within the fire brigade and with the on scene fire brigade leader, reactor operator in main control room, and offsite command post.
6. To have proper coverage during all phases of operation, members of each shift crew should be trained in fire protection. Training of the plant fire brigade should be coordinated with the local fire department so that responsibilities and duties are delineated in advance. This coordination should be part of the training course and implemented into the training of the local fire department staff. Local fire departments should be educated in the operational precautions when fighting fires on nuclear power plant sites. Local fire departments should be made aware of the need for radioactive protection of personnel and the	Comply	6. Members of each shift crew will be trained in fire protection, local fire department coordination will be part of the training course.

Table 9.5-1

COMPARISON OF KNU 5 & 6 WITH REQUIREMENTS OF APPENDIX A OF NRC BRANCH TECHNICAL POSITION ASB 9.5-1
(Sheet 8 of 40)

APPLICATION DOCKETED BUT CONSTRUCTION PERMIT NOT RECEIVED AS OF 7/1/76	KNU 5 & 6 POSITION	METHOD OF COMPLIANCE OR BASIS FOR NONCOMPLIANCE
special hazards associated with a nuclear power plant site.		
7. NFPA 27, "Private Fire Brigade" should be followed in organization, training, and fire drills. This standard also is applicable for the inspection and maintenance of firefighting equipment. Among the standards referenced in this document, the following should be utilized: NFPA 194, "Standard for Screw Threads and Gaskets for Fire Hose Coupling," NFPA 196, "Standard for Fire Hose," NFPA 197, "Training standard on Initial Fire Attacks," NFPA 601, "Recommended Manual of Instructions and Duties for the Plant Watchman on Guard." NFPA booklets and pamphlets listed on page 27-11 of Volume 8, 1971-72 are also applicable for good training references. In addition, courses in fire prevention and fire suppression which are recognized and/or sponsored by the fire protection industry should be utilized.	Comply	7. The training and organization of the fire brigade is based on KNU 5 & 6 plant emergency plan.
C. <u>Quality Assurance Program</u> Quality assurance (QA) programs of applicants and contractors should be developed and implemented to assure that the requirements for design, procurement, installation, and testing and administrative conrols for the fire protection program for safety related areas as defined in this Branch Position are satisfied. The program should be under the management control of the QA organization. The QA program criteria that apply to the fire protection program should include the following:	Comply	C. <u>Quality Assurance Program</u>
1. <u>Design Control and Procurement Document Control</u> Measurs should be established to assure that all design-related guidelines of the Branch Technical Position are included in design and procurement documents and that deviations therefrom are controlled.	Comply	

Table 9.5-1

COMPARISON OF KNU 5 & 6 WITH REQUIREMENTS OF APPENDIX A OF NRC BRANCH TECHNICAL POSITION ASB 9.5-1
(Sheet 9 of 40)

APPLICATION DOCKETED BUT CONSTRUCTION PERMIT NOT RECEIVED AS OF 7/1/76	KNU 5 & 6 POSITION	METHOD OF COMPLIANCE OR BASIS FOR NONCOMPLIANCE
2. Inspection, Procedures, and Drawings Inspections, tests, administrative controls, fire drills, and training that govern the fire protection program should be prescribed by documented instructions, procedures, or drawings and should be accomplished in accordance with these documents.	Comply	
3. Control of Purchased Material, Equipment, and Services Measures shuld be established to assure that purchased material, equipment, and services conform to the procurement documents.	Comply	
4. Inspection A program for independent inspection of activities affecting fire protection should be established and executed by, or for, the organization performing the activity to verify conformance with documented installation drawings and test procedures for accomplishing the activities.	Comply	
5. Test and Test Control A test program should be established and implemented to assure that testing is performed and verified by inspection and audit to demonstrate conformance with design and system readiness requirements. The tests should be performed in accordance with written test procedures and test results should be properly evaluated and acted upon.	Comply	
6. Inspection, Test, and Operating Status Measures should be established to provide for the identification of items that have satisfactorily passed required tests and inspections.	Comply	

Table 9.5-1

COMPARISON OF KNU 5 & 6 WITH REQUIREMENTS OF APPENDIX A
OF NRC BRANCH TECHNICAL POSITION ASB 9.5-1
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APPLICATION DOCKETED BUT CONSTRUCTION PERMIT NOT RECEIVED AS OF 7/1/76	KNU 5 & 6 POSITION	METHOD OF COMPLIANCE OR BASIS FOR NONCOMPLIANCE
7. Non conforming Items Measures should be established to control items that do not conform to specified requirements to prevent inadvertent use of the installation.	Comply	
8. Corrective Action Measures should be established to assure that conditions adverse to fire protection, such as failures, malfunctions, deficiencies, deviations, defective components, uncontrolled combustible material, and nonconformances are promptly identified, reported, and corrected.	Comply	
9. Records Records should be prepared and maintained to furnish evidence that the criteria enumerated above are being met for activities affecting the fire protection program.	Comply	
10. Audits Audits should be conducted and documented to verify compliance with the fire protection program including design and procurement documents, instructions, procedures and drawings, and inspection and test activities.	Comply	
D. General Guidelines for Plant Protection	Comply	D. General Guidelines for Plant Protection
1. Building Design		1. Building Design
(a) Plant layout should be arranged to:		(a) Plant layouts are arranged such that:
(1) Isolate safety-related systems from unacceptable fire hazards, and		(1) All safety-related systems and components are isolated from unacceptable fire hazards.
(2) Separate redundant safety-related systems from each other so that both are not subject to damage from a single fire hazard.	Partial compliance	(2) The normal separation of redundant safety-related systems is by physical barriers having a minimum fire rating of three hours. In the few locations where redundant

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		safety-related systems are not separated by three-hour rated barriers, a combination of the following are used: (i) Fire barrier of lesser rating or partial fire barrier. (ii) Automatic fire suppression for each train (including detection) (iii) Spatial separation as per Regulatory Guide 1.75 requirements (iv) Credit for a constantly manned area, such as the control room with detection.
(b) In order to accomplish 1.(a) above, safety-related systems and fire hazards should be identified throughout the plant. Therefore, a detailed fire hazards analysis should be made. The fire hazards analysis should be reviewed and updated as necessary.	Partial Compliance	(b) Identification of safety-related equipment throughout the plant is performed in order to ensure compliance with all separation criteria. The overall fire protection system design is based upon evaluation of potential fire hazards to this equipment and the resulting effect on safe shutdown capability.
(c) For multiple reactor sites, cable spreading rooms should not be shared between reactors. Each cable spreading room should be separated from other areas of the plant by barriers (walls and floors) having a minimum fire resistance of three hours. Cabling for redundant safety divisions should be separated by walls having three hour fire barriers.	Comply	(c) KNU 5 and 6 two unit plant, has two cable spreading rooms, one train A and one train B for each unit. Each cable spreading room is separated from other areas by three hour fire barriers.
(d) Interior wall and structural components, thermal insulation materials and radiation shielding materials, and soundproofing should be noncombustible. Interior finishes should be noncombustible, or listed by a nationally recognized testing laboratory, such as Factory Mutual or Underwriters' Laboratory, Inc., for flame spread, smoke, and fuel contribution of 25 or less in its use configuration (ASTM E-84 Test), "Surface	Comply	(d) Interior wall, structural components, and radiation shielding materials are noncombustible. The interior finishes are noncombustible or listed by Underwriters Laboratory, Inc., or Factory Mutual for flame spread, smoke, and fuel contribution of 25 or less in its final use configuration per (ASTM E-84) Test - "Surface Burning Characteristics of Building Materials."

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Burning Characteristics of Building Materials."		
(e) Metal deck roof construction should be noncombustible (see the building materials directory of the Underwriters Laboratory, Inc.) or listed as Class I by Factory Mutual System Approval Guide.	Comply	(e) All metal deck roof construction is noncombustible and listed as Class I by Factory Mutual, or Class A by Underwriters Laboratories.
(f) Suspended ceilings and their supports should be of noncombustible construction. Concealed spaces should be devoid of combustibles.	Partial compliance	(f) Suspended ceilings and their supports are of noncombustible materials as defined in the Fire Hazards Analysis. Concealed spaces are devoid of combustibles except for lighting and associated lighting cables that are in an aluminum sheath.
(g) High voltage-high amperage transformers installed inside buildings containing safety-related systems should be of the dry type, or insulated and cooled with noncombustible liquid.	Comply	(g) All transformers installed inside safety-related buildings are of the dry type.
(h) Buildings containing safety-related systems should be protected from exposure or spill fires involving oil-filled transformers by locating such transformers at least 50 feet distant or ensuring that such building walls within 50 feet of oil filled transformers are without openings and have a fire resistance rating of at least three hours.	Comply	(h) Buildings containing safety-related systems are protected from exposure or spill fires involving oil-filled transformers by being located more than 50 feet away.
(i) Floor drains, sized to remove expected fire fighting water flow should be provided in those areas where fixed water fire suppression systems are installed. Drains should also be provided in other areas where hand hose lines may be used if such fire fighting water could cause unacceptable damage to equipment in the area. Equipment should be installed on pedestals, or curbs should be provided as required to contain water and direct it to floor drains. (See NFPA 92M,	Comply	(i) Accumulation of water from the operation of any fire suppression system will not create unacceptable consequences. The flooding analysis for safety-related buildings will provide additional information. Generally, all equipment is installed on a 6-inch high pedestal. Rooms that contain combustible fluids have drains that will not spread burning fluids throughout the plant.

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"Waterproofing and Draining of Floors.") Drains in areas containing combustible liquids should have provisions for preventing the spread of the fire throughout the drain system. Water drainage from areas that may contain radioactivity should be sampled and analyzed before discharge to the environment.		
(j) Floors, walls, and ceilings enclosing separate fire areas should have minimum fire rating of three hours. Penetrations in these fire barriers, including conduits and piping, should be sealed or closed to provide a fire resistance rating at least equal to that of the fire barrier itself. Door openings should be protected with equivalent rated doors, frames, and hardware that have been tested and approved by a nationally recognized laboratory. Such doors should be normally closed and locked, or alarmed with alarm and annunciation in the control room. Penetrations for ventilation system should be protected by a standard "fire door damper" where required. (Refer to NFPA 80, "Fire Doors and Windows.")	Partial compliance	(j) Floors, walls, and ceilings of fire areas are separated from other fire areas of the plant by two- and three-hour fire rated barriers. Penetrations in these fire barriers are sealed to provide an equivalent fire rating. Door openings are protected with equivalent fire rated doors, frames, and hardware bearing a UL label. Fire barriers for each zone are evaluated with respect to the fire load and in-depth protection. Enclosed stairways will have walls and doors with a two hour fire resistance rating. Fire doors will be normally closed, but not locked or alarmed. The HVAC systems are designed in accordance with NFPA 90A, "Air Conditioning and Ventilation Systems." Duct penetrations of fire barriers will be provided with a fire damper equal to the rating of the barrier.
2. Control of Combustibles	Comply	2. Control of Combustibles
(a) Safety-related systems should be isolated or separated from combustible materials. When this is not possible because of the nature of the safety system or the combustible material, special protection should be provided to prevent a fire from defeating the safety system function. Such protection may involve a combination of autoomatic fire suppression, and construction		(a) Safety related systems are isolated or separated from combustible materials, and the combustible materials are provided with automatic sprinkler or spray suppression systems. Specifically:

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capable of withstanding and containing a fire that consumes all combustibles present. Examples of such combustible materials that may not be separable from the remainder of its system are:		
(1) Emergency diesel generator fuel oil day tanks.		(1) The diesel generator day tanks are located in separate rooms with three hour rated fire barriers around each room, and each is provided with an automatic pre-action water sprinkler system.
(2) Turbine-generator oil and hydraulic control fluid systems.		(2) The turbine-generator lube oil storage tank and conditioner are separated from other areas by a three hour rated barrier and are protected by water spray and sprinkler systems.
(3) Reactor coolant pump lube oil system.		(3) The reactor coolant pump lube oil systems are protected by individual automatic water spray systems. However, the water supply to these systems is controlled by a Category I containment isolation valve that is normally closed and is operated from the control room.
(b) Bulk gas storage (either compressed or cryogenic), should not be permitted inside structures housing safety-related equipment. Storage of flammable gas such as hydrogen should be located outdoors or in separate detached buildings so that a fire or explosion will not adversely affect any safety-related systems or equipment. (Refer to NFPA 50A, "Gaseous Hydrogen Systems.") Care should be taken to locate high pressure gas storage containers with the long axis parallel to building walls. This will minimize the possibility of wall penetration in the event of a container failure. Use of compressed gases (especially flammable and fuel gases)	Comply	(b) Bulk gas storage of hydrogen, nitrogen, and carbon dioxide is provided outdoors. The compressed air system is located in the nonsafety-related turbine building. The only forms of stored compressed gas in safety-related buildings is that associated with portable fire extinguishers. Small quantities of compressed gases will be used for laboratory purposes.

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inside buildings should be controlled. (Refer to NFPA 6, "Industrial Fire Loss Prevention.")		
(c) The use of plastic materials should be minimized. In particular, haloginated plastics such as polyvinyl chloride (PVC) and neoprene should be used only when substitute noncombustible materials are not available. All plastic materials, including flame and fire retardant materials, will burn in an intensity and BTU production in a range similar to that of ordinary hydrocarbons. When burning, they produce heavy smoke that obscures visibility and can plug air filters, especially charcoal and HEPA. The haloginated plastics also release free chlorine and hydrogen chloride when burning, which are toxic to humans and corrosive to equipment.	Partial compliance	(c) The use of plastic materials is minimized within the plant. With respect to the use of haloginated plastics, PVC is limited. Ethylene propylene rubber (EPR) and cross-linked polyethylene insulation are used on electrical cables; however, neoprene is used for cable jacketing on the 600-volt power cables. PVC is used in certain control panels to a limited extent. Cables will meet the flame test requirements of IEEE 383.
(d) Storage of flammable liquids should, as a minimum, comply with the requirements of NFPA 30, "Flammable and Combustible Liquids Code."	Comply	(d) Flammable liquids will be stored in accordance with NFPA 30.
3. <u>Electric Cable Construction, Cable Trays and Cable Penetrations</u>		3. <u>Electric Cable Construction, Cable Trays, and Cable Penetrations</u>
(a) Only noncombustible materials should be used for cable tray construction.	Comply	(a) Only noncombustible materials are used for table tray construction.
(b) See section F.3 for fire protection guidelines for cable spreading rooms.	Comply	(b) See section F.3.
(c) Automatic water sprinkler systems should be provided for cable trays outside the cable spreading room. Cables should be designed to allow wetting down with deluge water without electrical faulting. Manual hose stations and portable hand extinguishers should be provided as backup. Safety-related equipment in the vicinity of such cable trays that does not itself require water fire protection, but is subject to unacceptable damage from	Partial compliance	(c) There are automatic sprinkler systems for cable trays in the Access Control Building. These cable trays will meet Regulatory 1.75 separation and have fire protection consisting of automatic detection and manual water hose stations.

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APPLICATION DOCKETED BUT CONSTRUCTION PERMIT NOT RECEIVED AS OF 7/1/76	KNU 5 & 6 POSITION	METHOD OF COMPLIANCE OR BASIS FOR NONCOMPLIANCE
sprinkler water discharge, should be protected from sprinkler system operation or malfunction.		
(d) Cable and cable tray penetration of fire barriers (vertical and horizontal) should be sealed to give protection at least equivalent to that fire barrier. The design of fire barriers for hozizontal and vertical cable trays should, as a minimum, meet the requirements of ASTM E-119, "Fire Test of Building Construction and Materials," including the hose stream test.	Comply	(d) Vertical and horizontal cable tray penetrations are sealed to give protection equivalent to the fire barrier.
(e) Fire breaks should be provided as deemed necessary by the fire hazards analysis. Flame or flame retardant coatings may be used as a fire break for grouped electrical cables to limit spread of fire in cable ventings. (Possible cable derating owing to use of such coating materials must be considered during design.)	Comply	(e) Fire breaks are provided for vertical cable runs at each floor level (approximately 20 ft intervals).
(f) Electric cable constructions should, as a minimum, pass the current IEEE No. 383 flame test. (This does not imply that cables passing this test will not require additional fire protection.)	Partial compliance	(f) Generally, electrical cable (except some provided by the NSSS supplier that is inside cabinets, and that provided with the turbine-generator in the turbine building) meets the requirements of IEEE No. 383.
(g) To the extent practical, cable construction that does not give off corrosive gases while burning should be used.	Comply	(g) See Item D.2.c.
(h) Cable trays, raceways, conduit, trenches, or culverts should be used only for cables. Miscellaneous storage should not be permitted, nor should piping for flammable or combustible liquids or gases be installed in these areas.	Comply	(h) Cable trays raceways and conduit are used for electrical cabling only. There is no piping for flammable or combustible liquids or gases installed in these areas.
(i) The design of cable tunnels, culverts, and spreading rooms should provide for automatic or manual smoke venting as required to facilitate manual fire fighting capability.	Comply	(i) Cable tunnels, spreading rooms, and electrical penetration rooms utilize normal HVAC systems for smoke removal, in conjunction with manually-operated smoke fans to facilitate manual fire fighting capability.

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(j) Cables in the control room should be kept to the minimum necessary for operation of the control room. All cables entering the control room should terminate there. Cables should not be installed in floor trenches or culverts in the control room.	Comply	(j) Cables within the control room are required for control room operation. All cables entering the control room terminate there. There are no trenches or culverts.
4. Ventilation		4. Ventilation
(a) The products of combustion that need to be removed from a specific fire area should be evaluated to determine how they will be controlled. Smoke and corrosive gases should generally be automatically discharged directly outside to a safe location. Smoke and gases containing radioactive materials should be monitored in the fire area to determine if release to the environment is within the permissible limits of the plant Technical Specifications.	Comply	(a) Products of combustion will be removed from a fire zone on any given fire area or fire floor, by means of the normal exhaust duct systems, as shown in section I.7 under ventilation. Ventilation systems for the auxiliary, radwaste, fuel handling, and containment buildings are provided with radiation monitoring systems.
(b) Any ventilation system designed to exhaust smoke or corrosive gases should be evaluated to ensure that inadvertent operation or single failures will not violate the controlled areas of the plant design. This requirement includes containment functions for protection of the public and maintaining habitability for operations personnel.	Comply	(b) The HVAC systems used for normal and emergency plant conditions are used. Inadvertent operation or a single failure will not violate the controlled areas of the plant.
(c) The power supply and controls for mechanical ventilation systems should be run outside the fire area served by the system.	Partial compliance	(c) The power and control cables for safety-related mechanical ventilation systems are run outside the fire area served, except for the mechanical equipment rooms where the ventilation equipment is installed. In these cases there are remote manual switches provided.
(d) Fire suppression systems should be installed to protect charcoal filters in accordance with Regulatory Guide 1.52, "Design Testing and Maintenance Ciriteria for Atmospheric Cleanup Air Filtration."	Comply	(d) All charcoal filters are equipped with manual deluge water spray systems.

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(e) The fresh air supply intakes to areas containing safety-related equipment or systems should be located remote from the exhaust air outlets and smoke vents of other fire areas to minimize the possibility of contaminating the intake air with the products of combustion.	Comply	(e) HVAC system air supply intakes are located away from exhaust outlets to minimize the possibility of contaminating the intake air with the products of combustion.
(f) Stairwells should be designed to minimize smoke infiltration during a fire. Staircases should serve as escape routes and access routes for fire fighting. Fire exit routes should be clearly marked. Stairwells elevators, and chutes should be enclosed in masonry towers with minimum fire rating of three hours, and automatic fire doors at least equal to the enclosure construction, at each opening into the building. Elevators should not be used during fire emergencies.	Partial compliance	(f) The stairwells are designed to uniform building code (UBC) standards, which require two-hour fire resistance for the enclosure with 1-1/2-hour rated fire doors. All fire doors are closed at all times and are equipped with automatic door closers. Elevators will not be used during a fire, and plant will be familiar with access and egress routes, which will be clearly marked.
(g) Smoke and heat vents may be useful in specific areas such as cable spreading rooms and diesel fuel oil storage areas and switchgear rooms. When natural-convection ventilation is used, a minimum ratio of 1 sq foot of venting area per 200 sq feet of floor area should be provided. If forced-convection ventilation is used, 300 CFM should be provided for every 200 sq feet of floor area. See NFPA No. 204 for additional guidance on smoke control.	Partial compliance	(g) Smoke and heat venting is provided for all areas within safety-related structures. Forced-convection is used in all cases within the plant. See each zone for its specific rate.
(h) Self-contained breathing apparatus, using full-face, positive pressure masks approved by NIOSH (National Institute for Occupational Safety and Health - approval formerly given by the U.S. Bureau of Mines) should be provided for the fire brigade, damage control, and control room personnel. Control room personnel may be furnished breathing air by a manifold system piped from a storage reservoir if	Comply	(h) Self-contained breathing apparatus, using full face positive pressure masks approved by NIOSH (National Institute for Occupational Safety and Health) with a minimum one-half hour service or operating life are provided. Two extra air bottles are also provided for each self-contained breathing unit. In addition, an on-site 6-hour reserve air supply will be provided and arranged to

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practical. Service or operating life should be a minimum of one-half hour for the self-contained units. At least two extra air bottles should be located onsite for each self-contained breathing unit. In addition, an onsite 6-hour supply of reserve air should be provided and arranged to permit quick and complete replenishment of exhausted supply air bottles as they are returned. If compressors are used as a source of breathing air, only units approved for breathing air should be used. Special care must be taken to locate the compressor in areas free of dust and contaminants.		fully replenish exhausted supply air bottles as they are returned.
(i) Where total-flooding gas extinguishing systems are used, area intake and exhaust ventilation dampers should close upon initiation of gas flow to maintain necessary gas concentration. (See NFPA 12, "Carbon Dioxide Systems," and 12A, "Halon 1301 Systems.")	Not applicable	
5. Lighting and Communication Lighting and two-way voice communication are vital to safe shutdown and emergency response in the event of fire. Suitable fixed and portable emergency lighting and communication devices should be provided to satisfy the following requirements:		5. Lighting and Communication
(a) Fixed emergency lighting should consist of sealed beam units with individual 8-hour minimum battery power supplies.	Comply	(a) Emergency lighting which includes sealed beam units with individual 8 hour minimum battery power supplies are installed. Essential lighting is powered from the emergency diesel generators.
(b) Suitable sealed beam battery-powered portable hand lights should be provided for emergency use.	Comply	(b) Sealed beam battery powered portable hand lights are available.

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(c) Fixed emergency communication should use voice-powered head sets at preselected stations.	Comply	(c) A sound powered telephone system will be located throughout the plant at designated control points for plant maintenance and test and to serve as a backup communication system. A sound-powered telephone system will be located throughout the refueling areas and the control room.
(d) Fixed repeaters installed to permit use of portable radio communication units should be protected from exposure to fire damage.	Not applicable	(d) Portable radios are not used for communications.
E. Fire Detection and Suppression		E. Fire Detection and Suppression
1. Fire Detection		1. Fire Detection
(a) Fire detection systems should as a minimum comply with NFPA 72D, "Standard for the Installation, Maintenance and Use of Proprietary Protective Signaling Systems."	Comply	(a) NFPA No. 72. "Standard for the Installation, Maintenance, and Use of Proprietary Protective Signaling Systems," will be utilized for the design of the fire detection system.
(b) Fire detection system should give audible and visual alarm and annunciation in the control room. Local audible alarms should also sound at the location of the fire.	Comply	(b) Fire detection systems give audible and visual alarm and annunciation in the control room, and also at the local fire alarm panels. The plant public address system is used to announce fires plant wide.
(c) Fire alarms should be distinctive and unique. They should not be capable of being confused with any other plant system alarms.	Comply	Fire alarms are distinctive, unique, and will not be confused with any other plant working system.
(d) Fire detection and actuation system should be connected to the plant emergency power supply.	Comply	(d) The plant emergency diesel circuit will be used except in the event of a LOCA.

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2. Fire Protection Water Supply Systems		2. Fire Protection Water Supply Systems
(a) An underground yard fire main loop should be installed to furnish anticipated fire water requirements. NFPA 24 - Standard for Outside Protection - gives necessary guidance for such installation. It references other design codes and standards developed by such organizatons as the American National Standards Institute (ANSI) and the American Water Works Association (AWWA). Lined steel or cast iron pipe should be used to reduce internal tuberculation. Such tuberculation deposits in an unlined pipe over a period of years can significantly reduce water flow through the combination of increased friction and reduced pipe diameter. Means for treating and flushing the systems should be provided. Approved visually-indicating sectional control valves, such as post indicator valves, should be provided to isolate portions of the main for maintenance or repair without shutting off the entire system. The fire main system piping should be separate from service or sanitary water system piping.	Comply	(a) An underground yard fire main loop is installed to furnish anticipated fire water requirements. NFPA No. 24 - "Standard for Outside Protection," provides necessary guidelines for such installaton, references other design codes and standrds such as ANSI and AWWA (American Water Works Association), and was utilized in the design. Since cement-lined cast iron pipe is used, internal tuberculation is reduced. Post-indicator valves (approved visually-indicating sectional control valves) are provided to isolate portions of the fire main for maintenance or repair without shutting off the entire system. The fire main system piping is separate from service or sanitary water system piping.
(b) A common yard fire main loop may serve multi-unit nuclear power plant sites if cross-connected between units. Sectional control valves should permit maintaining independence of the individual loop around each unit. For such installations, common water supplies may also be utilized. The water supply should be sized for the largest single expected flow. For multiple reactor sites with widely separated plants (approaching 1 mile or more), separate yard fire main loops should be used.	Comply	(b) A common yard fire main loop serves both nuclear power plants. Sectional control valves permit maintaining independence of the individual supply to each unit and common water supplies are utilized. The water supply is sized for the largest single expected flow. The units are in close proximity and a single cross-connected fire main loop is considered adequate.

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(c) If pumps are required to meet system pressure or flow requirements, a sufficient number of pumps should be provided so that 100 percent capacity will be available with one pump inactive (e.g., three 50 percent pumps or two 100 percent pumps). The connection to the yard fire main loop from each fire pump should be widely separated, preferably located on opposite sides of the plant. Each pump should have its own driver with independent power supplies and control. At least one pump (if not powered from the emergency diesels) should be driven by nonelectrical means, preferably diesel engine. Pumps and drivers should be located in rooms separated from the remaining pumps and equipment by a minimum three-hour firewall. Alarms indicating pump running, driver availability, or failure to start should be provided in the control room. Details of the fire pump installation should, as a minimum, conform to NFPA 20, "Standard for the Installation of Centrifugal Fire Pumps."	Comply	(c) Two 50 percent diesel driven pumps, one 50 percent motor-driven pump, and one motor-driven jockey pump are located in separate rooms in the fire pump house, and separated by three-hour fire barriers. The status of the pumps will be indicated on the fire protection control panel in the control room. The pump installations comply with NFPA No. 20.
(d) Two separate reliable water supplies should be provided. If tanks are used, two 100 percent (minimum of 300,000 gallons each) system capacity tanks should should be installed. They should be so interconnected that pumps can take suction from either or both. However, a leak in one tank or its piping should not cause both tanks to drain. The main plant fire water supply capacity should be capable of refilling either tank in a minimum of either tank in a minimum of eight hours. Common tanks are permitted for fire and sanitary or service water storage. When this is done, however, minimum fire water storage requirements should be dedicated by means of a vertical standpipe for other water services.	Comply	(d) Two separate reliable water supplies consisting of two 100 percent system capacity tanks of 360,000 gallons each for fire protection water are installed. The tanks are interconnected so that the fire pumps can take suction from either or both tanks. A leak in one tank or its piping can be valved closed so as not to cause both tanks to drain. The plant water supply capacity is capable of refilling either tank in less than eight hours. Common tanks for fire water and service water are provided. The service water connections are located above the minimum fire water level.

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(e) The fire water supply (total capacity and flow rate) should be calculated on the basis of the largest expected flow rate for a period of two hours, but not less than 300,000 gallons. This flow rate should be based (conservatively) on 1,000 gpm for manual hose streams plus the greater of: (1) All sprinkler heads opened and flowing in the largest designed fire area, or (2) The largest open head deluge system(s) operating.	Comply	(e) The fire water supply (total capacity and flow rate) is calculated on the basis of the largest expected flow rate for a period of two hours, but not less than 300,000 gallons.
(f) Lakes or fresh water ponds of sufficient size may qualify as sole source of water for fire proection, but require at least two intakes to the pump supply. When a common water supply is permitted for fire protection and the ultimate heat sink, the following conditions should also be satisfied: (1) The additional fire protection water requirements are designed into the total storage capacity; and (2) Failure of the fire protection system should not degrade the function of the ultimate heat sink.	Not applicable	(f) Not Applicable
(g) Outside manual hose installation should be sufficient to reach any location with an effective hose stream. To accomplish this, hydrants should be installed approximately every 250 feet on the yard main system. The lateral to each hydrant from the yard main should be controlled by a visually indicating or key-operated (curb) valve. A hose house, equipped with hose and combination nozzle, and other auxiliary equipment recommended in NFPA 24, "Outside Protection," should be provided as needed but at least every 1,000 feet.	Comply	(g) The outside manual hose installation is sufficient to reach any location with an effective hose stream. To accomplish this, fire hydrants are installed approximately every 250 feet on the yard fire main system. If a fire hydrant must be taken out of service for maintenance purposes, a key-operated (curb) valve will be closed for isolation purposes. Hose houses equipped with hose, nozzles, and other auxiliary equipment as recommended by NFPA No. 24, "Outside Protection" are provided.

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Threads compatible with those used by local fire departments should be provided on all hydrants, hose couplings, and standpipe risers.		Threads compatible with those of the local fire department are provided on all hydrants, hose couplings, and standpipe risers.
3. Water Sprinklers and Hose Standpipe Systems		3. Water Sprinkers and Hose Standpipe Systems
(a) Each automatic sprinkler system and manual hose station standpipe should have an independent connection to the plant underground water main. Headers fed from each end are permitted inside buildings to supply multiple sprinkler and standpipe systems. When provided, such headers are considered an extension of the yard main system. The header arrangement should be such that no single failure can impair both the primary and backup fire protection systems. Each sprinkler and standpipe system should be equipped with outside screw and yoke gate valve, or other approved shut off valve, and water flow alarm. Safety-related equipment that does not itself require sprinkler water fire protection, but is subject to unacceptable damage if wetted by sprinkler water discharge should be protected by water shields or baffles.	Comply	(a) There are two water supplies to safety-related buildings. Manual hose stations are connected to one of them and sprinkler systems are connected to the other one. In this manner no single failure can impair both the primary and secondary fire protection systems. Each sprinkler system is equipped with an ouside screw and yoke gate valve. The standpipe system is provided with a hose valve at each fire hose station for isolation. Only dry pipe systems are used in safety-related areas to protect this equipment from single failures.
(b) All valves in the fire water systems should be electrically supervised. The electrical supervision signal should indicate in the control room and other appropriate command locations in the plant. (See NFPA 26, "Supervision of Valves.")	Partial compliance	(b) Primary valves in the fire pump house and the isolation valve to all water sprinkler or spray systems have a position indicator switch with a readout in the control room.
(c) Automatic sprinkler systems should, as a minimum, conform to requirements of appropriate standards such as NFPA 13, "Standard for the Installation of Sprinkler Systems," and NFPA 15, "Standard for Water Spray Fixed Systems."	Comply	(c) Automatic sprinkler systems conform to requirements of appropriate NFPA standards such as NFPA No. 13, "Standard for the Installation of Sprinkler Systems," and NFPA No. 15, "Standard for Water Spray Fixed Systems."

Table 9.5-1

COMPARISON OF KNU 5 & 6 WITH REQUIREMENTS OF APPENDIX A
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(d) Interior manual hose intallation should be able to reach any location with at least one effective hose stream. To accomplish this, standpipes with hose connections, equipped with a maximum of 75 feet of 1-1/2-inch woven jacket-lined fire hose and suitable nozzles should be provided in all buildings, including containment, on all floors and should be spaced at not more than 100-foot intervals. Individual standpipes should be of at least 4-inch diameter for multiple hose connections and 2-1/2-inch diameter for single hose connections. These systems should follow the requirements of NFPA 14, "Standpipe and Hose Systems" for sizing, spacing, and pipe support requirements.	Comply	(d) Interior manual fire hose installations are capable of reaching any location with at least one effective hose stream. To accomplish this, standpipes with fire hose connections, equipped with a maximum of 100 feet of 1-1/2-inch woven jacket-lined fire hose and suitable nozzles are provided on all floors, in all buildings. Individual standpipes are minimum 4-inch diameter for multiple fire hose connections and 2-1/2-inch diameter for single fire hose connections. These systems follow the requirements of NFPA No. 14, "Standpipe and Hose Systems," for sizing, spacing, and pipe support requirements.
Hose stations should be located outside entrances to normally unoccupied areas and inside normally occupied areas. Standpipes serving hose stations in areas housing safety-related equipment should have shut off valves and pressure reducing devices (if appliable) outside the area.	Comply	Hose stations for the interior of buildings are generally located just outside the entrance to the hazard being protected. Fire hose stations are located just outside the control room entrances, but not inside the control room. Adequate valves outside safety-related areas and pressure reducing devices are provided, as applicable.
Provisions should be made to supply water at least to standpipes and hose connections for manual fire fighting in areas within hose reach of equipment required for safe plant shutdown in the event of a safe shutdown earthquake (SSE). The standpipe system serving such hose stations should be analyzed for SSE loading, and should be provided with supports to assure system pressure integrity. The piping and valves for the portion of hose standpipe system affected by this functional requirement should at least satisfy ANSI Standard 831.1, "Power Piping." The water supply for this condition may be obtained by manual operator actuation of valve(s) in a connection to the hose standpipe	Comply	See sheet 6 of 6 figure 9.5-1.

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header from a normal Seismic Category I water system such as essential service water system. The cross-connection should be (1) capable of providing flow to at least two hose stations (approximately 75 gpm/hose station), and (2) designed to the same standards as the Seismic Category I water system; it should not degrade the performance of the Seismic Category I water system.		
(e) The proper type of hose nozzles to be supplied to each area should be based on the fire hazard analysis. The usual combination spray/straight-stream nozzle may cause unacceptable mechanical damage (for example, the delicate electronic equipment in the control room) and be unsuitable. Electrically safe nozzles should be provided at locations where electrical equipment or cabling is located.	Comply	(e) The proper hose nozzles are supplied to each area. See fire hazard analysis and P&ID drawings.
(f) Certain fires such as those involving flammable liquids respond well to foam suppression. Consideration should be given to use of any of the available foams for such specialized protection application. These include the more common chemical and mechanical low expansion foams, high expansion foam and the relatively new aqueous film forming foam (AFFF).	Not applicable	(f) Foam will not be used in safety-related areas.
4. <u>Halon Suppression Systems</u> The use of Halon fire extinguishing agents should, as a minimum, comply with the requirements of NFPA 12A and 12B, "Halogenated Fire Extinguishing Agent Systems Halon 1301 and Halon 1211." Only UL or FM approved agents should be used. In addition to the guidelines of NFPA 12A and 12B, preventative maintenance and testing of the systems, including check weighing of the Halon cylinders should be done at least quarterly.	Not applicable	4. <u>Halon Suppression Systems</u> Halon systems are not used in KNU 5 & 6 units.

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Particular consideration should also be given to: (a) minimum required Halon concentration and soak time, (b) toxicity of Halon, (c) toxicity and corrosive characteristics of thermal decomposition products of Halon.		
5. <u>Carbon Dioxide Suppression Systems</u> The use of carbon dioxide extinguishing systems should, as a minimum, comply with the requirements of NFPA 12, "Carbon Dioxide Extinguishing Systems." (a) Minimum required CO_2 concentration and soak time, (b) toxicity of CO_2, (c) possibility of secondary thermal shock (cooling) damage, (d) offsetting requirements for venting during CO_2 injection to prevent overpressurization versus sealing to prevent loss of agent, (e) design requirements from overpressurization, and (f) possibility and probability of CO_2 systems being out-of-service because of personnel safety consideration. CO_2 systems are disarmed whenever people are present in an area so protected. Areas entered frequently(even through duration time for any visit is short) have often been found with CO_2 systems shut off.	Not applicable	5. <u>Carbon Dioxide Suppression Systems</u> The carbon dioxide extinguishing system is not used in KNU 5 and 6 units.
6. <u>Portable Extinguishers</u> Fire extinguishers should be provided in accordance with guidelines of NFPA 10 and 10A, "Portable Fire Extinguishers, Maintenance and Use." Dry chemical extinguishers should be	Comply	6. <u>Portable Extinguishers</u> Fire extinguishers are provided in accordance with guidelines of NFPA No. 10 and 10A, "Portable Fire Extinguishers, Maintenance and Use." Dry chemical extinguishers are

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installed with due consideration given to cleanup problems after use and possible adverse effects on equipment installed in the area.		intalled with due consideration given to cleanup problems after use and possible adverse effects on equipment installed in the area.
F. Guidelines for Specific Plant Areas		F. Guidelines for Specific Plant Areas
1. Primary and Secondary Containment		1. Primary and Secondary Containment
(a) Normal Operation	Partial compliance	(a) Normal Operation
Fire protection requirements for the primary and secondary containment areas should be provided on the basis of specific identified hazards. For example: Lubricating oil or hydraulic fluid system for the primary coolant pumps. Cable tray arrangements and cable penetrations Charcoal filters		Fire protection requirements for the containment areas are provided on the basis of specific identified hazards. Water spray systems are provided for the reactor coolant pump oil systems. There are no charcoal filters in the containment, and cable trays have smoke detection and water hose stations.
Because of the general inaccessibility of these areas during normal plant operations, protection should be provided by automatic fixed systems. Automatic sprinklers should be installed for those hazards identified as requiring fixed suppression.	Partial compliance	Because of the general inaccessibility of the containment during normal operation, the water spray systems are actuated automatically, however, the water spray systems being provided require remote manual opening of the containment isolation valve to initiate flow. This is done to preclude inadvertent operation.
Operation of the fire protection systems should not compromise integrity of the containment or the other safety-related systems. Fire protection activities in the containment areas should function in conjunction with total containment requirements such as control of contaminated liquid and gaseous release and ventilation.	Comply	Operation of the fire protection system is semi-automatic and will not compromise containment integrity or safety-related systems, and will function in conjunction with total containment requirements such as ventilation, control of contaminated liquid, and gaseous release.

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Fire detection systems should alarm and annunciate in the control room. The type of detection used and the location of the detectors should be most suitable to the particular type of fire that could be expected from the identified hazard. A primary containment general area fire detection capability should be provided as backup for the above described hazard detection. To accomplish this, suitable smoke detection (e.g., visual obscuration, light scattering, and particle counting) should be installed in the air recirculation system ahead of any filters.	Partial compliance	Fire detection systems installed within the containment alarm and annunciate in the control room as well as locally.
Automatic fire suppression capability need not be provided in the primary containment atmospheres that are inerted during normal operation. However, special fire protection requirements during refueling and maintenance operations should be satisfied as provided below.	Not applicable	
(b) <u>Refueling and Maintenance</u>	Comply	
Refueling and maintenance operations in the containment may introduce additional hazards such as contamination control materials, decontamination supplies, wood planking, temporary wiring, welding, and flame cutting (with portable compressed fuel gas supply). Possible fires would not necessarily be in the vicinity of fixed detection and suppression systems.		
Management procedures and controls necessary to assure adequate fire protection are discussed in section 3a.		
In addition, manual fire fighting capability should be permanently installed in the containment. Standpipes with hose station, and portable fire extinguishers should be installed at strategic locations throughout containment for any required manual fire fighting operations.	Comply	Permanently installed standpipes with hose stations are provided in the containment. Portable fire extinguishers are stored near the personnel access hatch of the containment, which will be carried in and placed in strategic locations during refueling and maintenance periods.

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Adequate self-contained breathing apparatus should be provided near the containment entrances for fire fighting and damage control personnel. These units should be independent of any breathing apparatus or air supply systems provided for general plant activities.	Comply	Adequate self-contained breathing apparatus are provided near the containment entrance, these units are independent of any breathing apparatus of air supply systems provided for general plant activities.
2. <u>Control Room</u> The control room is essential to safe reactor operation. It must be protected against disabling fire damage, and should be separated from other areas of the plant by floors, walls, and roofs having minimum fire resistance ratings of three hours.	Comply	2. <u>Control Room</u> The floors, walls, and ceiling of the control room area have a three-hour fire resistance rating.
Control room cabinets and consoles are subject to damage from two distinct fire hazards:		
(a) Fire originating within a cabinet or console; and	Comply	(a) Smoke detectors are included in Class 1E cabinets and consoles that have controls for redundant safe shutdown circuits.
(b) Exposure fire involving combustibles in the general room area.		(b) The exposure fire in the general room area will be first detected by smoke detectors and then suppressed by operator action.
Manual fire fighting capability should be provided for both hazards. Hose stations and portable water and Halon extinguishers should be located in the control room to eliminate the need for operators to leave the control room. An additional hose piping shutoff valve and pressure reducing device should be installed outside the control room.		
Hose stations adjacent to the control room with portable extinguishers in the control room are acceptable.	Comply	Portable fire extinguishers are located in the control room, and manual water hose stations are located adjacent to it.
Nozzles that are compatible with the hazards and equipment in the control room should be provided for the manual hose station. The nozzles chosen should satisfy actual fire fighting needs, electrical safety, and minimize physical damage to electrical equipment from hose stream impingement.	Comply	Nozzles are rated for electrical safety.

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Fire detection in the control room cabinets and consoles should be provided by smoke- and heat-detectors in each fire area. Alarm and annunciation should be provided in the control room. Fire alarms in other parts of the plant should also be alarmed and annunciated in the control room.	Comply	Smoke detectors are provided for the control room. Alarm and annunciation is provided in the control room and for all parts of the plant.
Breathing apparatus for control room operators should be readily available. Control room floors, ceiling, supporting structures, and walls, including penetrations and doors, should be designed to a minimum fire rating of three hours. All penetration seals should be air-tight.	Comply	The control room floors, floor-ceiling structures, and walls including penetrations have a three- hour fire resistance rating. All penetration seals in the control room are air-tight.
The control room ventilation intake should be provided with smoke detection capability to automatically alarm locally, and isolate the control room ventilation system to protect operators by preventing smoke from entering the control room. Manually-operated venting of the control room should be available so that operators have the option of venting for visibility.	Partial compliance	Smoke detectors are provided in the control room, and the operators will manually vent the control room to provide visibility.
Cables should not be located in concealed floor and ceiling spaces. All cables that enter the control room should terminate in the control room. That is, no cabling should be simply routed through the control room from one area to another.	Comply	Only conduit for lighting is run above the dropped ceiling over the operating console area. Cables are not located in concealed floor and ceiling spaces. All cables that enter the control room terminate in the control room. Therefore, no cabling is is routed through the control room from one area to another.
Safety-related equipment should be mounted on pedestals, or the control room should have curbs and drains to direct water away from such equipment. Such drains should be provided with means for closing to maintain integrity of the control room in the event of other accidents requiring control room isolation.	Not applicable	

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3. Cable Spreading Room		
The primary fire suppression in the cable spreading room should be an automatic water system such as closed head sprinklers, open head deluge, or open directional spray nozzles. Deluge and open spray systems should have provisions for manual operation at a remote station; however, there should be provisions to preclude inadvertant operation. Location of sprinkler heads or spray nozzles should consider cable tray sizing and arrangements to assure adequate water coverage. Cables should be designed to allow wetting down with deluge water without electrical faulting.	Comply	The primary fire suppression systems are an automatic pre-action water system with manual hose station and portable extinguishers as a backup, for cable spreading rooms.
Open head deluge and open directional spray systems should be zoned so that a single failure will not deprive the entire area of automatic fire suppression capability.		
The use of foam is acceptable, provided it is of a type capable of being delivered by a sprinkler or deluge system, such as an aqueous film forming foam (AFFF).	Not applicable	
An automatic water suppression system with manual hoses and portable extinguisher backup is acceptable, provided:		
(a) At least two remote and separate entrances are provided to the room for access by fire brigade personnel; and	Comply	
(b) Aisle separation provided between tray stacks should be at least three feet wide and eight feet high.		
Alternately, gas systems (Halon or CO_2) may be used for primary fire suppression if they are backed up by an installed water spray system, hose stations, and portable extinguishers immediately outside the room, and if the access requirements stated above are met.	Not applicable	

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Electric cable construction should, as a minimum, pass the flame test in IEEE Standard 383, "IEEE Standard for Type Test of Class 1E Electric Cables, Field Splices and Connections for Nuclear Power Generating Stations."	Comply	
Drains to remove fire fighting water should be provided with adequate seals when gas extinguishing systems are also installed.	Comply	
Redundant safety-related cable division should be separated by walls with a three-hour fire rating.	Comply	
For multiple reactor unit sites, cable spreading rooms should not be shared between reactors Each cable spreading room of each unit should have divisional cable separation as stated above, and be separated from the other and the rest of the plant by a wall with a minimum fire rating of three hours. (See NFPA 251, "Fire Tests, Building Construction and Materials," or ASTM E-119, "Fire Test of Building Construction and Materials," for fire test resistance rating.)	Comply	
The ventilation system to the cable spreading room should be designed to isolate the area upon actuation of any gas extinguishing system in the area. In addition, smoke venting of the cable spreading room may be desirable. Such smoke venting systems should be controlled automatically by the fire detection or suppression system as appropriate. Capability for remote manual control should also be provided.	Partial compliance	Smoke venting of cable spreading rooms is is provided with a manual mode of operation.
4. <u>Plant Computer Room</u> Safety-related computers should be separated from other areas of the plant by barriers having a minimum three-hour fire resistant rating. Automatic fire detection should be provided to alarm and annunciate in the control room and alarm locally. Manual hose stations and portable water and Halon fire extinguishers should be provided.	Comply	4. <u>Plant Computer Room</u> The computer is not safety-related, but is separated from other areas of the plant by a three-hour fire barrier. Automatic detection will alarm the control room, and manual hose stations and portable extinguishers are available.

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5. **Switchgear Rooms** Switchgear rooms should be separated from the remainder of the plant by minimum three-hour rated fire barriers, if practicable. Automatic fire detection should alarm and annunciate in the control room and alarm locally. Fire hose stations and portable extinguishers should be readily available.	Comply	5. **Switchgear Rooms** Switchgear rooms are separated from the remainder of the plant by three-hour barriers. Automatic fire detection is installed that alarms locally. Manual water hoses and portable extinguishers are available for fire fighting.
Acceptable protection for cables that pass through the switchgear room is automatic water or gas agent suppression. Such automatic suppression must consider preventing unacceptable damage to electrical equipment and possible necessary containment of the agent following discharge.	Non compliance	
6. **Remote Safety-Related Panels** The general area housing remote safety-related panels should be provided with automatic fire detectors that alarm locally, and alarm and annunciate in the control room. Combustible materials should be controlled and limited to those required for operation. Portable extinguishers and manual hose stations should be provided.	Comply	

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7. Station Battery Rooms Battery rooms should be protected against fire explosions. Battery rooms should be separated from each other and other areas of the plant by barriers having a minimum fire rating of three hours inclusive of all penetrations and openings. (See NFPA 69, "Standard on Explosion Prevention Systems.") Ventilation systems in the battery rooms should be capable of maintaining the hydrogen concentration well below 2 percent by volume hydrogen concentration. Standpipe and hose and portable extinguishers should be provided. Alternatives:	Comply	7. Station Battery Rooms, Safety-Related The rooms are separated from each other and other areas of the plant by three-hour rated fire barriers. The normal ventilation system is designed to minimize hydrogen concentration. Manual water hoses stations and portable fire extinguishers are provided.
(a) Provide a total fire rated barrier enclosure of the battery room complex that exceeds the fire load contained in the room.	Not applicable	
(b) Reduce the fire load to be within the fire barrier capability of 1-1/2 hours;	Not applicable	
(c) Provide a remote manual-actuated sprinkler system in each room and provide the 1-1/2 hour fire barrier separation.	Not applicable	
8. Turbine Lubrication and Control Oil Storage and Use Areas A blank fire wall having a minimum resistance rating of the three hours should separate all areas containing safety-related systems and equipment from the turbine oil system.	Comply	8. Turbine Lubrication and Control Oil Storage and Use Areas All safety-related systems and components are separated from the turbine-generator lube oil systems by three hour fire barriers.

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9. Diesel Generator Areas Diesel generators should be separated from each other and other areas of the plant by fire barriers having a minimum fire resistance rating of three hours.	Comply	9. Diesel Generator Areas Diesel generators are separated by three-hour fire barriers.	
Automatic fire suppression such as AFFF foam, or sprinklers should be installed to combat any diesel generator or lubricating oil fires. Automatic fire detection should be provided to alarm and annunciate in the control room and alarm locally. Drainage for fire fighting water and means for local manual venting of smoke should be provided.	Comply	The diesel generator rooms are each provided with an automatic pre-action sprinkler system and a fire detection system that annunciates in the control room and alarms locally.	
Day tanks with total capacity up to 1100 gallons are permitted in the diesel generator area under the following conditions:	Partial Compliance	Day Tank Capacity is 2,250 gallons	2
(a) The day tank is located in a separate enclosure, with a minimum fire resistance rating of three hours, including doors or penetrations. These enclosures should be capable of containing the entire contents of the day tanks. The enclosure should be ventilated to avoid accumulation of oil fumes.	Comply		
(b) The enclosure should be protected by automatic fire suppression system such as AFFF or sprinklers.	Comply		
10. Diesel Fuel Oil Storage Areas Diesel fuel tanks with a capacity greater than 1100 gallons should not be located inside the buildings containing safety-related equipment.	Partial Compliance	10. Diesel Fuel Oil Storage Areas Two diesel fuel oil day tanks with a combined capacity of 4,500 gallons are located in the diesel building.	2
They should be located at least 50 feet from any building containing safety-related equipment, or if located within 50 feet, they should be housed in a separate building with construction having a minimum fire resistance rating of three hours. Buried tanks are considered as meeting the three-hour fire resistance requirements. See NFPA 30, "Flammable and Combustible Liquids Code," for additional guidance.		The diesel generator fuel oil storage tanks are not located inside safety-related buildings. These tanks are buried underground outside. The diesel fuel oil day tanks have a capacity of 2,250 gallons each. Day tank capacity in excess of 1,320 gallons is considered acceptable to the NFPA, providing the requirements of NFPA 37, Section 5-3.7	3

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When located in a separate building, the tank should be protected by an automatic fire suppression system such as AFFF or sprinklers.	Not applicable	are met. The day tank compartment design meets these requirements which include: 1) Complete enclosure by 3-hour fire walls 2) Use of class A fire doors, 3) enclosure design capable of containing entire contents of tank, 4) adequate enclosure ventilation, 5) tank vent to outside of building, and 6) automatic pre-action sprinkler systems are provided for the day tank enclosures. 3
Tanks, unless buried, should not be located directly above or below safety-related systems or equipment regardless of the fire rating of separating floors or ceilings.	Not applicable	
11. Safety-Related Pumps	Comply	
Pump houses and rooms housing safety-related pumps or other safety-related equipment should be separated from other areas of the plant by fire barriers having at least three-hour ratings. These rooms should be protected by automatic sprinkler protection unless a fire hazards analysis can demonstrate that a fire will not endanger other safety-related equipment required for safe plant shutdown. Early warning fire detection should be installed with alarm and annunciation locally and in the control room. Local hose stations and portable extinguishers should also be provided.		
Equipment pedestals or curbs and drains should be provided to remove and direct water away from safety-related equipment.	Comply	
Provisions should be made for manual control of the ventilation system to facilitate smoke removal, if required, for manual fire fighting operation.	Comply	
12. New Fuel Area	Comply	
Hand portable extinguishers should be located within this area. Also, local hose stations should be located outside, but within hose reach of this area. Automatic fire detection should alarm and annunciate in the control room and alarm locally. Combustibles should be limited to a minimum in the new fuel area. The storage area should be provided with a drainage system to preclude accumulation of water.		

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The storage configuration of new fuel should always be maintained so as to preclude criticality for any water density that might occur during fire water application.	Comply	
13. Spent Fuel Pool Area Protection for the spent fuel pool area should be provided by local hose stations and portable extinguishers. Automatic fire detection should be provided to alarm and annunciate in the control room and to alarm locally.	Comply	
14. Radwaste Building The radwaste building should be separated from other areas of the plant by fire barriers. Automatic sprinklers should be used in all areas where combustible materials are located. Automatic fire detection should be provided to annunciate and alarm in the control room and alarm locally. During a fire, the ventilation system in these areas should be capable of being isolated. Water should drain to liquid radwaste building sumps. Acceptable alternative fire protection is automatic fire detection to alarm and annunciate in the control room, in addition to manual hose stations and portable extinguishers consisting of hand held and large wheeled units.	Comply	
15. Decontamination Areas The decontamination areas should be protected by automatic sprinklers if flamamble liquids are stored. Automatic fire detection should be provided to annuncaite and alarm in the control room and alarm locally. The ventilation system should be capable of being isolated. Local hose stations and hand portable extinguishers should be provided as backup to the sprinkler system.	Comply	15. Decontamination Areas Sprinklers are not provided in the decontamination areas since flammable liquids will not be stored there.
16. Safety-Related Water Tanks Storage tanks that supply water for safe shutdown should be protected from the effects of	Comply	

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APPLICATION DOCKETED BUT CONSTRUCTION PERMIT NOT RECEIVED AS OF 7/1/76	KNU 5 & 6 POSITION	METHOD OF COMPLIANCE OR BASIS FOR NONCOMPLIANCE
fire. Local hose stations and portable extinguishers should be provided. Portable extinguishers should be located in nearby hose houses. Combustible materials should not be stored next to outdoor tanks. A minimum of 50 feet of separation should be provided between outdoor tanks and combustible materials where feasible.		
17. <u>Cooling Towers</u> Cooling towers should be of noncombustible construction, or so located that a fire will not adversly affect any safety-related system or equipment. Cooling towers should be of noncombustible construction when the basins are used for the ultimate heat sink or for the fire protection water supply.	Not applicable	
18. <u>Miscellaneous Areas</u> Miscellaneous areas such as records storage areas, shops, warehouses, and auxiliary boiler rooms should be so located that a fire or effects of a fire, including smoke, will not adversely affect any safety-related system or equipment. Fuel oil tanks for auxiliary boilers should be buried or provided with dikes to contain the entire tank contents.	Comply	18. <u>Miscellaneous Areas</u> Miscellaneous areas and buildings are so located that a fire or effects of fire, including smoke, will not adversely affect safety-related equipment. The fuel tank for the auxiliary boiler is provided with dikes that will contain the entire tank contents.
G. <u>Special Protection Guidelines</u>		G. <u>Special Protection Guidelines</u>
1. <u>Welding and Cutting, Acetylene-Oxygen Fuel Gas Systems</u> This equipment is used in various areas throughout the plant. Storage locations should be chosen to permit fire protection by automatic sprinkler systems. Local hose stations and portable equipment should be provided as backup. The requirements of NFPA 51 and 41B are applicable to these hazards. A permit system should be required to utilize this equipment. (Also refer to B.3.a herein.)	Comply	1. <u>Welding and Cutting, Acetylene-Oxygen Fuel Gas Systems</u> A permitted system will be in use where welding and cutting work is being applied. Storage of these materials will be in controlled areas. Hose station, portable fire extinguishers will be provided.

Table 9.5-1

COMPARISON OF KNU 5 & 6 WITH REQUIREMENTS OF APPENDIX A
OF NRC BRANCH TECHNICAL POSITION ASB 9.5-1
(Sheet 40 of 40)

APPLICATION DOCKETED BUT CONSTRUCTION PERMIT NOT RECEIVED AS OF 7/1/76	KNU 5 & 6 POSITION	METHOD OF COMPLIANCE OR BASIS FOR NONCOMPLIANCE
2. Storage Areas for Dry Ion Exchange Resins Dry ion exchange resins should not be stored near essential safety-related systems. Dry unused resins should be protected by automatic wet pipe sprinkler installations. Detection by smoke and heat detectors should alarm and annunciate in the control room and alarm locally. Local hose stations and portable extinguishers should provide backup for these areas. Storage areas of dry resin should have curbs and drains. (Refer to NFPA 92M, "Waterproofing and Draining of Floors.")	Comply	2. Storage Areas for Dry Ion Exchange Resins The primary storage is in proper storage area. Very limited temporary storage will be in controlled areas and protected by hose stations and portable fire extinguishers.
3. Hazardous Chemicals Hazardous chemicals should be stored and protected in accordance with the recommendations of NFPA 49, "Hazardous Chemicals Data." Chemical storage areas should be well ventilated and protected against flooding conditions since some chemicals may react with water to produce ignition.	Comply	3. Hazardous Chemicals Hazardous chemicals will be stored and protected in accordance with the recommendations of NFPA 49.
4. Materials Containing Radioactivity Materials that collect and contain radioactivity such as spent ion exchange resins, charcoal filters, and HEPA filters should be stored in closed metal tanks or containers that are located in areas free from ignition sources or combustibles. These materials should be protected from exposure to fires in adjacent areas as well. Consideration should be given to requirements for removal of isotopic decay heat from entrained radioactive materials.	Comply	4. Materials Containing Radioactivity Materials such as resins and filters that collect and contain radioactivity are stored in controlled areas and kept in closed containers.

Table 9.5-2

FIRE DETECTION INSTRUMENT TYPES AND LOCATIONS

(Sheet 1 of 8)

Building	Elevation	Room. No.[a]	Room Name	Name of detectors			
				Photoelectric[b]		Heat[b]	
				Total	Auto	Total	Auto
control				1			
control				2			
control				2			
control				2			
control				2			
control				2			
control				2			
control				1			
control				1			
control				1			
control				1			
control				1			
control				1			
control				1			
control				1			
control				1			
control				1			
control				6			
control				2			
control				1			

451

Table 9.5-2

FIRE DETECTION INSTRUMENT TYPES AND LOCATIONS

(Sheet 2 of 8)

Building	Elevation	Room. No.[a]	Room Name	Name of detectors				
				Photoelectric[b]		Heat[b]		
				Total	Auto	Total	Auto	
control				32	15			
control				1				
control				6				
control				4	2			
control				2	1			
control				2	1			513
control				2	1			
control				2	1			451
control				2	1			
control				2	1			
control				2	1			
control				2	1			
control				2	1			
control				1				628
control				1				
Diesel Generator				10	4			451 513
Diesel Generator				10	4			
Diesel Generator						2	2	
Diesel Generator						2	2	
Diesel Generator				1				
Diesel Generator				1				631
Diesel Generator				1				451

Table 9.5-2

FIRE DETECTION INSTRUMENT TYPES AND LOCATIONS

(Sheet 3 of 8)

Building	Elevation	Room. No.[a]	Room Name	Name of detectors				
				Photoelectric[b]		Heat[b]		
				Total	Auto	Total	Auto	
control	[redacted]	[redacted]	[redacted]	28				
control	[redacted]	[redacted]	[redacted]	2				
control	[redacted]	[redacted]	[redacted]	2				451
control	[redacted]	[redacted]	[redacted]	1				
control	[redacted]	[redacted]	[redacted]	1				
control	[redacted]	[redacted]	[redacted]	2				
control	[redacted]	[redacted]	[redacted]	1				
control	[redacted]	[redacted]	[redacted]	1				
control	[redacted]	[redacted]	[redacted]	1				
control	[redacted]	[redacted]	[redacted]	1				
control	[redacted]	[redacted]	[redacted]	1				
control	[redacted]	[redacted]	[redacted]	1				
control	[redacted]	[redacted]	[redacted]	1				
control	[redacted]	[redacted]	[redacted]	1				
control	[redacted]	[redacted]	[redacted]	2				
control	[redacted]	[redacted]	[redacted]	1				
control	[redacted]	[redacted]	[redacted]	1				
control	[redacted]	[redacted]	[redacted]			1		
control	[redacted]	[redacted]	[redacted]	1				
control	[redacted]	[redacted]	[redacted]	1				
control	[redacted]	[redacted]	[redacted]	24	14			
control	[redacted]	[redacted]	[redacted]	1				513
control	[redacted]	[redacted]	[redacted]	3				
control	[redacted]	[redacted]	[redacted]	3				
control	[redacted]	[redacted]	[redacted]	2	1			451

Table 9.5-2

FIRE DETECTION INSTRUMENT TYPES AND LOCATIONS

(Sheet 4 of 8)

Building	Elevation	Room. No.[a]	Room Name	Name of detectors			
				Photoelectric[b]		Heat[b]	
				Total	Auto	Total	Auto
control				1			
control				4	2		
control				2	1		
control				1			
control				2	1		
control				2	1		
control				2	1		
control				2	1		
control				1			
control				2	1		
control				1			
control				1			
Auxiliary				1			
Auxiliary				1			
Auxiliary				3	2		
Auxiliary				3	2		
Auxiliary				2	2		
Auxiliary				2	2		
Auxiliary				2	2		
Auxiliary				2	2		
Auxiliary				3	2		

451

513

Table 9.5-2

FIRE DETECTION INSTRUMENT TYPES AND LOCATIONS

(Sheet 5 of 8)

Building	Elevation	Room. No.[a]	Room Name	Name of detectors: Photoelectric[b] Total	Photoelectric[b] Auto	Heat[b] Total	Heat[b] Auto	
Auxiliary				16				
Auxiliary				2				451
Auxiliary				3				
Auxiliary				2				
Auxiliary				5				
Auxiliary				6				
Auxiliary				1				
Auxiliary				1				
Auxiliary				3				
Auxiliary				3				
Auxiliary				3				
Comp Cooling Water Bldg				5	1			
Comp Cooling Water Bldg				5	1			
Auxiliary				7				
Auxiliary				8				
Auxiliary				8	3			513
Auxiliary				8	3			

Table 9.5-2

FIRE DETECTION INSTRUMENT TYPES AND LOCATIONS

(Sheet 6 of 8)

Building	Elevation	Room. No.[a]	Room Name	Name of detectors				
				Photoelectric[b]		Heat[b]		
				Total	Auto	Total	Auto	
Auxiliary	[redacted]			11				
Auxiliary				2				451
Auxiliary				2				
Auxiliary				2				
Auxiliary				2				
Auxiliary				2				
Auxiliary				2				
Auxiliary				2				
Comp Cooling Water Bldg				6				513
Auxiliary				6	3			
Auxiliary				6	3			
Auxiliary				6				
Auxiliary				3				
Auxiliary				12				
Auxiliary				1				
Auxiliary				1				
Fuel				6	2			
Fuel				3				
Fuel				3				513
Fuel				8	2			
Fuel				11	4			
Containment				8				

Table 9.5-2

FIRE DETECTION INSTRUMENT TYPES AND LOCATIONS

(Sheet 7 of 8)

Building	Elevation	Room. No.[a]	Room Name	Name of detectors				
				Photoelectric[b]		Heat[b]		
				Total	Auto	Total	Auto	
Containment						9(3)[d]	6	
Containment				1				
Access Control				22				513
Access Control				1				
Access Control				3				451
Access Control				2				
Access Control				28				513
Yard						16	16	
Yard						24	24	
Yard						12	12	
Turbine						2	2	
Turbine						7	7	
Turbine				2				
Turbine						2	2	
Turbine				6				
Turbine				2				451 513
Turbine				22				
Turbine				1				
Turbine				1				
Turbine				1				630
Turbine				1				
Turbine				1				632
Turbine				1				627
Turbine				10		2	2	
Turbine				10				
Turbine				37				513
Turbine				1				451
Turbine				2				
Turbine				1				
Turbine				1				
Turbine						10	10	
Turbine				1				
Turbine				1				608
Turbine				2				
Turbine				1				
Radwaste[C]				4				451
Radwaste[C]				2				
Radwaste[C]				1				
Radwaste[C]				1				

Table 9.5-2

FIRE DETECTION INSTRUMENT TYPES AND LOCATIONS

(Sheet 8 of 8)

Building	Elevation	Room. No.[a]	Room Name	Name of detectors				
				Photoelectric[b]		Heat[b]		
				Total	Auto	Total	Auto	
Radwaste[c]	[redacted]	[redacted]	[redacted]	2				451
Radwaste[c]	[redacted]	[redacted]	[redacted]	1				625
Hot Machine Shop	[redacted]	[redacted]	[redacted]	4				
NSCW Electric Control Room	[redacted]	[redacted]	[redacted]	2				
NSCW Intake Structure	[redacted]	[redacted]	[redacted]	2				451
Aux.[C] Boiler	[redacted]	[redacted]	[redacted]	3				
Water[C] Treatment	[redacted]	[redacted]	[redacted]	9				
Water[C] Treatment	[redacted]	[redacted]	[redacted]	2				
Water[C] Treatment	[redacted]	[redacted]	[redacted]					
Water[C] Treatment	[redacted]	[redacted]	[redacted]					626
Fire[C] Water Pump	[redacted]	[redacted]	[redacted]	2				
Fire[C] Water Pump	[redacted]	[redacted]	[redacted]	1				
Cir. water Intake Struct	[redacted]	[redacted]	[redacted]	4				
Cir. Water System Electric Room	[redacted]	[redacted]	[redacted]	3				
Chlorination[C]	[redacted]	[redacted]	[redacted]	10				
Machine[C] Shop & Waredhouse	[redacted]	[redacted]	[redacted]	38				451

a. Refer to figure 3.11-1 for identification of room numbers.

b. Fire detectors in Auto column will detect fire and actuate water spray system after a delay period. The other detectors only detect and alarm locally and in the main control room.

c. Common for Units 5 and 6

d. One infrared detector per room

Table 9.5-3

AREAS REQUIRING BOTH EMERGENCY AND ESSENTIAL LIGHTING FOR SAFE REACTOR SHUTDOWN

Auxiliary Building

- RHR, charging, and containment spray pump rooms
- RHR heat exchanger rooms
- Turbine driven auxiliary feedwater pump room
- Motor driven auxiliary feedwater pump room
- Auxiliary feedwater control valve room
- Hydrogen recombiner skids and local control panel
- Local control areas for the above
- Access corridors to above

Control Building

- Main control room
- Auxiliary shutdown panel area
- ESF switchgear room
- ESF battery and dc equipment rooms
- Access corridors to above rooms

Component Cooling Water Building

- CCW pump rooms
- Hydrogen recombiner local control panel

Diesel Generator Building

Nuclear Service Water Pump House

Fuel Building

- Fuel pool handling area

Table 9.5-4

LIGHTING SYSTEM SINGLE FAILURE ANALYSIS

Name	Failure/ Malfunction	Normal Lighting	Effect On Essential Lighting	Effect on Emergency Lighting
Onsite power	One auxiliary trans- former loss	Half-lost automatic transfer to startup source	None	None
4.16 kV non- Class 1E switchgear	Loss	Half-lost	None	None
Offsite power	Total loss	None	None	None
4.16 kV Class 1E switchgear	Loss	None	Essential lights connected to that bus lost	Emergency lights con- nected to that train energize automatically
480V Class 1E load center	Loss	None	Essential lights connected to that bus lost	Emergency lights con- nected to that train energize automatically
480V Class 1E MCC	Loss	None	Essential lights connected to that bus lost	Emergency lights con- nected to that train energize automatically
480V essential lighting transformer	Loss	None	Essential lights connected to that bus lost	Emergency lights con- nected to that train energize automatically

Table 9.5-5

DIESEL GENERATOR STARTING SYSTEM
SINGLE ACTIVE FAILURE ANALYSIS

Component	Failure	Comments
Air receiver	Failure to maintain the required pressure.	A redundant air receiver is available, either one capable of starting the diesel engine.
Start air admission valves	Valve fails to open upon receipt of a diesel generator start signal.	Each air receiver is independently piped to two redundant admission valves. If one valve fails, the redundant valve is capable of admitting starting air. If both valves fail, the other air starting train will start the diesel.
Air distributor	Fails to distribute starting air to the cylinders in the proper sequence.	A redundant air distributor is available on each diesel engine.
Power supply	Loss of power from 125 V-dc power supply.	A redundant diesel generator unit is provided.

Table 9.5-6

EMERGENCY DIESEL ENGINE COMBUSTION AIR
INTAKE AND EXHAUST SYSTEM COMPONENT DATA (Sheet 1 of 2)

Air Intake Filter	
Quantity (per engine)	2
Type	Oil-bath
Design flow, scfm	14,103
Design pressure/temperature, psia/F	14.7/120
Material	Carbon steel
Quantity of oil, gals	59
Intake Silencer	
Quantity (per engine)	2
Type	Horizontal
Design flow, scfm	14,103
Design pressure/temperature, psia/F	14.7/120
Material	14 ga. hot rolled steel
Exhaust Silencer	
Quantity (per engine)	1
Type	Horizontal
Design flow, scfm	29,150
Design pressure drop/ temperature in H_2O/F	7/950
Material	Carbon steel
Piping	
Material	Carbon steel
Design code	
Inside diesel building	ANSI B31.1.0
Outside the building	ANSI B31.1.0
Seismic design	Seismic Category I

Table 9.5-6

EMERGENCY DIESEL ENGINE COMBUSTION AIR INTAKE AND EXHAUST SYSTEM COMPONENT DATA (Sheet 2 of 2)

Air Intake Opening	
Outside Wall	
Quantity (per engine room)	1
Size	100 ft^2
Louvers, material	Aluminum
Screen	1/2-inch square mesh, 16-gauge aluminum
Free area opening/overall louver area	50 percent aluminum
Intake air flow, scfm	28,206
Maximum intake air temperature, ^{o}F	92
Inside Wall	
Quantity (per engine room)	1
Size	60 ft^2
Intake flow, scfm	28,206
Maximum intake air temperature, ^{o}F	120

Table 9.5-7

SERVICE GAS SYSTEM
(Sheet 1 of 3)

Component Serviced With Nitrogen	System	Function
Main steam lines and steam generator secondary side	Main steam	Nitrogen blanketing
Feedwater heater shell side	Feedwater heater extraction, drains	Nitrogen blanketing
Pressurizer relief tank	Reactor coolant	Nitrogen blanketing
Volume control tank	Chemical and volume control	Degassing and nitrogen blanketing
CVCS mixed bed, cation, and boron thermal regeneration ion exchangers	Chemical and volume control	Resin mixing and scrubbing
Safety injection accumulators	Safety injection	System pressurization
Spray additive tank	Containment spray	Nitrogen blanketing
Turbine building closed cooling water surge tank	Turbine building closed cooling water	System pressurization
Component cooling water surge tank	Component cooling water	System pressurization

Table 9.5-7

SERVICE GAS SYSTEM
(Sheet 2 of 3)

Component Serviced With Nitrogen	System	Function
Auxiliary boiler	Auxiliary steam generator and auxiliary steam	Nitrogen blanketing
Central chilled water compression tank	Central chilled water	System pressurization
Essential chilled water compression tanks	Essential chilled water	System pressurization
Radwaste building fluidizing header	Solid radwaste	Resin fluidizing
Gaseous radwaste	Gaseous radwaste	System purge
Reactor coolant drain tank	Radioactive drain	Nitrogen blanketing
Equipment drain tank	Radioactive drain	Nitrogen blanketing
Turbine chemistry lab	-	Service gas
LRS evaporator	Liquid radwaste	Nitrogen blanketing
Steam generator blowdown heat exchanger	Steam generator blowdown	Nitrogen blanketing
Containment electrical penetration assemblies	-	Leakage testing

Table 9.5-7

SERVICE GAS SYSTEM
(Sheet 3 of 3)

Component Serviced With Nitrogen	System	Function
Volume control tank	Chemical and volume control	Oxygen scavenging
Main generator	-	Generator cooling

Component Serviced With Carbon Dioxide	System	Function
Main generator	-	Purging

Table 9.5.8

AUXILIARY STEAM SYSTEM COMPONENT DATA
(Sheet 1 of 5)

Auxiliary Steam Boiler	
Quantity	1 for both units
Type	Shop assembled, water tube
Evaporation rate, lb/hr	130,000
Fuel consumption, lb/hr	8,083
Fuel	No. 2 oil
Steam pressure at outlet, psig	135
Temperature at boiler outlet, °F	358 (sat)
Steam moisture content, percent	0.5 (max)
Feedwater temperature, °F	228
Blowdown at rated conditions, lb/hr	1,300
Boiler turndown ratio	8:1
Time to start from cold shutdown, hr	2.75
Time to start from standby using heating coil, hr	0.5
Forced Draft Fan	
Quantity	1
Air flow rate, ft^3/min	29,487
Static pressure, in. WG	11.5
Brake horsepower	110
Motor horsepower	134
Motor, r/min	1,750

Table 9.5.8

AUXILIARY STEAM SYSTEM COMPONENT DATA
(Sheet 2 of 5)

Boiler code requirements	ABMA, ASME B&PV Code, Section I
Auxiliary Steam Condensate Recovery Tank	
Quantity	1
Capacity, gal	600
Operating pressure, psig	2.3
Operating temperature, °F	200
Design pressure, psig	90
Design temperature, °F	250
Material	CS
Code	ASME B&PV Code, Section VIII
Auxiliary Steam Condensate Transfer Pumps	
Quantity	2
Type	Horizontal centrifugal
Rated flow, gpm	175
Minimum flow, gpm	25
Differential pressure @ rated flow, ft	170
Operating temperature, °F	93
Material	CS
Code	Standards of Hydraulic Institute
Motor horsepower	15
Motor, r/min	3,500

Table 9.5.8

AUXILIARY STEAM SYSTEM COMPONENT DATA
(Sheet 3 of 5)

Electrical requirements	3-phase, 460V, 60 Hz
Code	NEMA
Auxiliary Steam Deaerator	
Quantity	1
Condensate leaving deaerator, lb/hr	130,000
Operating pressure, psig	15
Maximum O_2 content, ppm	5
Storage capacity, gal.	1,585
Operating temperature, °F	250
Design pressure, psig	45
Design temperature, °F	400
Material	CS
Code	ASME B&PV Code, Section VIII
Auxiliary Steam Boiler Feedwater Pumps	
Quantity	2
Type	Horizontal centrifugal
Rated flow, lb/hr	130,000
Maximum flow, lb/hr	150,000
Minimum flow, lb/hr	11,000
Differential pressure @ rated flow, psi	177.5
Operating temperature, °F	250

2

Table 9.5.8

AUXILIARY STEAM SYSTEM COMPONENT DATA
(Sheet 4 of 5)

Material	CS
Code	Standards of Hydraulic Institute
Motor horsepower	75
Auxiliary Steam Boiler Feedwater Pumps (Continued)	
Motor, r/min	3,550
Electrical requirements	3-phase, 460V, 60 Hz
Code	NEMA
Auxiliary Steam Continous Blowdown Tank	
Quantity	1
Capacity, gal	625
Operating pressure, psig	7
Operating temperature, °F	232
Design pressure, psig	10
Design temperature, °F	238
Material	CS
Code	ASME B&PV, Section VIII
Auxiliary Steam Ammonia/Hydrazine Tank	
Quantity	1 ammonia tank 1 hydrazine tank

Table 9.5.8

AUXILIARY STEAM SYSTEM COMPONENT DATA
(Sheet 5 of 5)

Capacity (each), gal	75
Operating pressure, psig	Ambient
Operating temperature, °F	Ambient
Material	SS 304
Code	ANSI B31.1.0
Auxiliary Steam Chemical Feed Pumps	
Quantity	3
Type	Positive displacement
Chemical service	Ammonia, hydrazine, common spare
Pressure rating, psig	300
Operating temperature, °F	Ambient
Motor horsepower	0.25
Motor, r/min	1725
Electrical requirement	3-phase, 460V, 60 Hz
Code	NEMA

본 도면은 참고용 도면임
관련 도면목록 :Table 1.7-2(Sh. 1 of 12)
관리도면 : P&ID , 0-M-KC-F001

2

KOREA HYDRO & NUCLEAR POWER COMPANY KORI 3 & 4 FSAR

FIRE PROTECTION SYSTEM
(Sheet 1 OF 6)

Figure 9.5-1

Amendment 539
2015.11.19

KOREA HYDRO & NUCLEAR POWER COMPANY KORI 3 & 4 FSAR

FIRE PROTECTION SYSTEM

(Sheet 2 OF 6)

Figure 9.5–1

KOREA HYDRO & NUCLEAR POWER COMPANY
KRN 3 & 4 FSAR

P & I DIAGRAM
FIRE PROTECTION SYSTEM
(Sheet 3 of 6)
Figure 9.5-1

Amendment 539
2015.11.19

KOREA ELECTRIC POWER CORPORATION
KRN 3 & 4 FSAR

P & I DIAGRAM
FIRE PROTECTION SYSTEM
(Sheet 4 of 6)

Figure 9.5-1

KOREA HYDRO & NUCLEAR POWER COMPANY KORI 3 & 4 FSAR

P & I DIAGRAM
FIRE PROTECTION SYSTEM
(Sheet 5 OF 6)
Figure 9.5-1

KOREA ELECTRIC POWER CORPORATION
KOREA NUCLEAR UNITS 5 & 6
FSAR

P & I DIAGRAM
FIRE PROTECTION SYSTEM
(Sheet 6 of 6)

Figure 9.5-1

Amendment 539
2015.11.19

EAST SEA

KOREA ELECTRIC POWER CORPORATION
KOREA NUCLEAR UNITS 5 & 6
FSAR

FIRE PROTECTION
SITE PLAN
(Sheet 1 of 12)

Figure 9.5-2

KOREA ELECTRIC POWER CORPORATION
KOREA NUCLEAR UNITS 5 & 6
FSAR

FIRE PROTECTION
SYMBOLS
(Sheet 2 of 12)

Figure 9.5-2

KOREA ELECTRIC POWER CORPORATION
KOREA NUCLEAR UNITS 5 & 6
FSAR

FIRE PROTECTION
PLAN AT BELOW GRADE EL. 73 FT.
(Sheet 3 of 12)

Figure 9.5-2

NOTE: FIRE PROTECTION DRAWINGS

THIS DRAWING IS FOR THE PURPOSE OF INDICATING FIRE PROTECTION BOUNDARIES AND LOCATION OF FIRE PROTECTION EQUIPMENT ONLY.

DO NOT USE FOR ANY OTHER PURPOSE

KOREA ELECTRIC POWER CORPORATION
KOREA NUCLEAR UNITS 5 & 6
FSAR

FIRE PROTECTION
PLAN AT GRADE EL. 100 FT.
(Sheet 4 of 12)

Figure 9.5-2

NOTE: FIRE PROTECTION DRAWINGS

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DO NOT USE FOR ANY OTHER PURPOSE

KOREA ELECTRIC POWER CORPORATION
KOREA NUCLEAR UNITS 5 & 6
FSAR

FIRE PROTECTION
PLAN AT OPERATING FLOOR
EL. 126 FT. & 135 FT.
(Sheet 5 of 12)

Figure 9.5-2

NOTE: FIRE PROTECTION DRAWINGS

THIS DRAWING IS FOR THE PURPOSE OF INDICATING FIRE PROTECTION BOUNDARIES AND LOCATION OF FIRE PROTECTION EQUIPMENT ONLY.

DO NOT USE FOR ANY OTHER PURPOSE

KOREA ELECTRIC POWER CORPORATION
KOREA NUCLEAR UNITS 5 & 6
FSAR

FIRE PROTECTION
PLANT AT EL. 148 FT.
(Sheet 6 of 12)

Figure 9.5-2

NOTE: FIRE PROTECTION DRAWINGS

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DO NOT USE FOR ANY OTHER PURPOSE

KOREA ELECTRIC POWER CORPORATION
KOREA NUCLEAR UNITS 5 & 6
FSAR

FIRE PROTECTION
MISCELLANEOUS PLANS
(Sheet 7 of 12)

Figure 9.5-2

NOTE: FIRE PROTECTION DRAWINGS

THIS DRAWING IS FOR THE PURPOSE OF INDICATING FIRE PROTECTION BOUNDARIES AND LOCATION OF FIRE PROTECTION EQUIPMENT ONLY.

DO NOT USE FOR ANY OTHER PURPOSE

KOREA ELECTRIC POWER CORPORATION
KOREA NUCLEAR UNITS 5 & 6
FSAR

FIRE PROTECTION
SECTION A
(Sheet 8 of 12)

Figure 9.5-2

NOTE: FIRE PROTECTION DRAWINGS

THIS DRAWING IS FOR THE PURPOSE OF INDICATING FIRE PROTECTION BOUNDARIES AND LOCATION OF FIRE PROTECTION EQUIPMENT ONLY.

DO NOT USE FOR ANY OTHER PURPOSE

KOREA ELECTRIC POWER CORPORATION
KOREA NUCLEAR UNITS 5 & 6
FSAR

FIRE PROTECTION
SECTION B
(Sheet 9 of 12)

Figure 9.5-2

NOTE: FIRE PROTECTION DRAWINGS

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FIRE PROTECTION
SECTIONS C & E
(Sheet 10 of 12)

Figure 9.5-2

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FIRE PROTECTION
SECTIONS D, F, G, H, & J
(Sheet 11 of 12)

Figure 9.5-2

KOREA ELECTRIC POWER CORPORATION
KOREA NUCLEAR UNITS 5 & 6
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FIRE PROTECTION
RADWASTE BUILDING
(Sheet 12 of 12)

Figure 9.5-2

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FIRE ZONES AND BARRIERS CONTROL BLDG. ELEVATION 100'(Sheet 2of 21)
FSAR Figure 9.5-3

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FIRE ZONES AND BARRIERS DIESEL GENERATOR BLDG. ELEVATION 119'
(Sheet 3of 21)
FSAR Figure 9.5-3

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FIRE ZONES AND BARRIERS CONTROL BLDG. ELEVATION 126'(Sheet 4of 21)
FSAR Figure 9.5-3

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FIRE ZONES AND BARRIERS CONTROL BLDG. ELEVATION 148'(Sheet 5of 21)
FSAR Figure 9.5-3

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FIRE ZONES AND BARRIERS AUXILIARY BLDG. ELEVATION 74'(Sheet 6of 21)
FSAR Figure 9.5-3

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FIRE ZONES AND BARRIERS AUXILIARY BLDG. ELEVATION 88'(Sheet 7of 21)
FSAR Figure 9.5-3

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FIRE ZONES AND BARRIERS AUXILIARY BLDG. ELEVATION 100'(Sheet 8of 21)
FSAR Figure 9.5-3

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FIRE ZONES AND BARRIERS AUXILIARY BLDG. ELEVATION 126'(Sheet 9 of 21)
FSAR Figure 9.5-3

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FIRE ZONES AND BARRIERS AUXILIARY BLDG. ELEVATION 148'(Sheet 10 of 21)
FSAR Figure 9.5-3

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FIRE ZONES AND BARRIERS FUEL/CCW BLDG. ELEVATION 100'(Sheet 11 of 21)
FSAR Figure 9.5-3

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FIRE ZONES AND BARRIERS FUEL/CCW BLDG. ELEVATION 126'(Sheet 12 of 21)
FSAR Figure 9.5-3

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FIRE ZONES AND BARRIERS FUEL/CCW BLDG. ELEVATION 148'(Sheet 13 of 21)
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FIRE ZONES AND BARRIERS TURBINE BLDG. ELEVATION 73'(Sheet 14 of 21)
FSAR Figure 9.5-3

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FIRE ZONES AND BARRIERS TURBINE BLDG. ELEVATION 100'(Sheet 15 of 21)
FSAR Figure 9.5-3

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FIRE ZONES AND BARRIERS TURBINE BLDG. ELEVATION 135'(Sheet 16 of 21)
FSAR Figure 9.5-3

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FIRE ZONES AND BARRIERS ACCESS CONTROL BLDG. ELEVATION 74'& 100'
(Sheet 17 of 21)
FSAR Figure 9.5-3

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FIRE ZONES AND BARRIERS RADWASTE BLDG. ELEVATION 100'(Sheet 18 of 21)
FSAR Figure 9.5-3

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FIRE ZONES AND BARRIERS CW/NSCW INTAKE & ELECTRIC ROOM, CHLORINATION BLDG. ELEVATION 100'(Sheet 19 of 21)
FSAR Figure 9.5-3

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FIRE ZONES AND BARRIERS AUX. BOILER & WATER TREATMENT BLDG., FIRE WATER PUMP BLDG. '(Sheet 20 of 21)
FSAR Figure 9.5-3

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FIRE ZONES AND BARRIERS YARD '(Sheet 21 of 21)
FSAR Figure 9.5-3

KOREA ELECTRIC POWER CORPORATION
KOREA NUCLEAR UNITS 5 & 6
FSAR

SYSTEM BLOCK DIAGRAM
(Sheet 1 of 4)

Figure 9.5-4

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KOREA ELECTRIC POWER CORPORATION
KOREA NUCLEAR UNITS 5 & 6
FSAR

SYSTEM BLOCK DIAGRAM
(Sheet 2 of 4)

Figure 9.5-4

KOREA ELECTRIC POWER CORPORATION
KOREA NUCLEAR UNITS 5 & 6
FSAR

SYSTEM BLOCK DIAGRAM
(Sheet 3 of 4)
Figure 9.5-4

KOREA ELECTRIC POWER CORPORATION
KOREA NUCLEAR UNITS 5 & 6
FSAR

SYSTEM BLOCK DIAGRAM
(Sheet 4 of 4)
Figure 9.5-4

KOREA HYDRO & NUCLEAR POWER
COMPANY KORI 3&4 FSAR

STAND-BY DIESEL AND
DIESEL FUEL OIL SYSTEM
(SHEET 1 OF 2)

Figure 9.5-5

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3

KOREA ELECTRIC POWER CORPORATION
KRN 3 & 4 FSAR

STAND-BY DIESEL AND DIESEL FUEL
OIL SYSTEM
(SHEET 2 OF 2)

FIGURE 9.5-5

KOREA ELECTRIC POWER CORPORATION
KRN 3 & 4 FSAR

JACKET WATER
PIPING SCHEMATIC

Figure 9.5-6

KOREA ELECTRIC POWER CORPORATION
KOREA NUCLEAR UNITS 5 & 6
FSAR

STARTING AIR
PIPING SCHEMATIC

Figure 9.5-7

KOREA ELECTRIC POWER CORPORATION
KOREA NUCLEAR UNITS 5 & 6
FSAR

LUBE OIL
PIPING SCHEMATIC

Figure 9.5-8

KOREA ELECTRIC POWER CORPORATION
KOREA NUCLEAR UNITS 5 & 6
FSAR

DIESEL GENERATOR AIR
INTAKE AND EXHAUST SYSTEM

Figure 9.5-9

KOREA HYDRO & NUCLEAR POWER COMPANY KORI 3 & 4 FSAR

SERVICE GASES

Figure 9.5-10

KOREA HYDRO & NUCLEAR POWER COMPANY

KRN 3 & 4 FSAR

AUXILIARY STEAM SYSTEM

FIGURE 9.5-11